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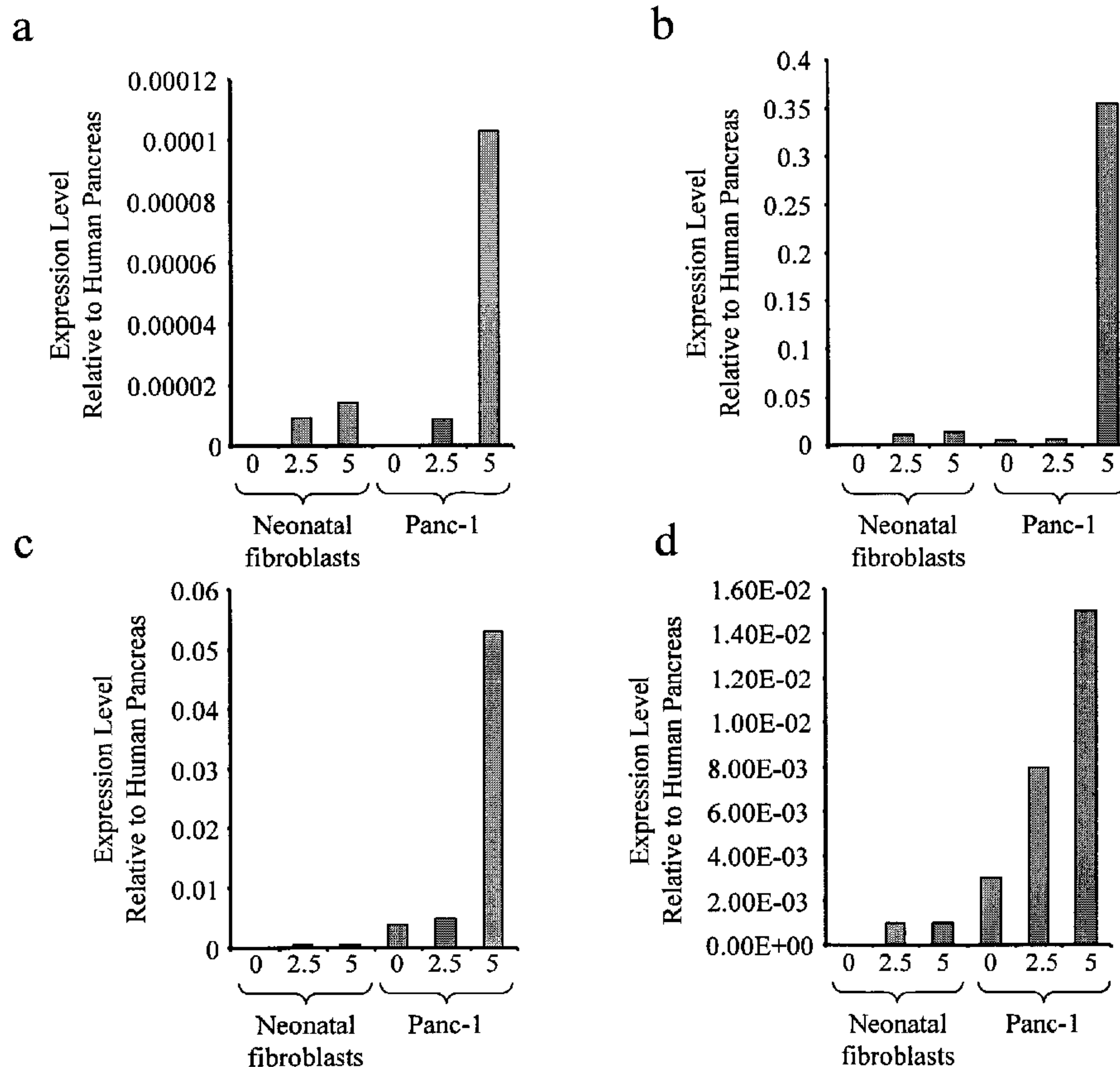
(72) Inventeurs/Inventors:
DAVIS, JANET E., US;
FUNG, RAMIE, US

(73) Propriétaire/Owner:
LIFESCAN, INC., US

(74) Agent: NORTON ROSE FULBRIGHT CANADA
LLP/S.E.N.C.R.L., S.R.L.

(54) Titre : METHODES POUR PROMOUVOIR LA DIFFERENCIATION CELLULAIRE

(54) Title: METHODS TO PROMOTE CELL DIFFERENTIATION



(57) Abrégé/Abstract:

The present invention provides a methods for promoting the differentiation of cells. In one aspect, the method comprises the steps of providing cells and contacting the cells with at least one chromatin-remodeling agent, wherein the at least one chromatin-remodeling agent increases the expression of PDX-1 within the cells. The present invention includes uses corresponding to the method.

ABSTRACT

The present invention provides a methods for promoting the differentiation of cells. In one aspect, the method comprises the steps of providing cells and contacting the cells with at least one chromatin-remodeling agent, wherein the at least one chromatin-remodeling agent increases the expression of PDX-1 within the cells. The present invention includes uses corresponding to the method.

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METHODS TO PROMOTE CELL DIFFERENTIATION**FIELD OF THE INVENTION**

This invention relates to a method for inducing the differentiation of cells. In particular,
5 this invention relates to methods that induce cells to differentiate into a pancreatic
lineage, or into a pancreatic hormone-producing cell, or into a β -cell lineage. This
invention also provides methods and compositions for utilizing such cells in the
therapeutic treatment of diabetes.

BACKGROUND

10 Loss of organ function can result from congenital defects, injury or disease. One
example of a disease causing loss of organ function is diabetes mellitus, or diabetes. The
majority of diabetes cases fall into two clinical types: Type 1, also known as juvenile-
onset diabetes or insulin dependent diabetes mellitus (IDDM); and Type 2, also known as
adult-onset diabetes. A common method of treatment of Type 1 diabetes involves the
15 exogenous administration of insulin, typically by injection with either a syringe or a
pump. This method does not completely normalize blood glucose levels and is often
associated with an increased risk of hypoglycemia. More effective glycemic control can
be achieved if the function of the pancreas can be restored or rejuvenated via
transplantation or cell-based therapies.

20 There are many transplantation therapies currently used to treat diabetes: One such
treatment involves transplanting isolated islets of Langerhans into the diabetic patient.
One challenge to human islet transplantation has been the lack of sufficient number of
islets to treat the large number of diabetic patients.

Alternative sources of cellular material for transplantation may include, for example, cells
25 derived from other tissues such as, for example, chorionic villus, amniotic fluid, or bone
marrow. These other tissues may be fetal or embryonic tissues. In addition, the endocrine

cells of the islets of Langerhans, including β -cells, are constantly turning over by processes of apoptosis and proliferation of new islet cells (neogenesis). As such, the pancreas is thought to be a source of undifferentiated cells that are capable of differentiating into pancreatic hormone producing cells.

- 5 However, one challenge of these cellular approaches has been the ability of these cells to differentiate into a β - cell lineage or a pancreatic hormone-secreting cell. Such differentiation involves changes in gene expression.

Mechanisms for cellular differentiation: Gene expression is the combined process of the transcription of a gene into mRNA, the processing of that mRNA, and its translation into
 10 protein (for protein-encoding genes). A comparison of the gene-expression patterns of cells from the pancreas, which secrete digestive enzymes and hormones, and the liver, the site of lipid transport and energy transduction, reveals marked differences in genes that are highly expressed. This difference is consistent with the physiological roles of these tissues. For example, insulin gene expression in a mammal is restricted to β -cells of the
 15 pancreas through control mechanisms mediated in part by specific transcription factors, including MafA, and NeuroD. In other cells of the body, pancreatic hormones, such as, for example, insulin, as well as the other specific peptidase genes are transcriptionally silent.

DNA is never found as a naked molecule in animal or plant cell nuclei. DNA is always
 20 packaged into chromatin and found in association with proteins and other molecules. The molecules include, for example, histone proteins (soluble in acid solutions), HMG proteins (soluble in neutral saline), residual proteins (soluble in concentrated urea solutions), phosphoproteins (soluble in basic solutions), RNA species (soluble in aqueous phenol solutions), and lipid species (soluble in chloroform-methanol solutions).
 25 Chromatin is that portion of the cell nucleus that contains the entire DNA of the nucleus in animal or plant cells.

Covalent modification of histones has been implicated in regulation of gene expression. Reversible acetylation of histone proteins combines with DNA methylation and other

modifications to generate an epigenetic code of altered chromatin structure and function. The covalent modifications to histones may include acetylation, methylation, phosphorylation, ubiquitinylation and sumoylation.

- The acetylation state of histones and other proteins is dynamically regulated by the competing actions of acetyltransferases and deacetylases. Hypoacetylated histones promote chromatin condensation and are associated with transcriptionally silent loci, wherein access of the DNA to transcription factors or the transcriptional apparatus is limited. Such alterations to chromatin may play a seminal role in tissue differentiation by determining the complement of genes expressed within individual cell types.
- 10 The methylation of DNA at cytosine residues is associated with gene silencing. Treatment with agents that alter this secondary DNA modification to create demethylated sites is correlated with active gene transcription and expression. The drug, 5-azacytidine, may be incorporated into DNA in place of cytidine. As a consequence, the 5' position is blocked, leading to creation and perpetuation of demethylated DNA sequences. Changes
15 in the state of cellular differentiation have been reported after 5'-azacytidine treatment; for example, muscle cells have been induced to develop from non-muscle cell precursors. The drug also has been shown to activate genes on a silent X chromosome.

- Factors that control pancreatic development: The homeodomain protein PDX-1 (Pancreatic and Duodenal Homeobox gene-1, also known as IDX- 1, IPF-1, STF-1 or
20 IUF-1) plays a central role in regulating pancreatic islet development and function. PDX-1 regulates transcription of these genes associated with β -cell identity, including insulin, glucokinase, islet amyloid polypeptide, and glucose transporter type 2 (GLUT2).

- US20050090465 states the ectopic expression of PDX-1 in liver and skin induces a pancreatic islet cell phenotype in liver and skin cells and results in the expression,
25 production, and processing of pancreatic hormones.

US20040002447 provides methods for inducing insulin gene expression in cells. In some embodiments, the methods comprise the steps of: (i) providing a cell that expresses a

PDX-1 polynucleotide; and (ii) contacting the cell with a histone deacetylase inhibitor, thereby inducing insulin gene expression in the cells.

The methods disclosed in US20050090465 and US20040002447 require the ectopic expression of PDX-1 in order to induce insulin gene expression in cells. Thus, there
5 remains a significant need to develop methods to generate pancreatic hormone-secreting cells from an abundant cell source that does not require the ectopic expression of PDX-1.

SUMMARY

The present invention includes methods that promote the differentiation of cells by altering the expression of genes within the cells. In one embodiment, the genes may be required for
10 the differentiation of a desired cell type. Alternatively, the genes may be associated with the function of a desired cell type. In one embodiment, the expression of genes required for the differentiation and the function of a desired cell type may be altered.

The cells to be differentiated may themselves be fully differentiated cells of another cell lineage or type, or they may be partially differentiated progenitor cells, or they may be
15 undifferentiated progenitor cells.

In one embodiment, the present invention is directed to methods that cause a cell that does not normally express PDX-1 to differentiate into a cell of the pancreatic lineage, or into a pancreatic hormone-producing cell, or into a cell of the β -cell lineage.

In one embodiment, the present invention is directed to methods that cause a cell that has
20 lost the expression of PDX-1 to differentiate into a cell of the pancreatic lineage, or into a pancreatic hormone-producing cell, or into a cell of the β -cell lineage.

In one embodiment, the differentiation of cells may be promoted by contacting the cells with at least one chromatin-remodeling agent. Cells may be contacted with a single treatment of at least one chromatin-remodeling agent. In an alternate embodiment, the cells may be
25 contacted with multiple treatments of the at least one chromatin-remodeling agent. The multiple treatments may be with the same agent, or a different agent.

In one embodiment the at least one chromatin-remodeling agent may be an inhibitor of histone deacetylase activity. The inhibitor of histone deacetylase activity may be selected from the group consisting of butyrates, hydroxamic acids, cyclic peptides and benzamides. In some embodiments, the inhibitor of histone deacetylase activity may be selected from the group consisting of 4-phenylbutyrate, sodium butyrate, trichostatin A, suberoyl anilide hydroxamic acid (SAHA), oxamflatin, trapoxin B, FR901228, apicidin, chlamydocin, depuecin, scriptaid, depsipeptide, and N- acetyldinaline.

In one embodiment, the present invention may be directed to methods that promote the differentiation of cells into a pancreatic lineage, or into a pancreatic hormone-producing cell, or into a β -cell lineage.

In one embodiment, differentiation may be promoted by increasing the expression of at least one differentiation-related gene. In one embodiment, the at least one differentiation-related gene may be PDX-1. In an alternate embodiment, the at least one differentiation-related gene may be Sox-17. In an alternate embodiment, the at least one differentiation-related gene may be HNF-3 beta.

In one embodiment, the cells do not normally express the homeodomain protein PDX-1, and treatment with the at least one chromatin-remodeling agent stimulates the expression of PDX-1. In another embodiment, expression of PDX-1 may be restored in cells that have lost the expression of PDX-1 during culture *in vitro*.

In one embodiment, cells may be contacted with multiple treatments of at least one chromatin-remodeling agent. The multiple treatments may stimulate or increase the expression of PDX-1. In an alternate embodiment, the initial treatment with the at least one chromatin-remodeling agent may stimulate or increases the expression of PDX-1, and the subsequent treatments may stimulate the expression of pancreatic hormones. The multiple treatments may be with the same agent or a different agent.

In an alternate embodiment, the initial treatment with the at least one chromatin-remodeling agent may stimulate or increases the expression of PDX-1, and the subsequent

treatments with the at least one chromatin-remodeling agent may stimulate the expression of at least one other differentiation-related gene.

5 In some embodiments, the methods or parts thereof are performed ex-vivo, in-vivo or in-vitro as appropriate.

According to a further aspect of the invention, uses corresponding to the methods of the invention are provided.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows the effects of Histone Deacetylase Inhibitor Treatment on Gene Expression in Panc-1 Cells and Neonatal Fibroblasts. The data shown is the effect of 2.5 μ M and 5 μ M trichostatin A treatment on the expression of glucagon (panel a), Sox-17 (panel b), Pdx-1 (panel c) and HNF-3 beta (panel d). Untreated cells are shown as a negative control for comparison. The experimental procedure is outlined in **Example 6**.

Figure 2 shows changes in gene expression in amniotic fluid-derived cells over time, following addition of 1.25 μ M trichostatin A. Data shown is relative expression of insulin (panel a), Sox-17 (panel b), Pdx-1 (panel c) and HNF-3 beta (panel d) compared to an untreated control. The experimental procedure is outlined in **Example 7**.

Figure 3 shows changes in gene expression in late passage pancreatic-derived stromal cells over time, following addition of 2.5 μ M trichostatin A. Data shown in relative expression of Sox-17 (panel a), HNF-3 beta and Pdx-1 (panel b), and glucagon (panel c) compared to an untreated control. The experimental procedure is outlined in **Example 8**.

Figure 4 shows the changes in gene expression in amniotic fluid-derived cells with time, following continuous, chronic treatment with trichostatin A. Data shown in relative expression of glucagon (panel a), HNF-3 beta (panel b), insulin (panel c), Pdx-1 (panel d) and

sox-17 (panel e) compared to an untreated control. The experimental procedure is outlined in **Example 9**.

Figure 5 shows the changes in gene expression in late passage pancreatic-derived stromal cells with time, following continuous, chronic treatment with trichostatin A. Data shown are relative expression of glucagon (panel a), HNF-3 beta (panel b), Pdx-1 (panel c) and sox-17 (panel d) compared to an untreated control. The experimental procedure is outlined in **Example 10**.

Figure 6 shows the effects of a selection of HDAC inhibitors on the viability of an amniotic fluid-derived cell line at 24 h and 72 h post addition. The experimental procedure is outlined in **Example 16**. Compounds, identified by the numbers on the x-axis were added to the cells at a concentration of 5 μ M.

- 5 **Figure 7** shows the effects of a selection of HDAC inhibitors on the viability of an amniotic fluid-derived cell line at 24 h and 72 h post addition. The experimental procedure is outlined in **Example 16**. Compounds, identified by the numbers on the x-axis were added to the cells at a concentration of 5 μ M.

- 10 **Figure 8** shows the effects of a selection of HDAC inhibitors on the viability of an amniotic fluid-derived cell line. The experimental procedure is outlined in **Example 16**. Compounds, identified in the legend were added to the cells at the concentrations shown on the x axis. Viability was determined 24h post compound treatment.

- 15 **Figure 9** shows the effects of a selection of HDAC inhibitors on the viability of an adult pancreatic-derived cell line. The experimental procedure is outlined in **Example 16**. Compounds, identified in the legend were added to the cells at the concentrations shown on the x axis. Viability was determined 24h post compound treatment.

- 20 **Figure 10** shows the effects of a selection of HDAC inhibitors on the viability of an amniotic fluid-derived cell line. The experimental procedure is outlined in **Example 16**. Compounds, identified in the legend were added to the cells at the concentrations shown on the x axis. Viability was determined 72h post compound treatment.

- Figure 11** shows the effects of a selection of HDAC inhibitors on the viability of an adult pancreatic-derived cell line. The experimental procedure is outlined in **Example 16**. Compounds, identified in the legend were added to the cells at the concentrations shown on the x axis. Viability was determined 72h post treatment.

- 25 **Figure 12** shows the effects of a selection of putative HDAC inhibitor compounds on HDAC enzyme activity. Compounds, identified in the legend were incubated with

HDAC enzyme at the concentrations shown. Results were normalized to results observed with TSA.

DETAILED DESCRIPTION OF THE INVENTION

For clarity of disclosure, and not by way of limitation, the detailed description of the invention is divided into the following subsections that describe or illustrate certain features, embodiments or applications of the present invention.

Cells useful in the present invention.

Cells suitable for use in the methods of the present invention may be obtained from tissues such as, for example, bone marrow, umbilical cord blood, amniotic sac, amniotic fluid, placenta, skin, fat, muscle, vasculature, liver, pancreas, or peripheral blood, using methods that are well known in the art. The cells may be fully differentiated, or they may be partially differentiated or undifferentiated cells. The cells may be stem cells of progenitor cells.

Differentiation is the process by which an unspecialized ("uncommitted") or less specialized cell acquires the features of a specialized cell, such as a nerve cell or a muscle cell, for example. A differentiated cell is one that has taken on a more specialized ("committed") position within the lineage of a cell. The term committed, when applied to the process of differentiation, refers to a cell that has proceeded in the differentiation pathway to a point where, under normal circumstances, it will continue to differentiate into a specific cell type or subset of cell types, and cannot, under normal circumstances, differentiate into a different cell type or revert to a less differentiated cell type. De-differentiation refers to the process by which a cell reverts to a less specialized (or committed) position within the lineage of a cell. As used herein, the lineage of a cell defines the heredity of the cell, i.e. which cells it came from and what cells it can give rise to. The lineage of a cell places the cell within a hereditary scheme of development and differentiation.

A progenitor cell is a cell that has the capacity to create progeny that are more differentiated than itself, yet retains the capacity to replenish pool of progenitors. By that definition, stem cells themselves are also progenitor cells, as are the more immediate precursors to terminally differentiated cells.

- 5 Isolation of a population of cells may be achieved using monoclonal antibodies specific proteins expressed on the surface of the cells. The monoclonal antibodies may be adhered to substrate to facilitate the separation of the bound cells. The methods that may be used to isolate cells suitable for use in the present invention may be chosen by one of ordinary skill in the art. Examples of such methods are taught in US6087113,
10 US6261549, US5914262, US5908782, and US20040058412.

Cells may be characterized, for example, by growth characteristics (e.g., population doubling capability, doubling time, passages to senescence), karyotype analysis (e.g., normal karyotype; maternal or neonatal lineage), flow cytometry (e.g., FACS analysis), immunohistochemistry and/or immunocytochemistry (e.g., for detection of epitopes),
15 gene expression profiling (e.g., gene chip arrays; polymerase chain reaction (for example, reverse transcriptase PCR, real time PCR, and conventional PCR)), protein arrays, protein secretion (e.g., by plasma clotting assay or analysis of conditioned medium, for example, by Enzyme Linked Immuno-Sorbent Assay (ELISA)), mixed lymphocyte reaction (e.g., as measure of stimulation of PBMCs), and/or other methods known in the
20 art.

Cells suitable for use in the methods of the present invention may also include cells obtained from commercial sources, such as, for example human mesenchymal stem cells sold under the trade name POIETICS™ (Cat. No PT-2501, Cambrex). These mesenchymal stem cells are positive for the expression of the following markers: CD29,
25 CD44, CD105 and CD166. The cells are negative for the expression of the markers CD14, CD34 and CD45.

In one aspect of the present invention, the cells may be pancreatic-derived stromal cells. These cells may be isolated by a multi-stage method, which is described in **Example 1**.

Alternatively, they may be isolated by any suitable method known to those of skill in the art. Examples of suitable isolation methods are taught in US2003/0082155, US5,834,308, US6,001,647, US6,703,017, US6,815,203, WO2004/011621.

In one aspect of the present invention, the cells may be amniotic fluid-derived cells.

- 5 These cells may be isolated by a multi-stage method that is described in detail in **Example 2**. Alternatively, they may be isolated by any suitable method known to those of skill in the art. Examples of suitable isolation methods are taught in WO2003/042405, US2005/0054093, in't Anker *et al*, *Blood* 102, 1548-1549, 2003, Tsai *et al*, *Human Reproduction* 19, 1450-1456, 2004.

- 10 Isolated cells, or tissue from which cells are obtained may be used to initiate, or seed, cell cultures. Isolated cells may be transferred to sterile tissue culture vessels, either uncoated or coated with extracellular matrix or ligands such as laminin, collagen (native, denatured or crosslinked), gelatin, fibronectin, and other extracellular matrix proteins. Cells may be cultured in any culture medium capable of sustaining growth of the cells such as, for
15 example, DMEM (high or low glucose), advanced DMEM, DMEM/MCDB 201, Eagle's basal medium, Ham's F10 medium (F10), Ham's F-12 medium (F12), Iscove's modified Dulbecco's - 17 medium, Mesenchymal Stem Cell Growth Medium (MSCGM), DMEM/F12, RPMI 1640, and CELL-GRO-FREE. The culture medium may be supplemented with one or more components including, for example, fetal bovine serum
20 (FBS); equine serum (ES); human serum (HS); beta- mercaptoethanol (BME or 2-ME); one or more growth factors, for example, platelet-derived growth factor (PDGF), epidermal growth factor (EGF), fibroblast growth factor (FGF), vascular endothelial growth factor (VEGF), insulin-like growth factor-1 (IGF-1), leukocyte inhibitory factor (LIF) and erythropoietin; amino acids, including L-valine; and one or more antibiotic
25 and/or antimycotic agents to control microbial contamination, such as, for example, penicillin G. streptomycin sulfate, amphotericin B. gentamicin, and nystatin, either alone or in combination. The cells may be seeded in culture vessels at a density to allow cell growth.

Methods for the selection of the most appropriate culture medium, medium preparation, and cell culture techniques are well known in the art and are described in a variety of sources, including Doyle *et al.*, (eds.), 1995, CELL & TISSUE CULTURE: LABORATORY PROCEDURES, John Wiley & Sons, Chichester; and Ho and Wang
 5 (eds.), 1991, ANIMAL CELL BIOREACTORS, Butterworth-Heinemann, Boston.

Cells suitable for use in the present invention may be expanded by culturing in a defined growth media containing at least one factor that stimulates the proliferation of the cells. The at least one factor may include, for example, nicotinamide, members of TGF- β family, including TGF- β 1, 2, and 3, bone morphogenic proteins (BMP-2, -4, 6, -7, -11, -
 10 12, and -13), serum albumin, fibroblast growth factor family, platelet-derived growth factor-AA, and -BB, platelet rich plasma, insulin growth factor (IGF-I, II) growth differentiation factor (GDF-5, -6, -8, -10, 11), glucagon like peptide-I and II (GLP-I and II), GLP-1 and GLP-2 mimetobody, Exendin-4, retinoic acid, parathyroid hormone, insulin, progesterone, aprotinin, hydrocortisone, ethanolamine, beta mercaptoethanol,
 15 epidermal growth factor (EGF), gastrin I and II, copper chelators such as triethylene pentamine, TGF- β , forskolin, sodium butyrate, activin, betacellulin, noggin, neuron growth factor, nodal, insulin/transferring/selenium (ITS), hepatocyte growth factor (HGF), keratinocyte growth factor (KGF), bovine pituitary extract, islet neogenesis-associated protein (INGAP), proteasome inhibitors, notch pathway inhibitors, sonic
 20 hedgehog inhibitors, or combinations thereof. Alternatively, cells suitable for use in the present invention may be expanded by culturing in conditioned media. By “conditioned media” is meant that a population of cells is grown in a basic defined cell culture medium and contributes soluble factors to the medium. In one such use, the cells are removed from the medium, while the soluble factors the cells produce remain. This medium is
 25 then used to nourish a different population of cells.

Characterization of The Cells of the Present Invention

Methods for assessing expression of genes, via protein or nucleic acid levels in cultured or isolated cells are standard in the art. These include real-time polymerase chain reaction (RT-PCR), see, for example, the methods described in **Example 3**, Northern

blots, *in situ* hybridization (see, e.g., *Current Protocols in Molecular Biology* (Ausubel *et al.*, eds. 2001 supplement)), Western blotting, and for markers that are accessible in intact cells, flow cytometry analysis (FACS) (see, e.g., Harlow and Lane, *Using Antibodies: A Laboratory Manual*, New York: Cold Spring Harbor Laboratory Press (1998), and the
 5 methods described in **Example 4**) and immunoassays, such as immunohistochemical analysis of sectioned material (See, for example, the methods described in **Example 5**).

Examples of antibodies useful for detecting certain protein markers are listed in **Table I A&B**. It should be noted that other antibodies directed to the same markers that are recognized by the antibodies listed in **Table I A&B** are available, or can be readily
 10 developed. Such other antibodies can also be employed for assessing expression of markers in the cells isolated in accordance with the present invention.

Characteristics of cells of the β -cell lineage are well known to those skilled in the art, and additional characteristics of the β -cell lineage continue to be identified. These characteristics can be used to confirm that the amniotic fluid-derived cells isolated in
 15 accordance with the present invention have differentiated to acquire the properties characteristic of the β -cell lineage. β -cell lineage specific characteristics include the expression of one or more transcription factors such as, for example, PDX-1 (pancreatic and duodenal homeobox gene-1), NGN-3 (neurogenin-3), Hlxb9, Nkx6, Isl1, Pax6, NeuroD, Hnf1a, Hnf6, Hnf3 Beta, and Mafa, among others. These transcription factors
 20 are well established in the art for identification of endocrine cells. See, for example, Edlund (*Nature Reviews Genetics* 3: 524-632 (2002)).

Differentiation Of Cells by Chromatin-Remodeling.

Differentiation of the cells useful in the present invention may be achieved by altering the expression of genes within the cells. This may be achieved by treating the cells with at
 25 least one agent that remodels the chromatin structure within the cells, such that a region of DNA containing active or potentially active genes is more loosely packaged, less condensed, and can be accessed for transcription. Ideally, treatment of the cells with the at least one agent that remodels the chromatin structure within the cells should result in

the alteration of gene expression without being toxic to the cell, or triggering an adverse reaction, such as, for example, cell death. One of skill in the art can readily determine such toxic or adverse events and select an agent that remodels the chromatin structure within the cells where such events are minimized.

- 5 In one embodiment, the cells are part of an *in vitro* cell culture. Generally, a cell, such as a stem cell, or a progenitor cell in culture, may be contacted with an amount of at least one chromatin-remodeling agent effective to alter the expression of genes within the cell.

Cells treated with a chromatin-remodeling agent may exhibit global changes in gene expression not restricted to any single gene or family of genes. The outcome may down-
10 regulate some genes, up-regulate others, and may leave still other genes unchanged depending on the cell type, its differentiation stage, and responses over time to both the treatment protocol and environmental or other stimulatory signals, such as, for example, cell division.

Further complexity may arise where chromatin-remodeling agents alter expression of
15 genes that themselves regulate other downstream genes, for example transcription factor genes. Finally, chromatin-remodeling agents may not affect all gene regulatory domains in an equivalent manner and therefore may not yield full gene expression commiserate with a fully differentiated cell. For example, a chromatin-remodeling agent may not alter to the same degree gene enhancer regions, which operate bi-directionally at variable
20 distances from promoter regions, and as a consequence, a gene may be turned on without achieving full expression.

The genes whose expression levels are altered by treatment with chromatin-remodeling agents may be required for the differentiation of a desired cell type, herein referred to as “differentiation-related” genes. Alternatively, the genes may be associated with the
25 function of a desired cell type. The function may include, for example, secretion of insulin in the case of a β -cell. The chromatin-remodeling agents may simultaneously affect the expression of differentiation-related genes and genes associated with the function of a desired cell type.

Chromatin remodeling may be achieved by direct covalent modification of histones. The covalent modification may be by acetylation, methylation, phosphorylation, ubiquitinylation, and sumoylation. The covalent modification may be achieved by adding at least one chromatin-remodeling agent that stimulates one or all of these
 5 modifications. Alternatively, the at least one chromatin-remodeling agent may inhibit one or more of these modifications.

In one embodiment, method of the present invention essentially involves:

- Isolating a population of cells,
- Contacting the population of cells with at least one chromatin-remodeling agent,
- 10 - Determining the changes in gene expression of the population of cells,
- Culturing the treated population of cells *in vitro*.

In one embodiment, the method of the present invention essentially involves:

- Isolating a population of cells that does not express PDX-1 or has lost the expression of PDX-1 during culture *in vitro*,
- 15 - Contacting the population of cells with at least one chromatin-remodeling agent,
- Determining subsequent the changes in gene expression of the population of cells,
- Culturing the treated population of cells *in vitro*.

Changes in gene expression may by up-regulation, or by down-regulation, or a combination. The at least one chromatin-remodeling agent may affect the expression
 20 level of one gene, or multiple genes, to the same, or a different extent. The at least one chromatin-remodeling agent may affect the expression level of one gene, or multiple genes and may not affect the expression levels of other genes.

The cells may require one or more than one treatment of the at least one chromatin-remodeling agent. The more than one treatment may be with the same chromatin-
 25 remodeling agent or a different chromatin-remodeling agent.

The concentration of the at least one chromatin-remodeling agent may vary depending on the cell used, the choice of chromatin-remodeling agent or agents, the gene or genes whose expression levels are to be altered, the culture conditions, and the like. The at least one chromatin-remodeling agent may be contacted with the cells for up to about 72
 5 hours, or up to about 48 hours, or up to about 24 hours, or up to about 12 hours, or up to about 6 hours, or up to about 4 hours, or up to about 2 hours, or up to about 1 hour.

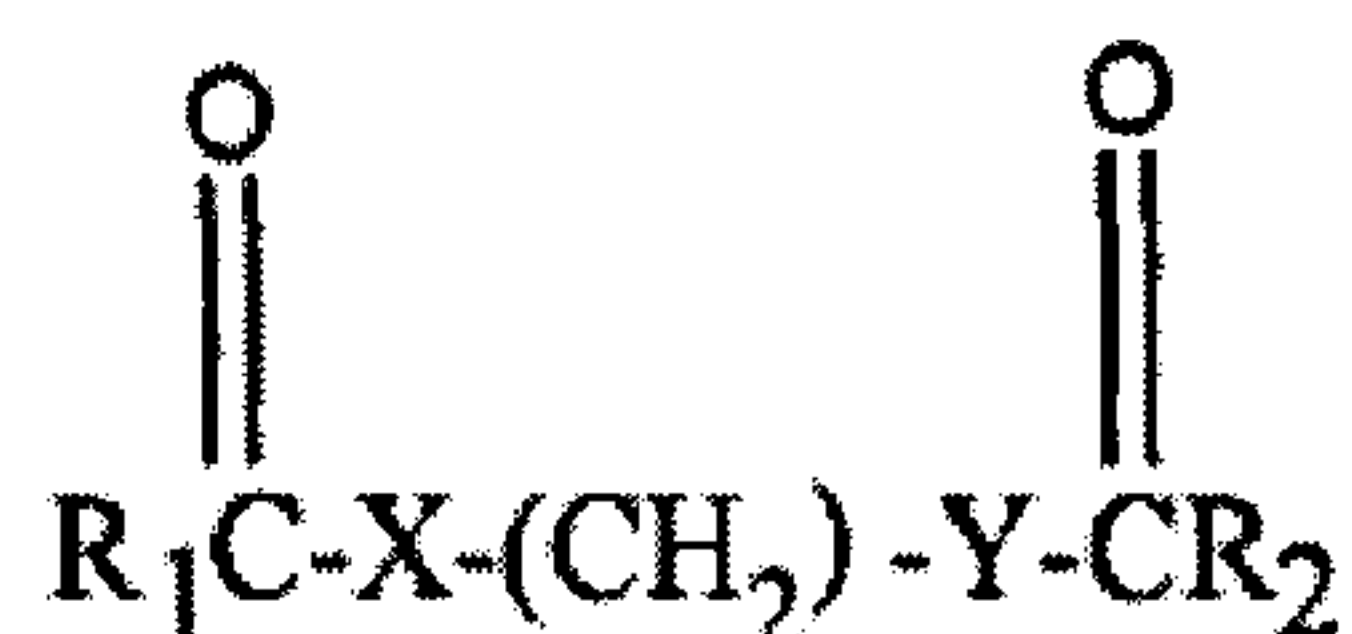
Cells treated with at the at least one chromatin-remodeling agent may be treated with at least one other factor to promote the differentiation of the cells into a specific cell type. Factors may include, for example, nicotinamide, members of the TGF- β family,
 10 including TGF- β 1, 2, and 3, bone morphogenic proteins (BMP-2, -4, 6, -7, -11, -12, and -13), serum albumin, fibroblast growth factor family members, platelet-derived growth factor-AA, and -BB, platelet rich plasma, insulin growth factor (IGF-I, -II) growth differentiation factor (GDF-5, -6, -8, -10, -11), glucagon like peptide-I and -II (GLP-I and -II), GLP-1 and GLP-2 mimetobody, Exendin-4, retinoic acid, parathyroid hormone,
 15 insulin, progesterone, aprotinin, hydrocortisone, ethanolamine, beta mercaptoethanol, epidermal growth factor (EGF), gastrin I and II, copper chelators such as triethylene pentamine, forskolin, sodium-Butyrate, activin, betacellulin, ITS, noggin, neurite growth factor, nodal, hepatocyte growth factor (HGF), keratinocyte growth factor (KGF), bovine pituitary extract, islet neogenesis-associated protein (INGAP), proteasome inhibitors,
 20 notch pathway inhibitors, sonic hedgehog inhibitors, or combinations thereof.

The combination and concentrations of growth factors, the length of culture, and other culture conditions can be optimized by those skilled in the art to achieve effective differentiation by, for example, monitoring the percentage of cells that have differentiated into cells characteristic of the desired lineage. The one or more growth factors may be
 25 added in an amount sufficient to induce the differentiation of the cells of the present invention into cells bearing markers of a β -cell lineage over a time period of about one to four weeks.

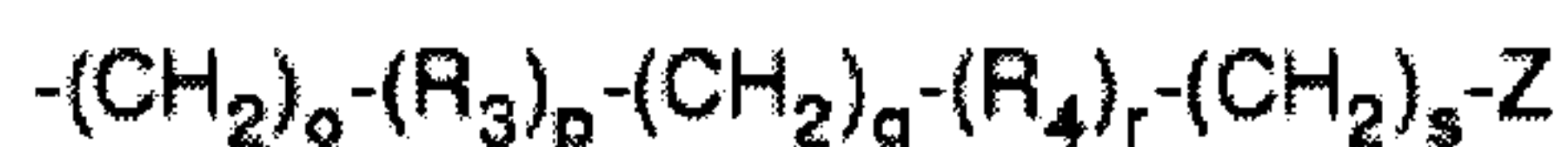
Chromatin-Remodeling Agents.

An aspect of the present invention, the chromatin-remodeling agent is a modulator of histone deacetylase activity. "Histone deacetylase" refers to enzymes that remove acetyl groups from histones. The modulator of histone deacetylase activity may enhance the activity of histone deacetylase enzymes, or it may inhibit the activity of histone deacetylase enzymes.

In one aspect, the inhibitor of histone deacetylase activity may be a delta dicarbonyl compound, such as, for example, compounds disclosed in European Patent Application EP1216986, having the general formula:

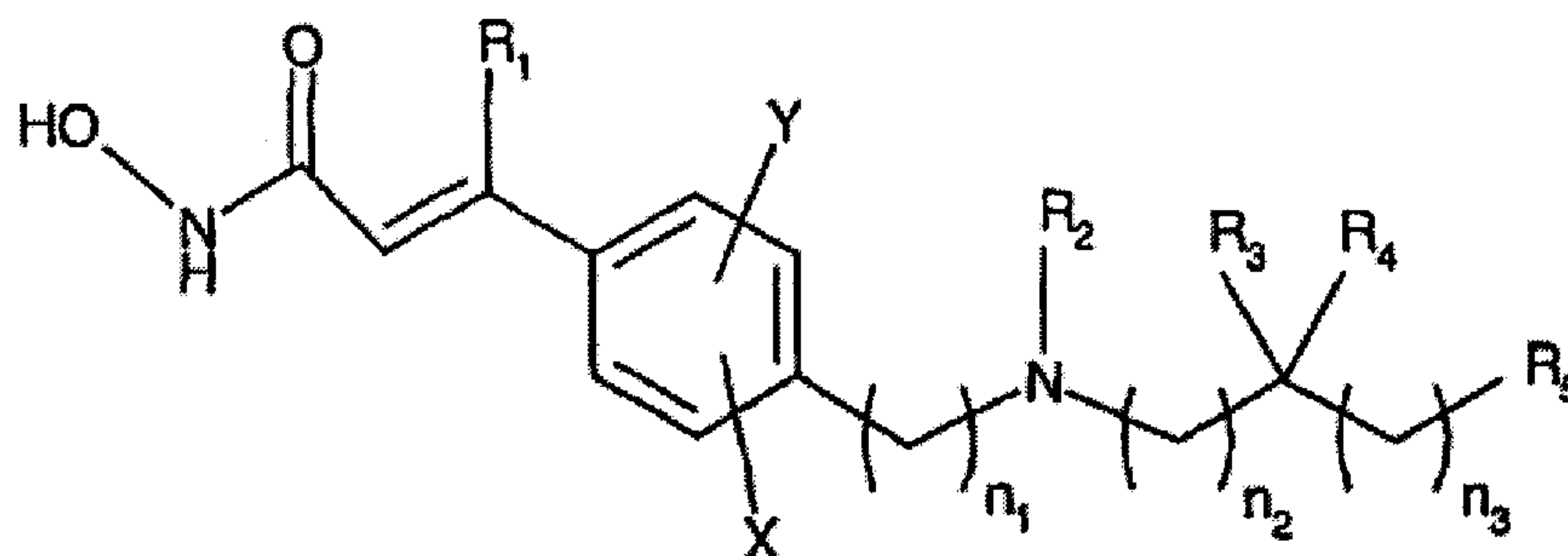


- 10 Wherein X is selected from the group consisting of oxygen, sulfur and N(R); wherein Y is selected from the group consisting of sulfur, N(R), and CH₂; wherein R is either H or CH₃; wherein R₁ and R₂ are the same or different and have the general formula:



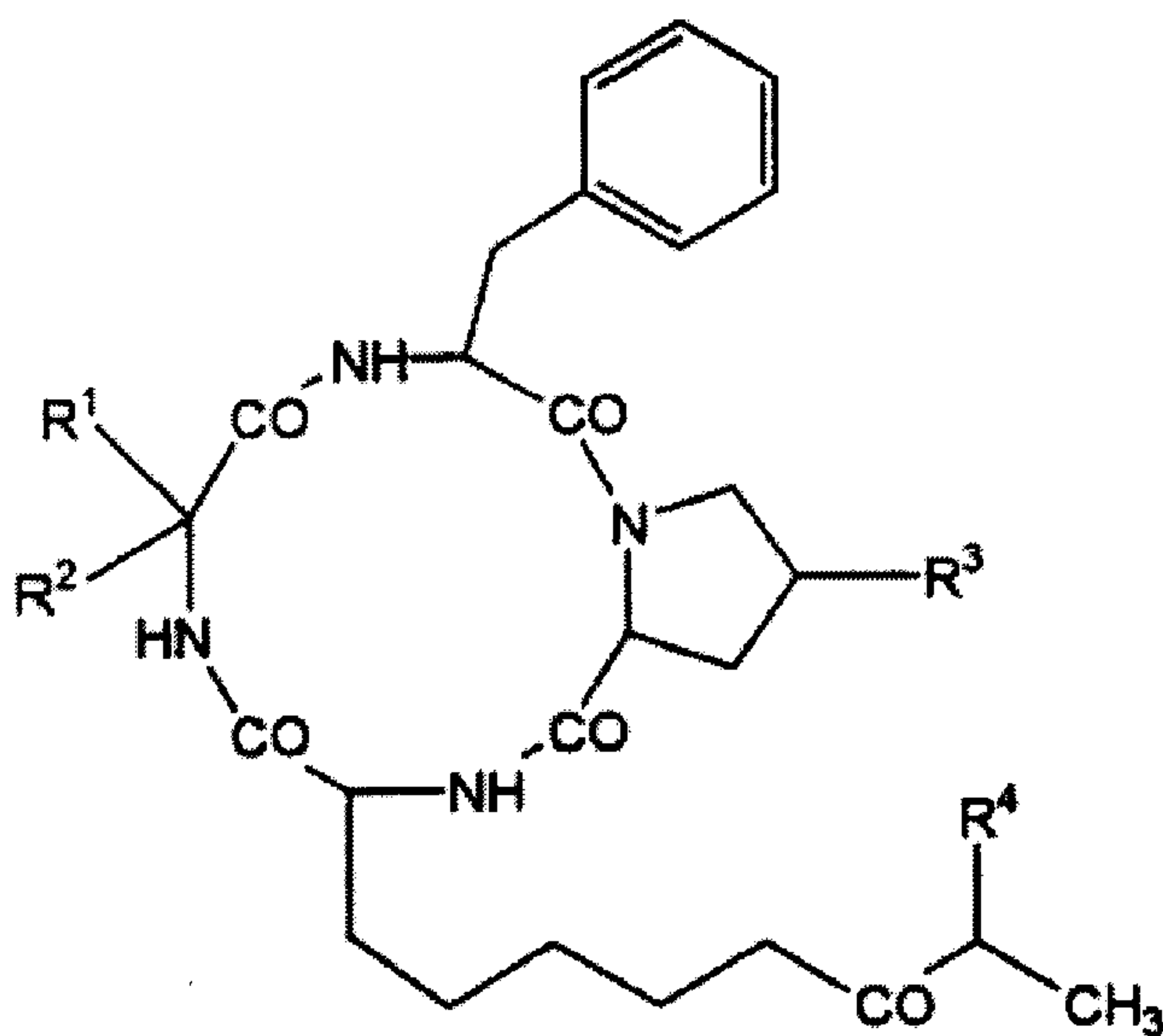
- 15 Wherein R₃ and R₄ are the same or different and are selected from the group (CH=CH), (C≡C), sulfur and oxygen; wherein Z is selected from the group consisting of hydrogen and substituted or unsubstituted aryl, heteroaryl, cycloalkyl having the general formula C_nH_{2n-1} and alkoxy; wherein n is 3 or greater; and wherein o, p, q, r and s are the same or different and are each between 0 and 10.

- 20 In one aspect, the inhibitor of histone deacetylase activity may be a hydroxamate compound, such as, for example, compounds disclosed in WO0222577, having the general formula:



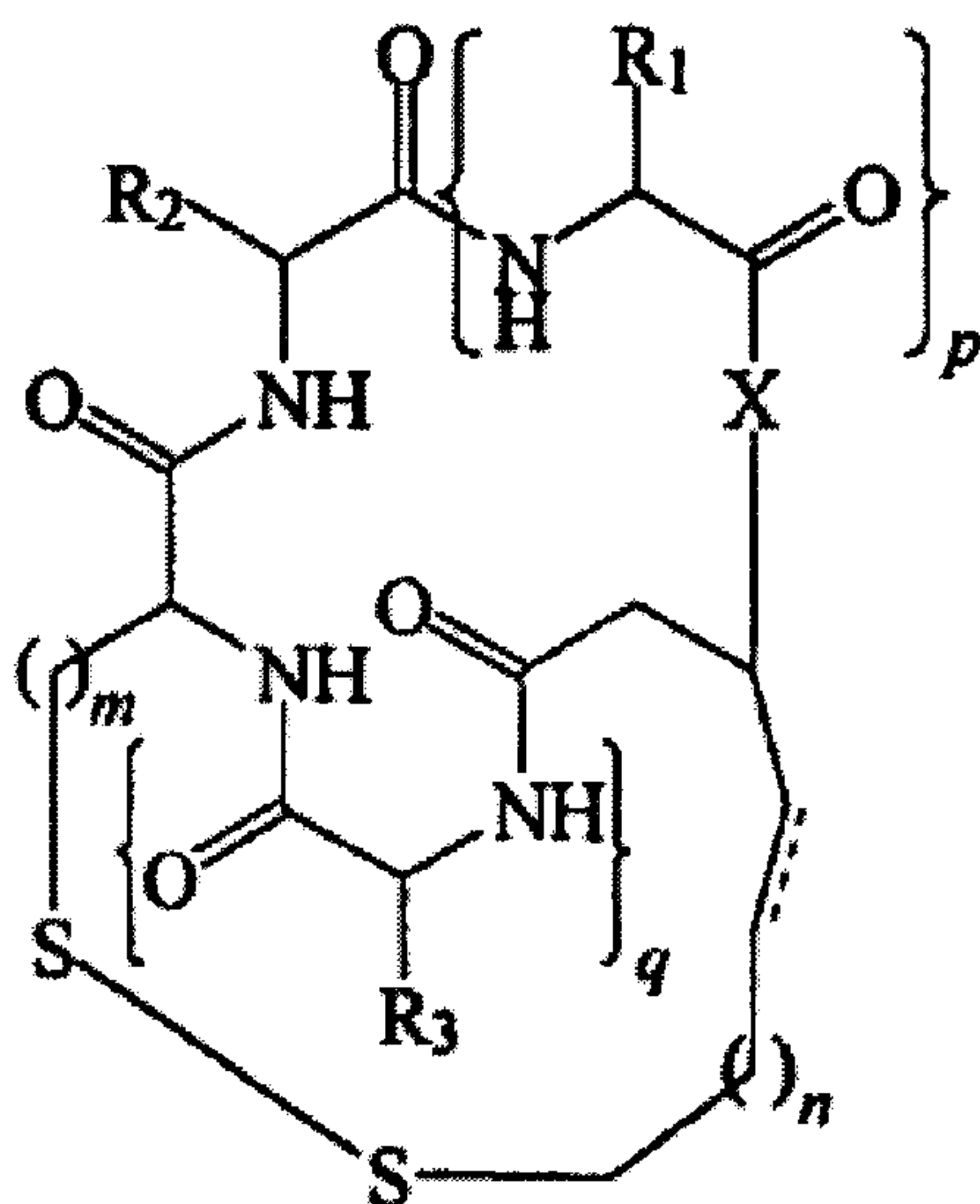
- Wherein R_1 is H, halo, or a straight chain C_1 - C_6 alkyl; R_2 is selected from H, C_1 - C_{10} alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, C_4 - C_9 heterocycloalkylalkyl, cycloalkylalkyl, aryl, heteroaryl, arylalkyl, heteroarylalkyl, $-(CH_2)_nC(O)R_6$, -
- 5 $(CH_2)_nOC(O)R_6$, amino acyl, $HON-C(O)-CH=C(R_1)$ -aryl-alkyl- and $-(CH_2)_nR_7$; R_3 and R_4 are the same or different and independently H, C_1 - C_6 alkyl, acyl or acylamino, or R_3 and R_4 together with the carbon to which they are bound represent $C=Q$ $C=S$, or $C=NR_8$, or R_2 together with the nitrogen to which it is bound and R_3 together with the carbon to which it is bound can form a C_4 - C_9 heterocycloalkyl, a heteroaryl, a polyheteroaryl, a
- 10 non-aromatic polyheterocycle, or a mixed aryl and non-aryl polyheterocycle ring; R_5 is selected from H, C_1 - C_6 alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, acyl, aryl, heteroaryl, arylalkyl, heteroarylalkyl, aromatic polycycle, non-aromatic polycycle, mixed aryl and non-aryl polycycle, polyheteroaryl, non-aromatic polyheterocycle, and mixed aryl and non-aryl polyheterocycle; n , n_1 , n_2 and n_3 are the same or different and
- 15 independently selected from 0 - 6, when n_1 is 1-6, each carbon atom can be optionally and independently substituted with R_3 and/or R_4 ; X and Y are the same or different and independently selected from H, halo, C_1 - C_4 alkyl, NO_2 , $C(O)R_1$, OR_9 , SR_9 , CN , and $N1R_{10}R_{11}$; R_6 is selected from H, C_1 - C_6 alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, cycloalkylalkyl, aryl, heteroaryl, arylalkyl, heteroarylalkyl, OR_{12} , and $NR_{13}R_{14}$; R_7 is
- 20 selected from OR_{15} , SR_{15} , $S(O)R_{16}$, SO_2R_{17} , $NR_{13}R_{14}$, and $NR_{12}SO_2R_6$; R_8 is selected from H, OR_{15} , $NR_{13}R_{14}$, C_1 - C_6 alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, aryl, heteroaryl, arylalkyl, and heteroarylalkyl; R_9 is selected from C_1 - C_4 alkyl and $C(O)$ -alkyl; R_{10} and R_{11} are the same or different and independently selected from H, C_1 - C_4 alkyl, and

- C(O)-alkyl; R_{12} is selected from H, C_1 - C_6 alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, C_4 - C_9 heterocycloalkylalkyl, aryl, mixed aryl and non-aryl polycycle, heteroaryl, arylalkyl, and heteroarylalkyl; R_{13} and R_{14} are the same or different and independently selected from H, C_1 - C_6 , alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, aryl, heteroaryl, arylalkyl, heteroarylalkyl, amino acyl, or R_{13} and R_{14} together with the nitrogen to which they are bound are C_4 - C_9 heterocycloalkyl, heteroaryl, polyheteroaryl, non-aromatic polyheterocycle or mixed aryl and non-aryl polyheterocycle; R_{15} is selected from H, C_1 - C_6 alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, aryl, heteroaryl, arylalkyl, heteroarylalkyl and $(CH_2)_mZ1R_{12}$; R_{16} is selected from C_1 - C_6 alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, aryl, heteroaryl, polyheteroaryl, arylalkyl, heteroarylalkyl and $(CH_2)_mZ1R_{12}$; R_{17} is selected from C_1 - C_6 alkyl, C_4 - C_9 cycloalkyl, C_4 - C_9 heterocycloalkyl, aryl, aromatic polycycle, heteroaryl, arylalkyl, heteroarylalkyl, polyheteroaryl and $NR_{13}R_{14}$; m is an integer selected from 0 to 6; and Z is selected from O, NR_{13} , S and S(O); or a pharmaceutically acceptable salt thereof.
- 15 In one aspect, the inhibitor of histone deacetylase activity may be a cyclic tetrapeptide compound, such as, for example, compounds disclosed in WO0021979, having the general formula:



Wherein R1 is methyl, W is methyl or ethyl, W is hydrogen or methyl and W is hydroxy optionally having a hydroxy-protective group, providing that when W is hydrogen, W is ethyl.

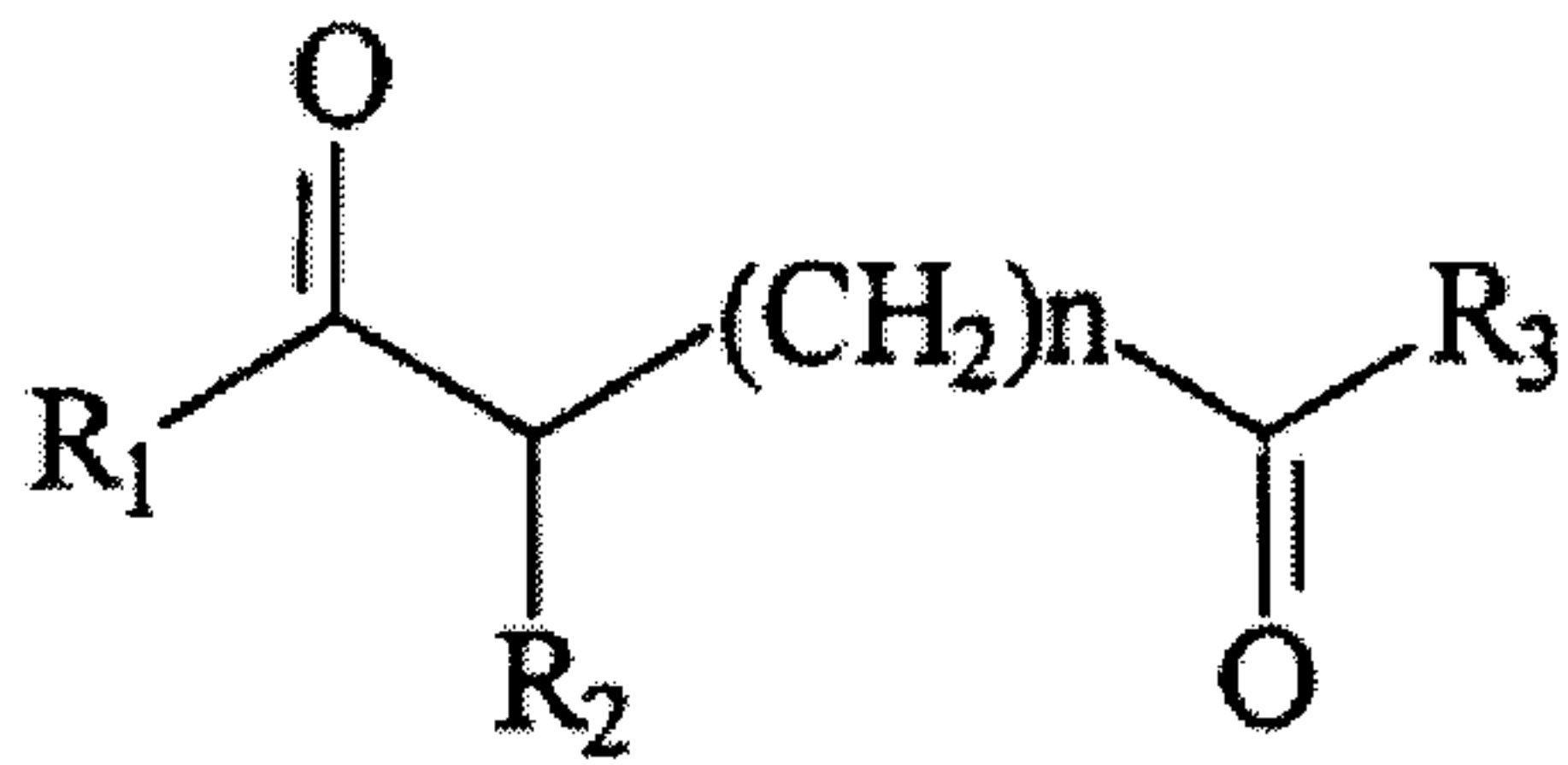
In one aspect, the inhibitor of histone deacetylase activity may be a depsipeptide compound, such as, for example, compounds disclosed in WO0142282, having the general formula:



Wherein m is 1, 2, 3 or 4; n is 0, 1, 2 or 3; p and q are independently 1 or 2; X is O, NH or NR; R₁, R₂, and R₃ are the same or different and independently an amino acid side-chain moiety or an amino acid side-chain derivative; and R is a lower chain alkyl, aryl or arylalkyl moiety, with the proviso that the compound is not FR901228.

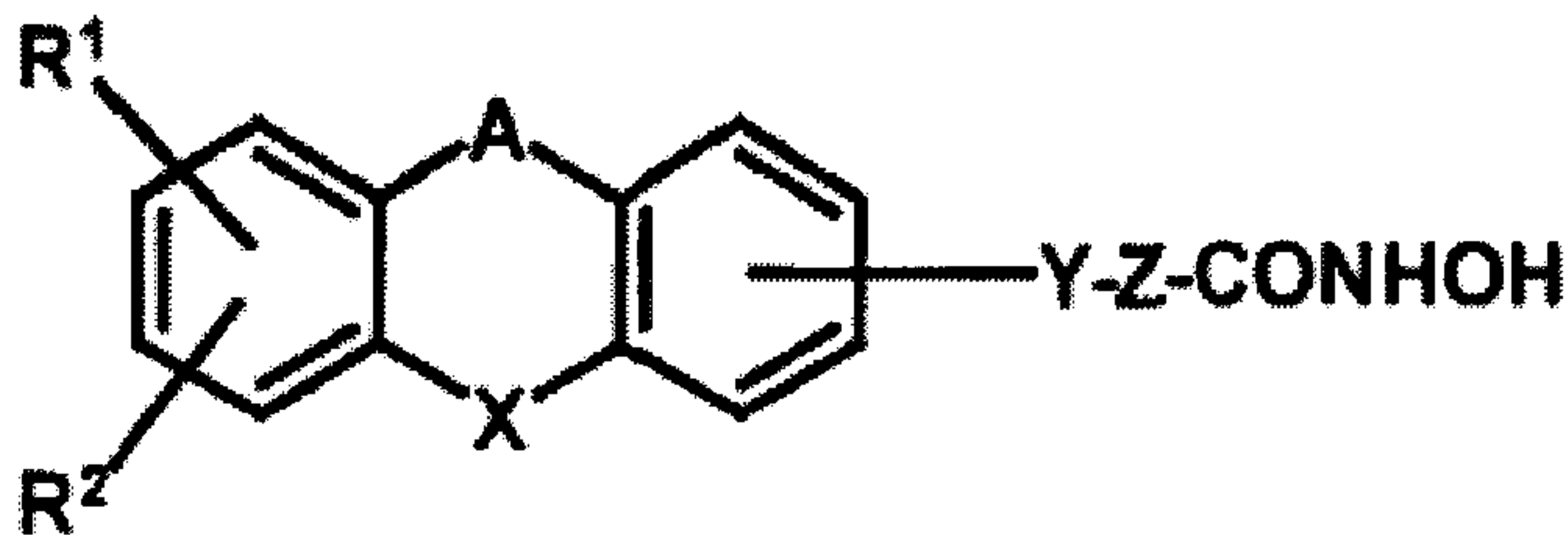
In one aspect, the inhibitor of histone deacetylase activity may be 6-(1,3-Dioxo-1H, 3H-benzo[de]isoquinolin-2-yl)-hexanoic acid hydroxyamide, termed "scriptaid", as disclosed in WO0149290.

15 In one aspect, the inhibitor of histone deacetylase activity may be compounds having the
general formula:



- Wherein R_1 , and R_2 are the same or different and are each a hydrophobic moiety; wherein R_3 is a hydroxamic acid, hydroxylamino, hydroxyl, amino, alkylamino, or alkyloxy group; and n is an integer from 3 to 10, or a pharmaceutically acceptable salt thereof, such as, for example, compounds disclosed in WO0118171.

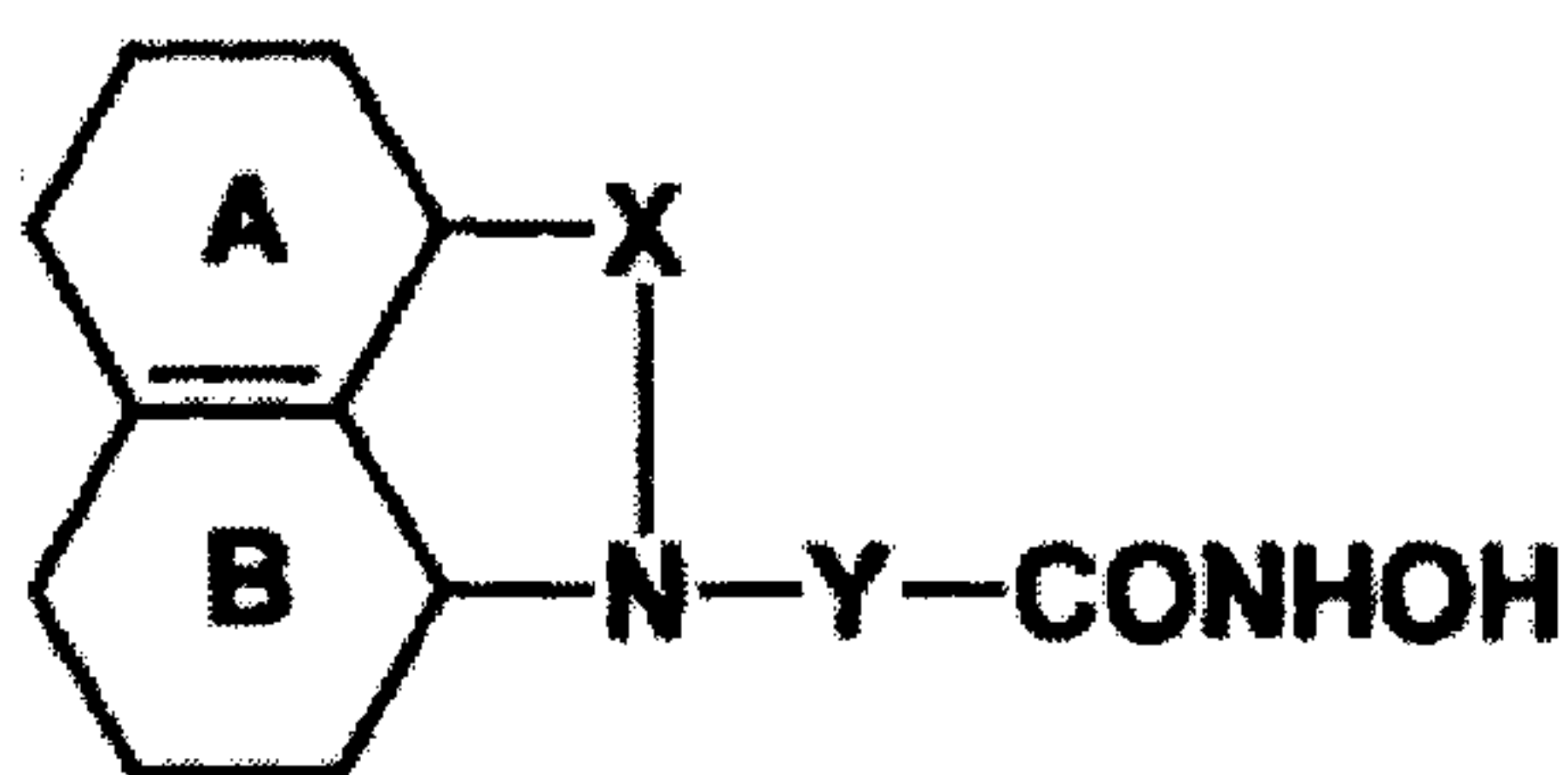
In one aspect, the inhibitor of histone deacetylase activity may be a tricyclic alkylhydroxamate compound, such as, for example, compounds disclosed in WO2002085883, having the general formula:



- Wherein A denotes a bond, the groups $-\text{CH}_2\text{-O-}$, $-\text{CH}_2\text{-S-}$, $-\text{CH}_2\text{-CH}_2\text{-}$, or $-\text{NH-CO-}$; X denotes the group $-\text{NR}^3\text{-}$, $=\text{CO}$, or $-\text{CH}(\text{OH})\text{-}$; Y denotes an oxygen atom, a sulfur atom, or the group $-\text{NR}^4\text{-}$; Z denotes a straight chain alkylene group comprising 4, 5, 6, 7, or 8 carbon atoms, wherein one CH_2 group may be replaced by an oxygen or a sulfur atom, or wherein 2 carbon atoms form a $\text{C}=\text{C}$ double bond, and which is either unsubstituted or substituted by one or two substituents selected from $(1-4\text{C})$ alkyl and halogen atoms; R^1 and R^2 denote substituents independently selected from a hydrogen atom, halogen atoms, $(1-4\text{C})$ alkyl, trifluoromethyl, hydroxy, $(1-4\text{C})$ alkoxy, benzyloxy, $(1-3\text{C})$ alkylenedioxy, nitro, amino, $(1-4\text{C})$ alkylamino, di $[(1-4\text{C})\text{alkyl}]$ -amino, or $(1-4\text{C})$ alkanoylamino groups; R^3

and R^4 independently denote hydrogen atoms or $(1-4C)$ alkyl groups; their enantiomers, diastereoisomers, racemates and mixtures thereof.

In one aspect, the inhibitor of histone deacetylase activity may be a tricyclic lactam or sultam derivative, such as, for example, compounds disclosed in WO2002062773, having
5 the general formula:



Wherein



denotes a cyclohexenyl group or a phenyl group,

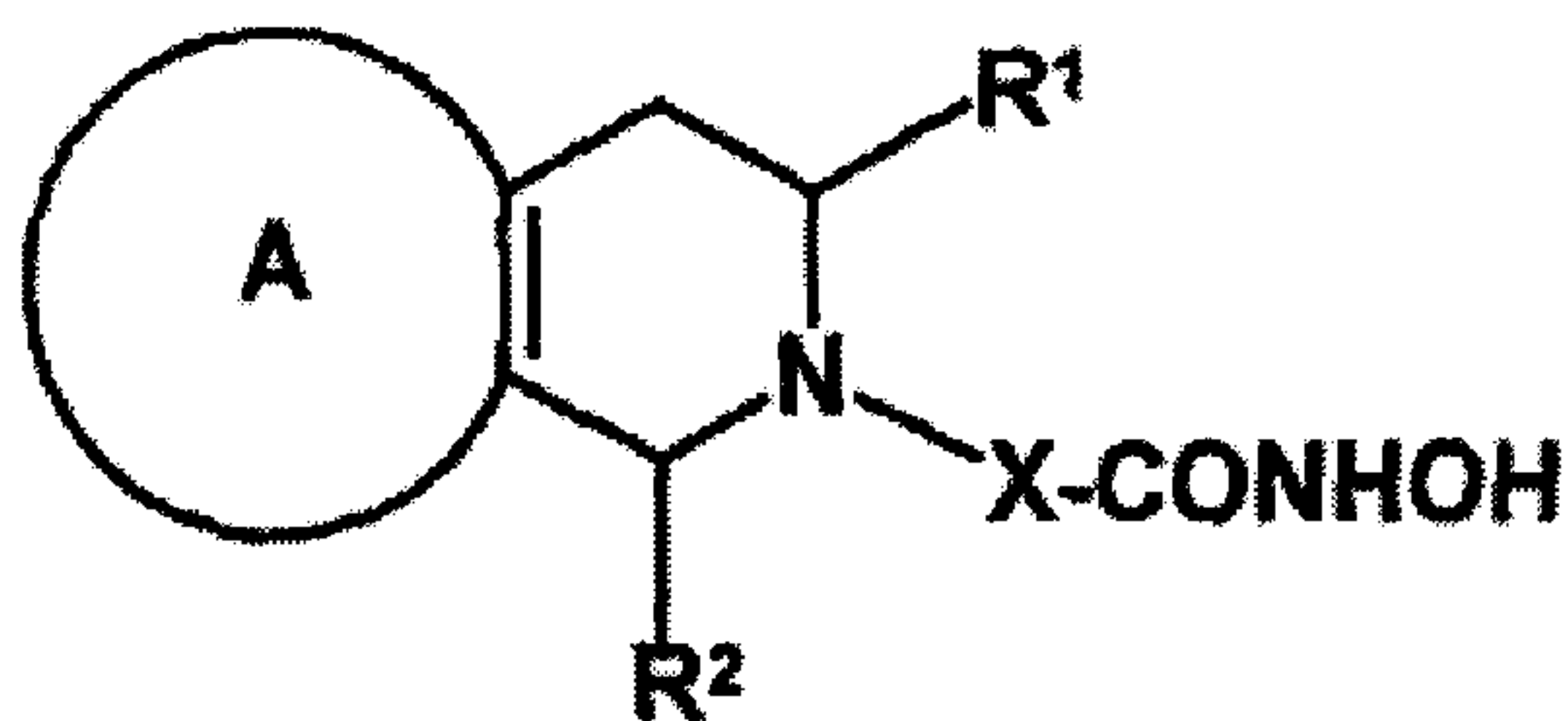


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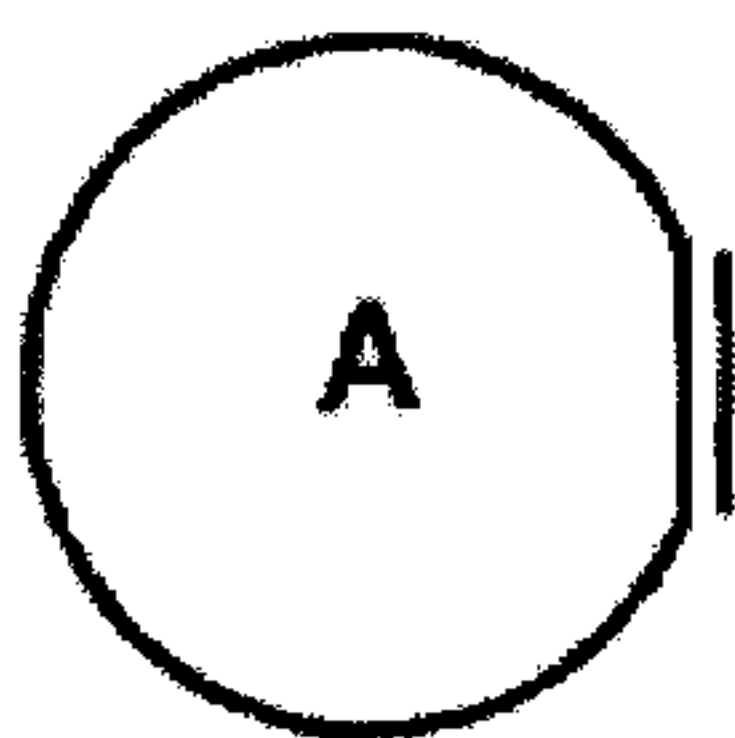
denotes a cyclohexenyl or a phenyl group which may be unsubstituted or substituted by one or more substituents independently selected from a halogen atom, a nitro group, an amino group, an $(1-4C)$ alkylamino group, a di $[(1-4C)$ alkyl]-amino group, or an $(1-4C)$ alkanoylamino group, X is a carbonyl group or a sulfonyl group, Y is a straight chain
15 alkylene group comprising 5, 6, or 7 carbon atoms, wherein one CH_2 group may be replaced by an oxygen or a sulfur atom, or wherein 2 carbon atoms form a $C=C$ double bond, and which is either unsubstituted or substituted by one or two substituents selected

from (1-4C)alkyl and halogen atoms, their enantiomers, diastereoisomers, racemates and mixtures thereof and pharmaceutically acceptable salts.

In one aspect, the inhibitor of histone deacetylase activity may be tetrahydropyridine derivative, such as, for example, compounds disclosed in WO2002051842, having the
5 general formula:



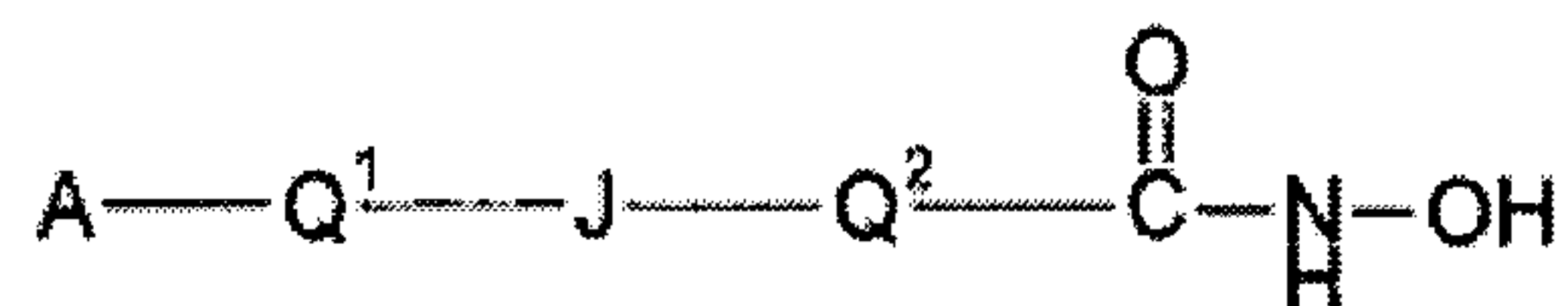
Wherein



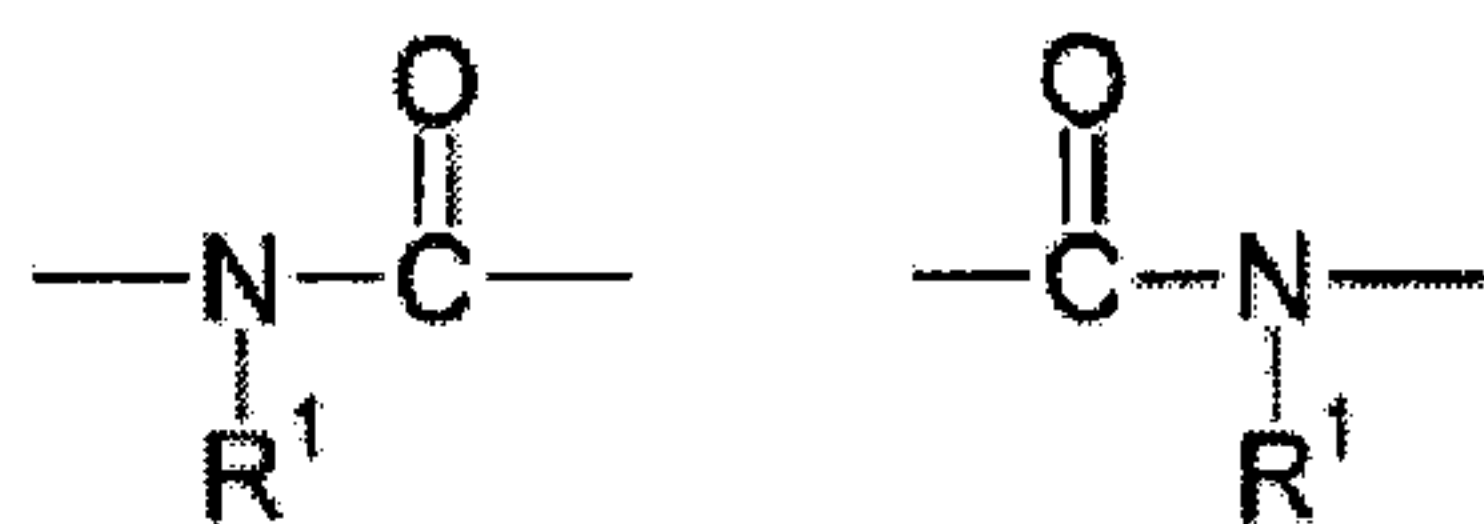
Denotes (a) a phenyl group which may be unsubstituted or substituted with 1, 2 or 3
10 substituents independently selected from a halogen atom, an (1-4C)alkyl-,
trifluoromethyl-, hydroxy-, (1-4C)alkoxy-, benzyloxy-, (1-3C)alkylenedioxy-, nitro-,
amino-, (1-4C)alkylamino-, di[(1-4C)alkyl]-amino-, (1-4C)alkanoyl-amino-, or a phenyl
group, which may be unsubstituted or substituted by 1, 2, or 3 substituents independently
selected from a chlorine atom, an (1-4C)alkyl-, trifluoromethyl-, hydroxy-, (1-4C)alkoxy-
15 , (1-3C)alkylenedioxy-, nitro-, amino-, (1-4C)alkylamino-, di[(1-4C)alkyl]amino-, and a
(1-4C) alkanoylamino group, or (b) denotes an indolyl group which may be unsubstituted
or substituted with 1, 2 or 3 substituents independently selected from a halogen atom, an
(1-4C)alkyl-, trifluoromethyl-, hydroxy-, (1-4C)alkoxy-, benzyloxy-, (1-
3C)alkylenedioxy-, nitro-, amino-, (1-4C)alkylamino-, di[(1-4C)alkyl]amino-, or a (1-

4C)alkanoylamino-group, R^1 and R^2 are the same as or different from each other and are a hydrogen atom, an (1-4C) alkyl-, a trifluoromethyl group, or an aryl group, X is a straight chain alkylene group comprising 5, 6, or 7 carbon atoms, wherein one CH_2 group may be replaced by an oxygen or a sulfur atom, or wherein 2 carbon atoms form a $C=C$ double bond, and which is either unsubstituted or substituted by one or two substituents selected from (1-4C)alkyl and halogen atoms, their enantiomers, diastereoisomers, racemates and mixtures thereof and pharmaceutically acceptable salts.

In one aspect, the inhibitor of histone deacetylase activity may be a carbamic acid compound, such as, for example, compounds disclosed in WO2002026696, having the general formula:

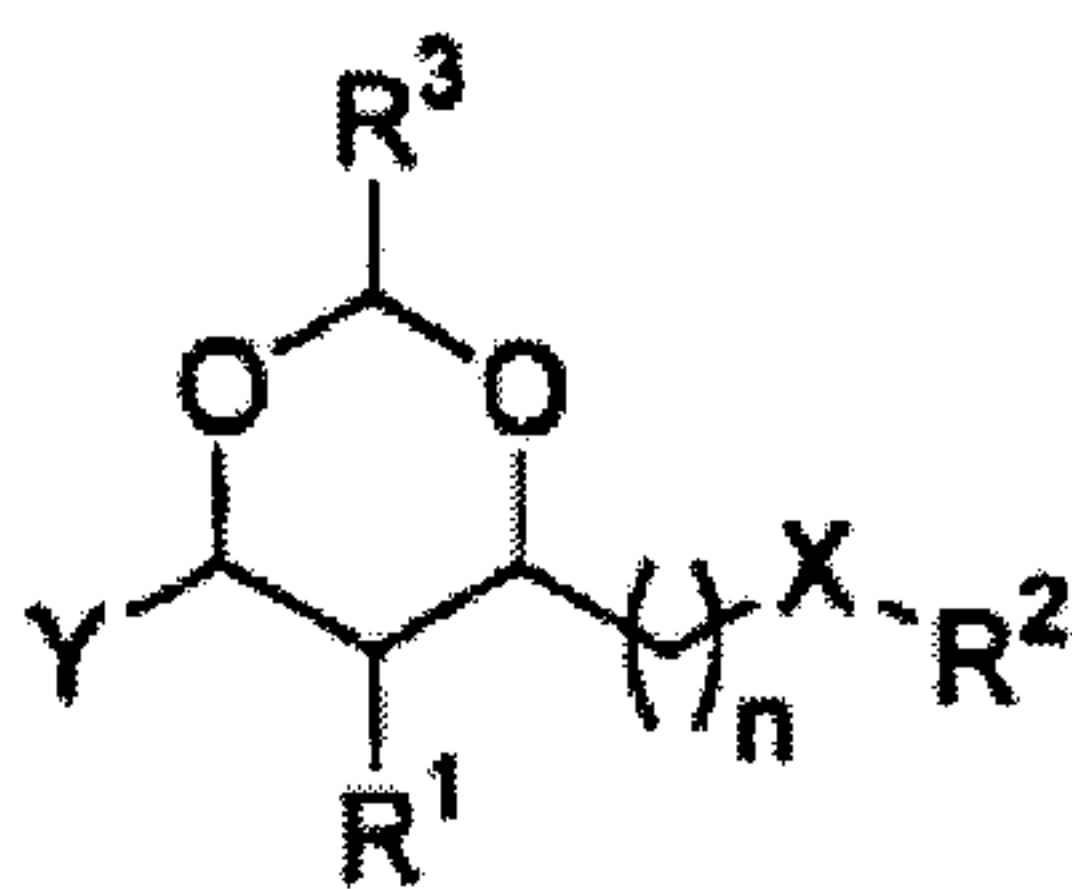


Wherein A is an aryl group; Q^1 is an aryl leader group having a backbone of at least 2 carbon atoms; J is an amide linkage selected from:



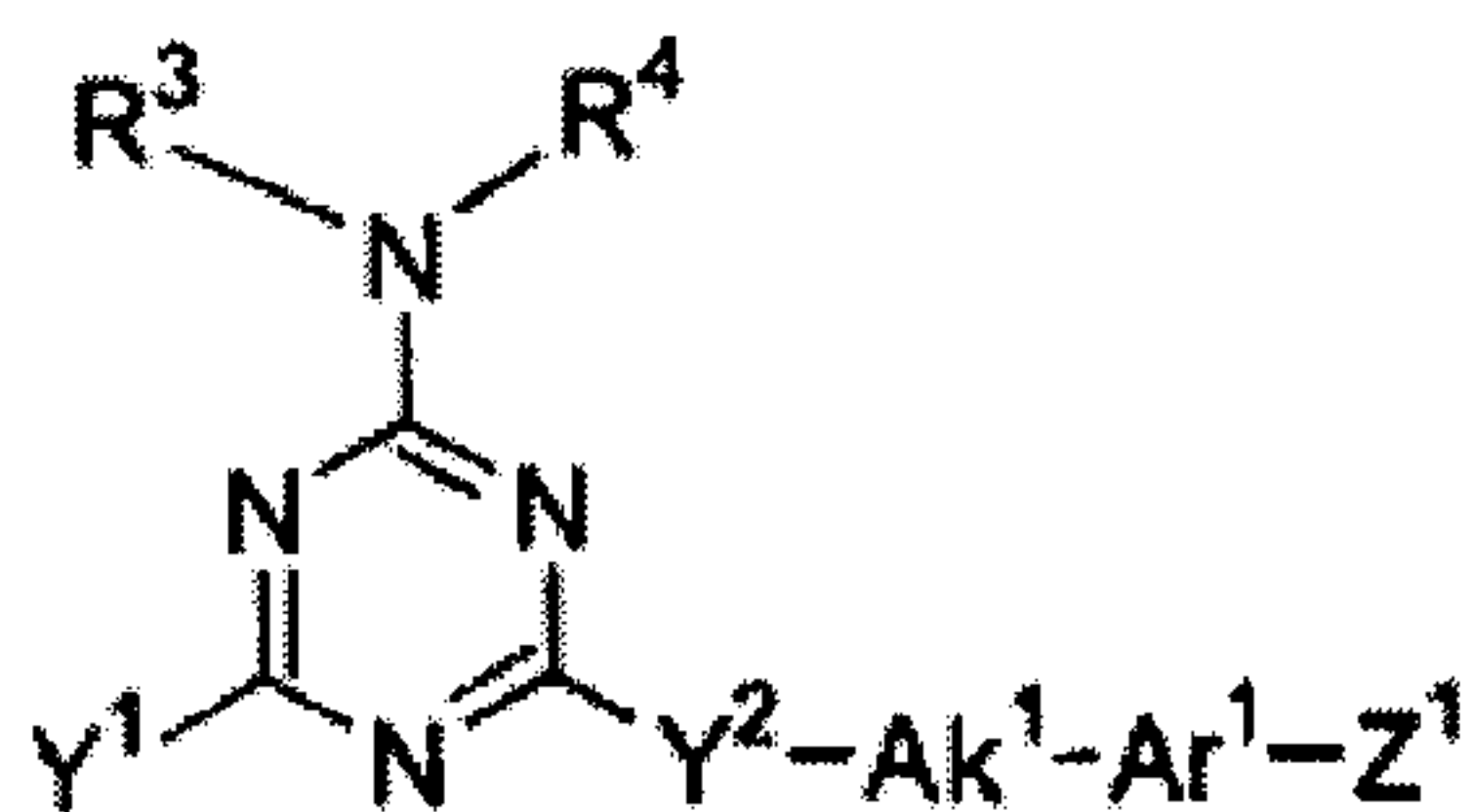
R^1 is an amido substituent; and, Q^2 is an acid leader group; and wherein: A, is a C_{5-20} aryl group, and is optionally substituted; the aryl leader group is a C_{1-7} alkylene group and is optionally substituted; the amido substituent, R^1 , is hydrogen, C_{1-7} alkyl, C_{3-20} heterocyclyl, or C_{5-20} aryl; the acid leader group, Q^2 , is C_{1-7} alkylene; C_{5-20} arylene; C_{5-20} arylene- C_{1-7} alkylene; C_{1-7} alkylene- C_{5-20} arylene; and is optionally substituted; and, the acid leader group, Q^2 , has a backbone of at least 3 carbon atoms; and pharmaceutically acceptable salts, solvates, amides, esters, ethers, chemically protected forms, and prodrugs thereof.

In one aspect, the inhibitor of histone deacetylase activity may be a dioxane compound, such as, for example, compounds disclosed in WO2002089782, having the general formula:



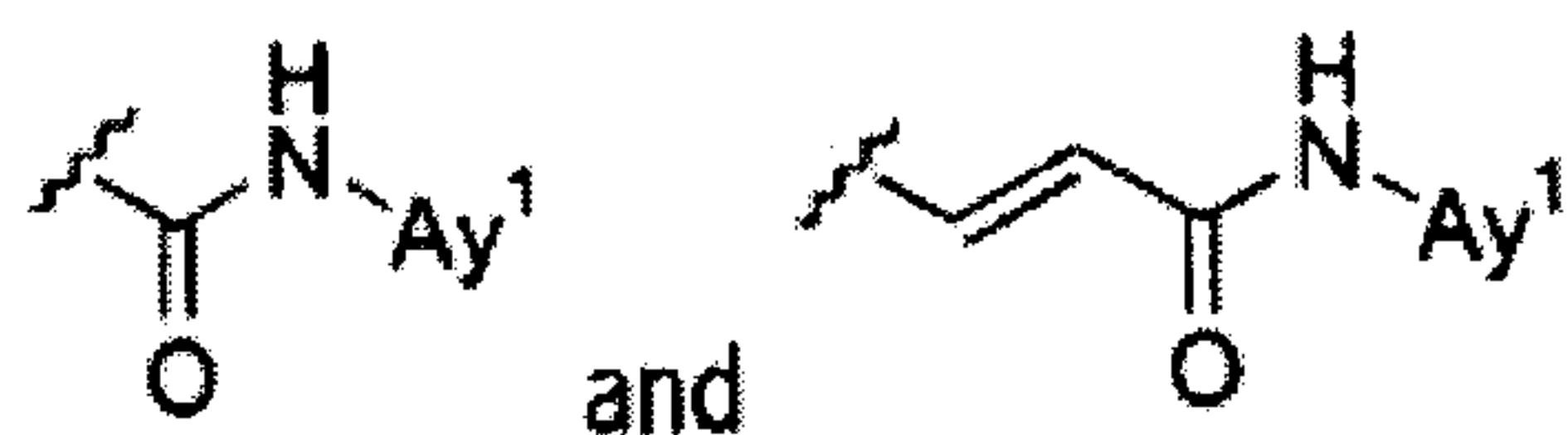
- 5 Wherein R^1 is hydrogen, or an aliphatic, heteroaliphatic, aryl, heteroaryl, -(aliphatic)aryl, -(aliphatic)heteroaryl, -(heteroaliphatic)aryl, or -(heteroaliphatic) heteroaryl moiety; n is 1-5; R^2 is hydrogen, a protecting group, or an aliphatic, heteroaliphatic, aryl, heteroaryl, -(aliphatic)aryl, -(aliphatic)heteroaryl, -(heteroaliphatic)aryl, or- (heteroaliphatic)heteroaryl moiety; X is -O-, -C(R^{2A})₂-, -S-, or -NR^{2A}-, wherein R^{2A} is
10 hydrogen, a protecting group, or an aliphatic, heteroaliphatic, aryl, heteroaryl, -(aliphatic)aryl, -(aliphatic) heteroaryl, (heteroaliphatic)aryl, or-(heteroaliphatic)heteroaryl moiety; or wherein two or more occurrences of R^2 and R^{2A} , taken together, form a cyclic aliphatic or heteroaliphatic moiety, or an aryl or heteroaryl moiety; R^3 is an aliphatic, heteroaliphatic, aryl, heteroaryl, -(aliphatic)aryl, -(aliphatic)heteroaryl, -
15 (heteroaliphatic)aryl, or -(heteroaliphatic)heteroaryl moiety; and Y is hydrogen or an aliphatic, heteroaliphatic, aryl, heteroaryl, -(aliphatic)aryl, (aliphatic) heteroaryl, -(heteroaliphatic)aryl, or-(heteroaliphatic)heteroaryl moiety, whereby each of the foregoing aliphatic and heteroaliphatic groups is independently substituted or unsubstituted, cyclic or acyclic, linear or branched, and each of the foregoing aryl and
20 heteroaryl groups is substituted or unsubstituted.

In one aspect, the inhibitor of histone deacetylase activity may be a compound having the general formula:



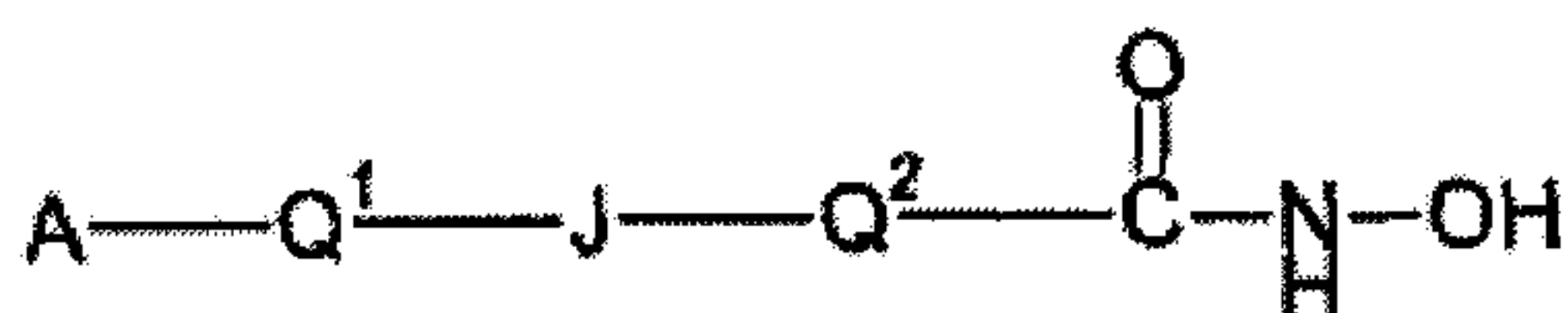
Wherein R^3 and R^4 are independently selected from the group consisting of hydrogen, L^1 , Cy^1 , and $-L^1-Cy^1$, wherein L^1 is C_1 - C_6 alkyl, C_2 - C_6 heteroalkyl, or C_3 - C_6 alkenyl; and Cy^1 is cycloalkyl, aryl, heteroaryl, or heterocyclyl, each of which is optionally substituted, and each of which is optionally fused to one or two aryl or heteroaryl rings, or to one or two saturated or partially unsaturated cycloalkyl or heterocyclic rings, each of which rings is optionally substituted; or R^3 and R^4 are taken together with the adjacent nitrogen atom to form a 5-, 6-, or 7- membered ring, wherein the ring atoms are independently selected from the group consisting of C, O, S, and N, and wherein the ring is optionally substituted, and optionally forms part of a bicyclic ring system, or is optionally fused to one or two aryl or heteroaryl rings, or to one or two saturated or partially unsaturated cycloalkyl or heterocyclic rings, each of which rings and ring systems is optionally substituted; Y^1 is selected from the group consisting of $-N(R^1)(R^2)$, $-CH_2-C(O)-N(R^1)(R^2)$, halogen, and hydrogen, wherein R^1 and R^2 are independently selected from the group consisting of hydrogen, L^1 , Cy^1 , and $-L^1-Cy^1$, wherein L^1 is C_1 - C_6 alkyl, C_2 - C_6 heteroalkyl, or C_3 - C_6 alkenyl; and Cy^1 is cycloalkyl, aryl, heteroaryl, or heterocyclyl, each of which is optionally substituted, and each of which is optionally fused to one or two aryl or heteroaryl rings, or to one or two saturated or partially unsaturated cycloalkyl or heterocyclic rings, each of which rings is optionally substituted; or R^1 and R^2 are taken together with the adjacent nitrogen atom to form a 5-, 6-, or 7- membered ring, wherein the ring atoms are independently selected from the group consisting of C, O, S, and N, and wherein the ring is optionally substituted, and optionally forms part of a bicyclic ring system, or is optionally fused to one or two aryl or heteroaryl rings, or to one or two saturated or partially unsaturated cycloalkyl or heterocyclic rings, each of which rings and ring systems is optionally substituted; Y^2 is a chemical bond or $N(R^0)$, where R^0 is selected from the group consisting of hydrogen, alkyl, aryl, aralkyl, and acyl; Ak^1 is C_1 - C_6 alkylene, C_1 - C_6 - heteroalkylene (preferably, in

which one (H₂- is replaced with -NH-, and more preferably -NH-CH₂-), C₂-C₆ alkenylene or C₂-C₆ alkynylene; Ar¹ is arylene or heteroarylene, either of which is optionally substituted; and Z¹ is selected from the group consisting of



- 5 wherein Ay¹ is aryl or heteroaryl, each of which is optionally substituted. Such compounds are disclosed in WO2003024448.

In one aspect, the inhibitor of histone deacetylase activity may be a carbamic acid compound, such as, for example, compounds disclosed in WO2002030879, having the general formula:

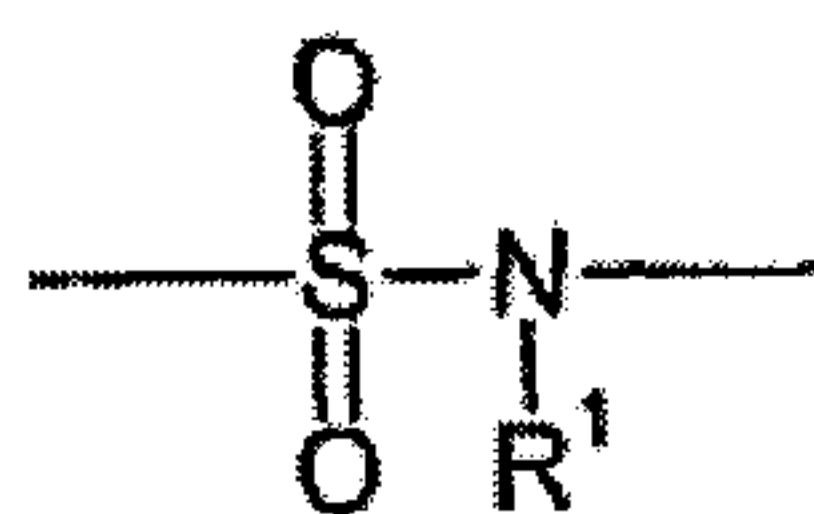


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Wherein A is an aryl group; Q¹ is a covalent bond or an aryl leader group; J is a sulfonamide linkage selected from:



- 15 R¹ is a sulfonamido substituent; and, Q² is an acid leader group; with the proviso that if J is:



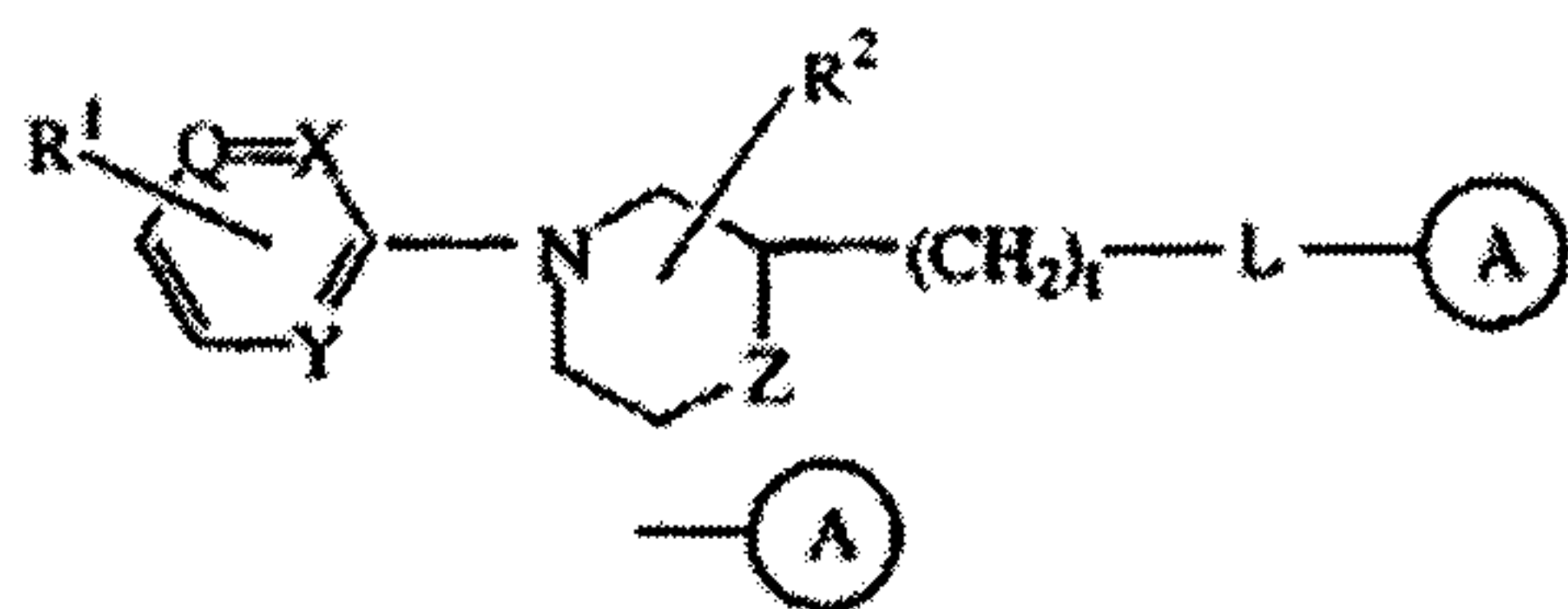
then Q^1 is an aryl leader group; and wherein: A, is a C_{5-20} aryl group, and is optionally substituted; the aryl leader group, if present, is a C_{1-7} alkylene group and is optionally substituted; the sulfonamido substituent, R^1 , is hydrogen, C_{1-7} alkyl, C_{3-20} heterocyclyl, or C_{5-20} aryl; the acid leader group, Q^2 , is C_{1-7} alkylene; C_{5-20} arylene; C_{5-20} arylene- C_{1-7} alkylene; C_{1-7} alkylene- C_{5-20} arylene; or an ether linkage; and is optionally substituted; and pharmaceutically acceptable salts, solvates, amides, esters, ethers, chemically protected forms, and prodrugs thereof.

In one aspect, the inhibitor of histone deacetylase activity may be a carbamic acid compound, such as, for example, compounds disclosed in WO2003082288, having the general formula:



Wherein Cy is independently a cyclyl group; Q^1 is independently a covalent bond or cyclyl leader group; the piperazin-1,4-diyl group is optionally substituted; J^1 is independently a covalent bond or $-C(=O)-$; J^2 is independently $-C(=O)-$ or $-S(=O)_2-$; Q^2 is independently an acid leader group; wherein: Cy is independently: C_{3-20} carbocyclyl, C_{3-20} heterocyclyl, or C_{5-20} aryl; and is optionally substituted; Q^1 is independently: a covalent bond; C_{1-7} alkylene; or C_{1-7} alkylene- $X-C_{1-7}$ alkylene, $-X-C_{1-7}$ alkylene, or C_{1-7} alkylene- $X-$, wherein X is $-O-$ or $-S-$; and is optionally substituted; Q^2 is independently: C_{4-8} alkylene; and is optionally substituted; and has a backbone length of at least 4 atoms; or: Q^2 is independently: C_{5-20} arylene; C_{5-20} arylene- C_{1-7} alkylene; C_{1-7} alkylene- C_{5-20} arylene; or, C_{1-7} alkylene- C_{5-20} arylene- C_{1-7} alkylene; and is optionally substituted; and has a backbone length of at least 4 atoms; or a pharmaceutically acceptable salt, solvate, amide, ester, ether, chemically protected form, or prodrug thereof.

In one aspect, the inhibitor of histone deacetylase activity may be piperazinyl-, piperidinyl- and morpholinyl- derivatives, such as, for example, compounds disclosed in WO2003076438, having the general formula:



the *N*-oxide forms, the pharmaceutically acceptable addition salts and the stereochemically isomeric forms thereof, wherein *t* is 0, 1, 2, 3 or 4 and when *t* is 0 then a direct bond is intended;

each Q is nitrogen or ;

each X is nitrogen or ;

each Y is nitrogen or ;

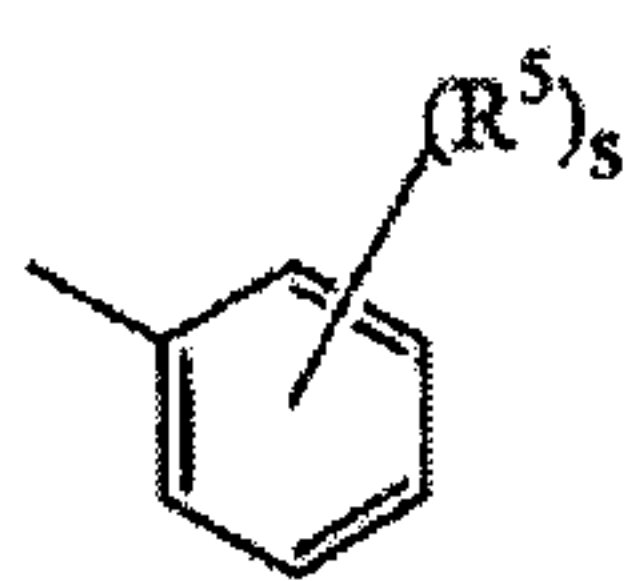
each Z is -NH-, -O- or -CH₂-;

5

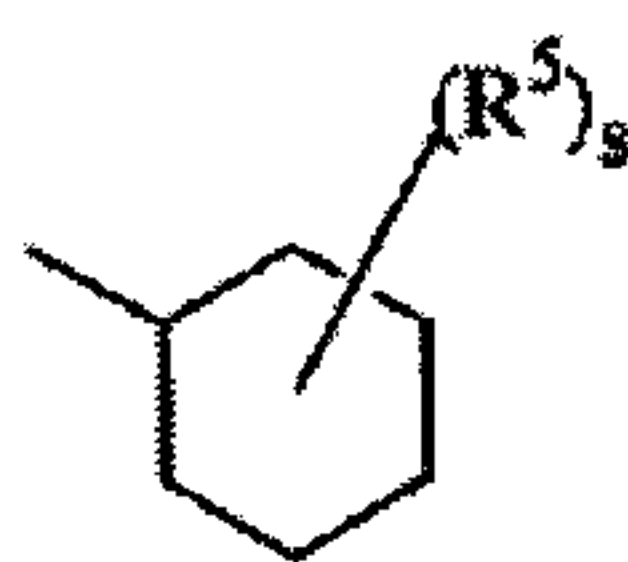
R¹ is -C(O)NR³R⁴, -NHC(O)R⁷, -C(O)-C₁₋₆alkanediylSR⁷, -NR⁸C(O)N(OH)R⁷, -NR⁸C(O)C₁₋₆alkanediylSR⁷, -NR⁸C(O)C=N(OH)R⁷ or another Zn-chelating-group wherein R³ and R⁴ are each independently selected from hydrogen, hydroxy, C₁₋₆alkyl, hydroxyC₁₋₆alkyl, aminoC₁₋₆alkyl or aminoaryl; R⁷ is hydrogen, C₁₋₆alkyl, C₁₋₆alkylcarbonyl, arylC₁₋₆alkyl, C₁₋₆alkylpyrazinyl, pyridinone, pyrrolidinone or
 10 methylimidazolyl; R⁸ is hydrogen or C₁₋₆alkyl; R² is hydrogen, hydroxy, amino, hydroxyC₁₋₆alkyl, C₁₋₆alkyl, C₁₋₆alkyloxy, arylC₁₋₆alkyl, aminocarbonyl, hydroxycarbonyl, aminoC₁₋₆alkyl, : aminocarbonylC₁₋₆alkyl, hydroxycarbonylC₁₋₆alkyl, hydroxyaminocarbonyl, C₁₋₆alkyloxycarbonyl, C₁₋₆alkylaminoC₁₋₆alkyl or di(C₁₋₆alkyl)aminoC₁₋₆alkyl; -L- is a bivalent radical selected from -NR⁹C(O)-, -NR⁹SO₂- or -NR⁹CH₂- wherein R⁹ is hydrogen, C₁₋₆alkyl, C₃₋₁₀cycloalkyl, hydroxyC₁₋₆alkyl, C₁₋₆alkyloxyC₁₋₆alkyl or di(C₁₋₆alkyl)aminoC₁₋₆alkyl;
 15



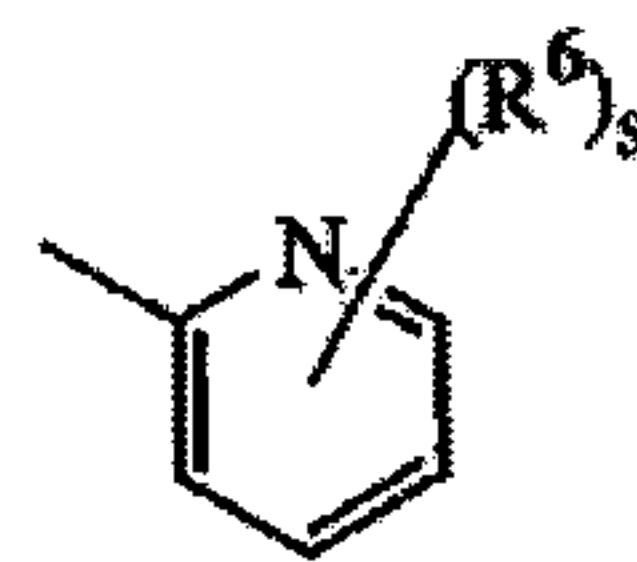
is a radical selected from



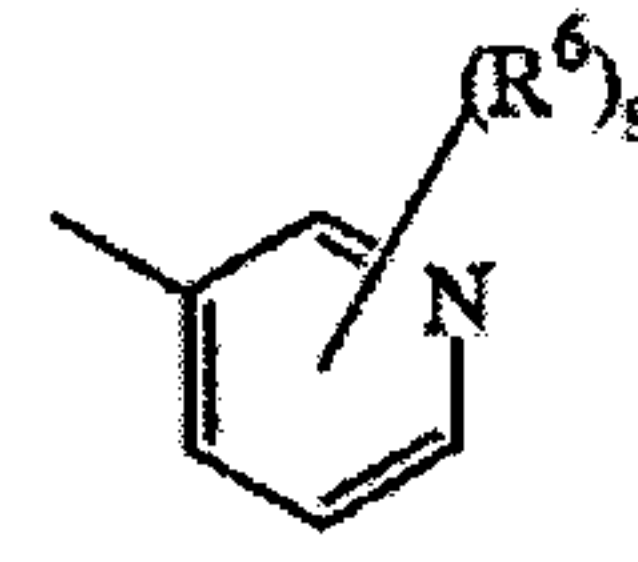
(a-1)



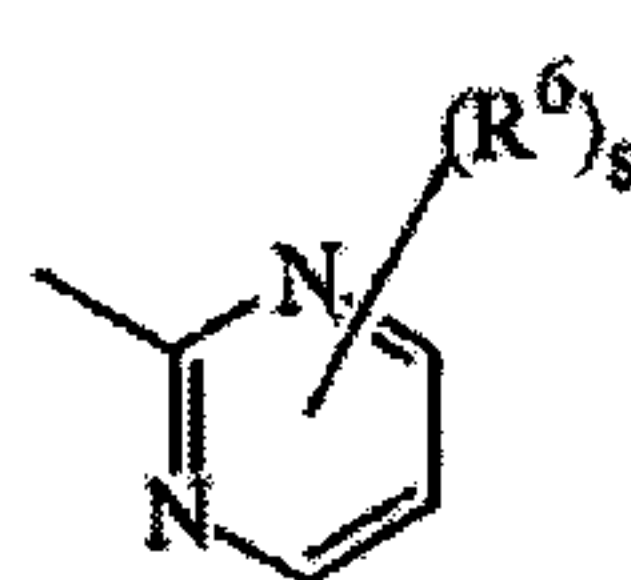
(a-2)



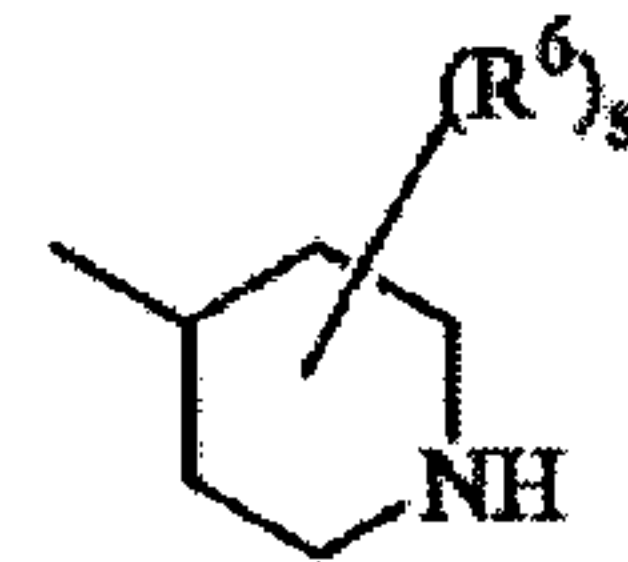
(a-3)



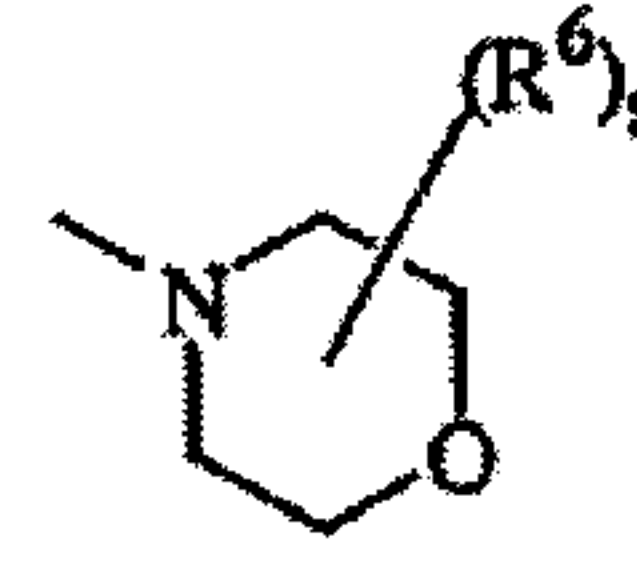
(a-4)



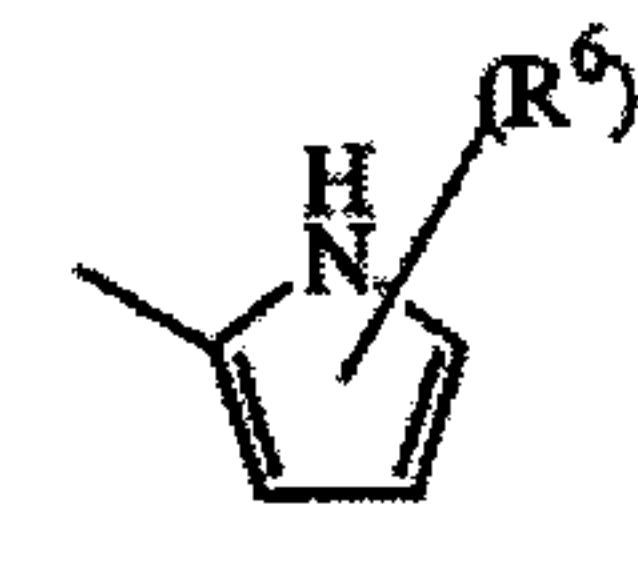
(a-5)



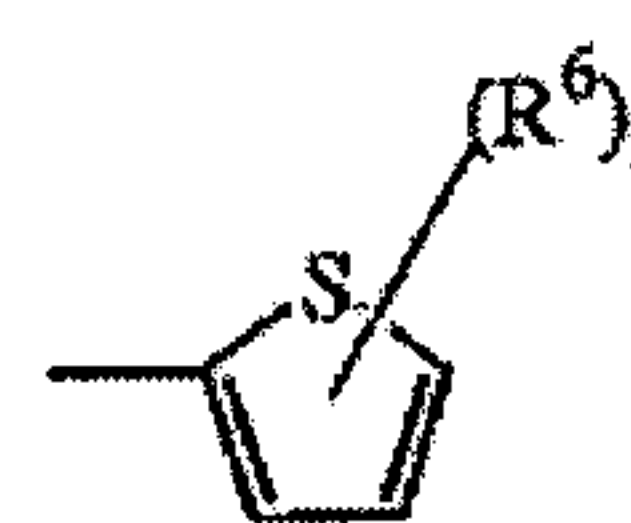
(a-6)



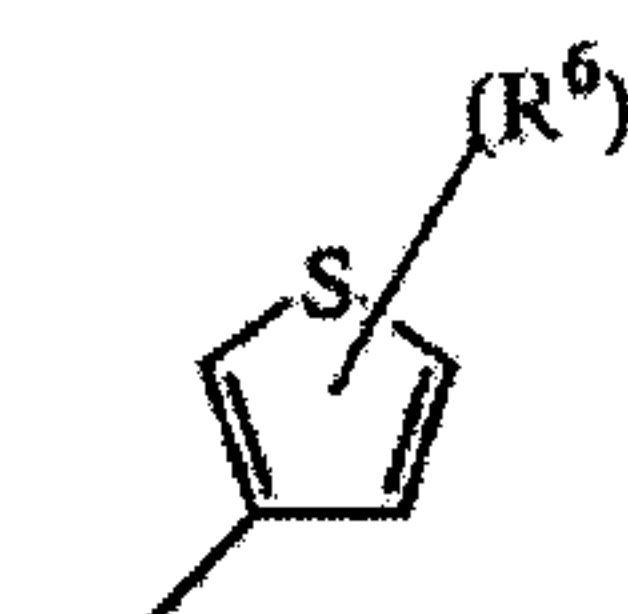
(a-7)



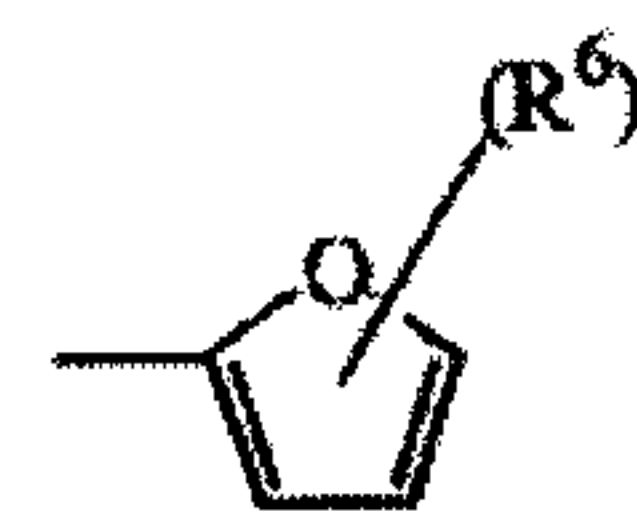
(a-8)



(a-9)



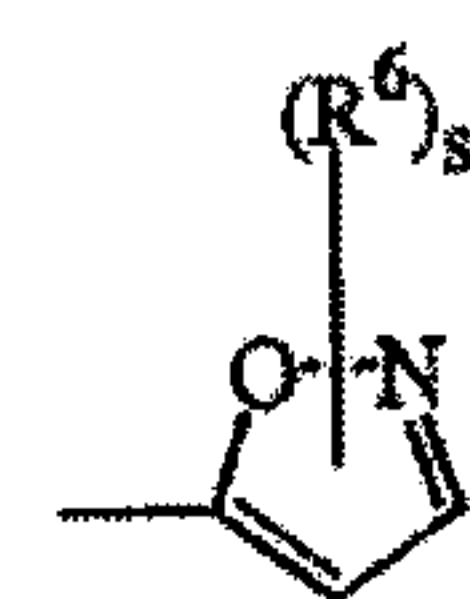
(a-10)



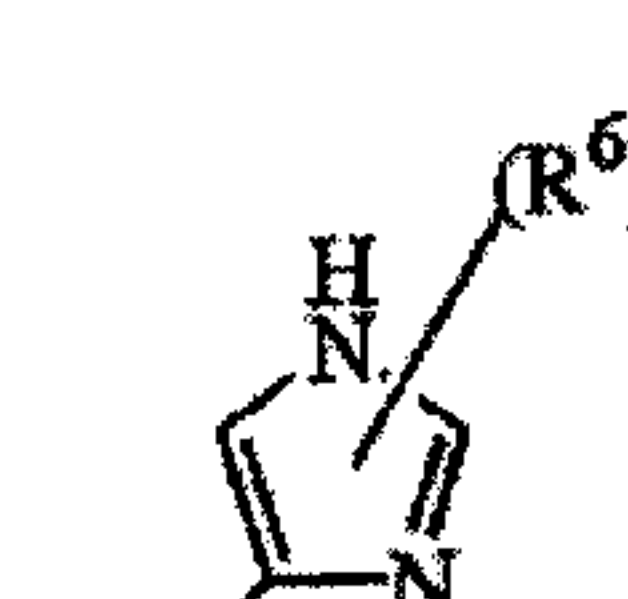
(a-11)



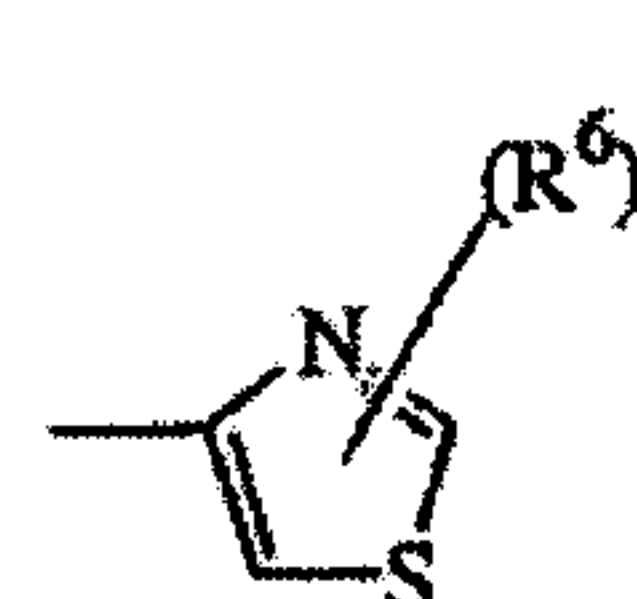
(a-12)



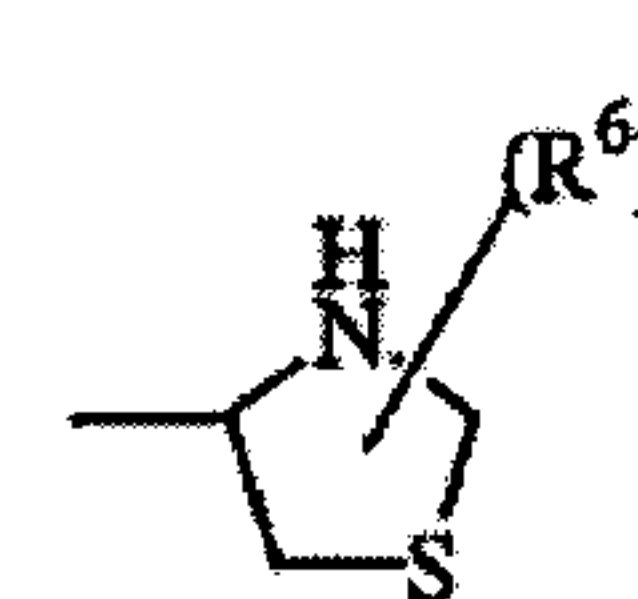
(a-13)



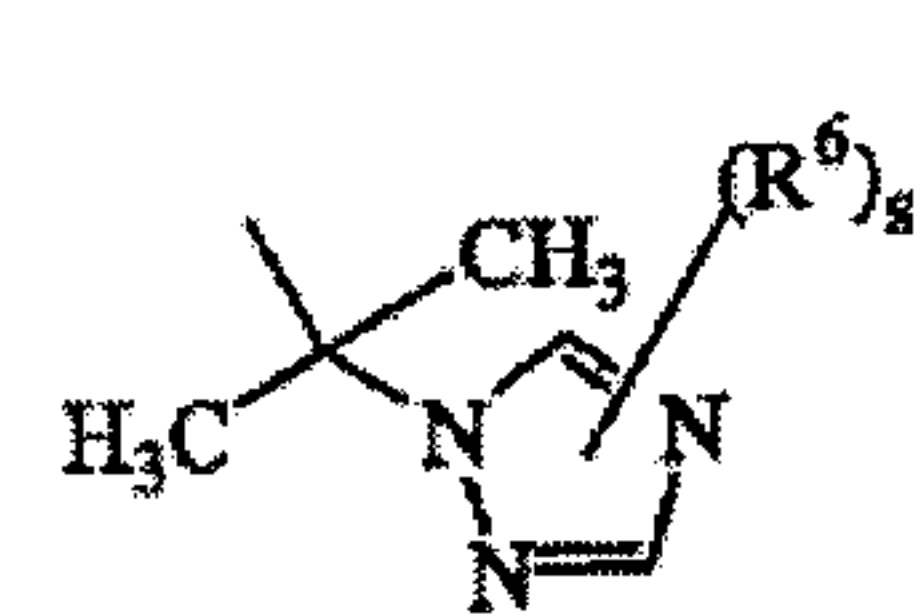
(a-14)



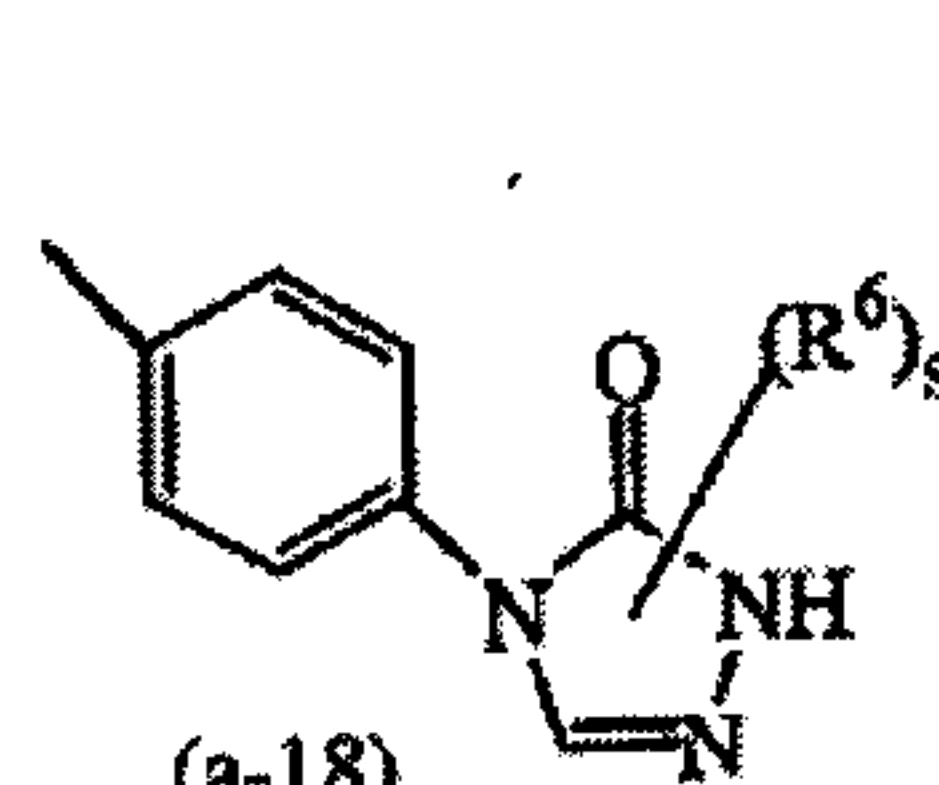
(a-15)



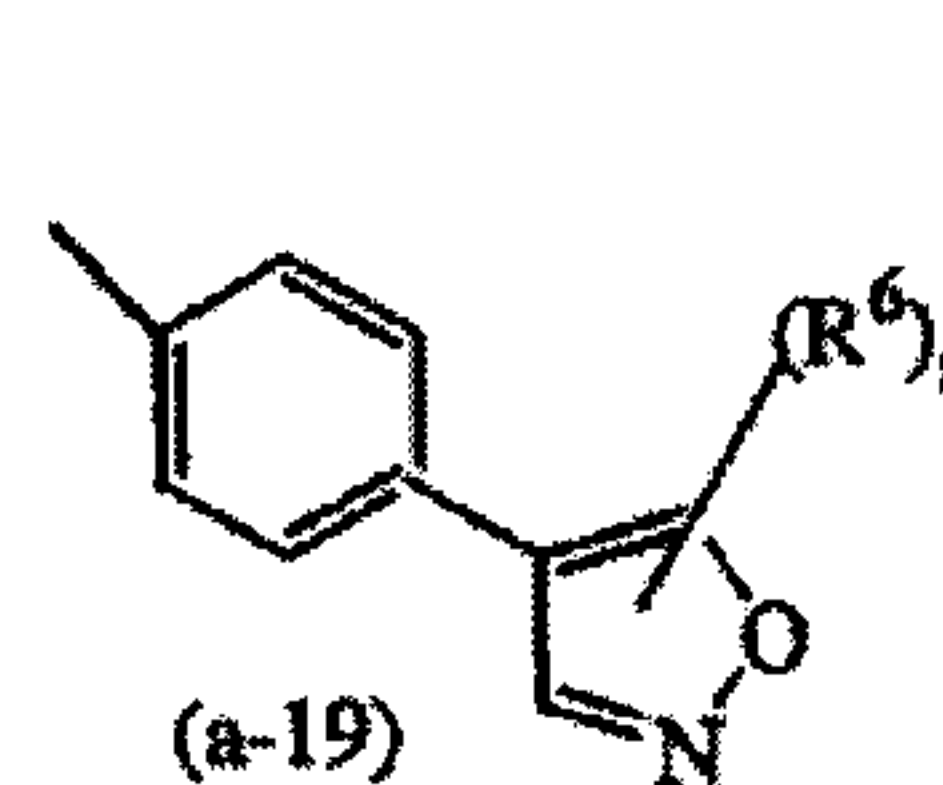
(a-16)



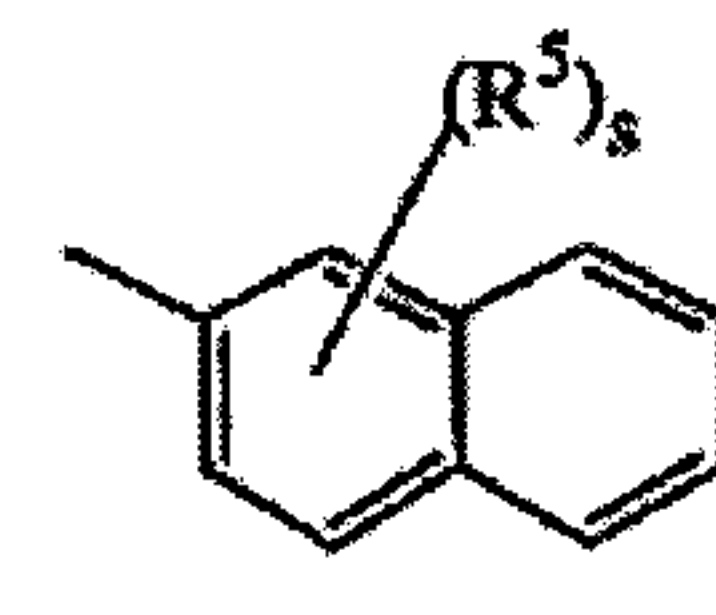
(a-17)



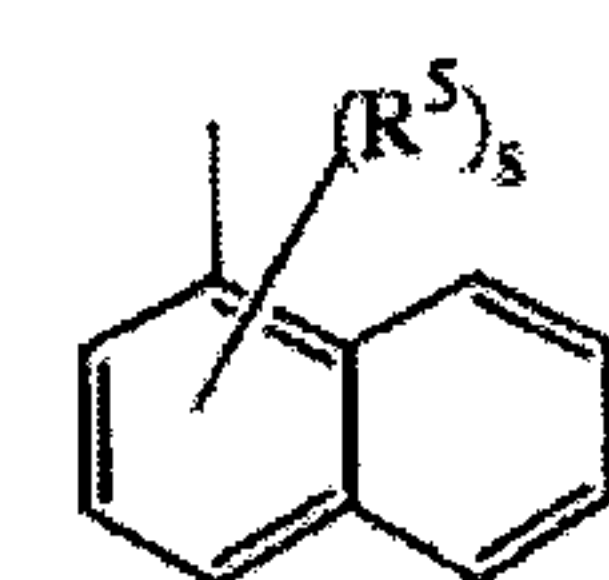
(a-18)



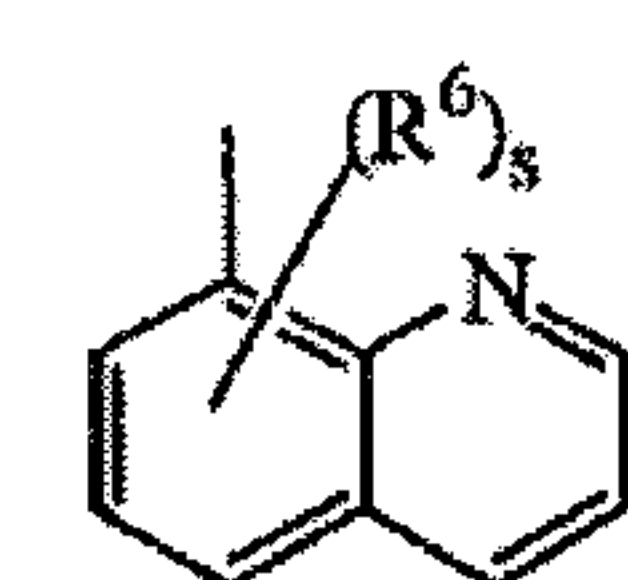
(a-19)



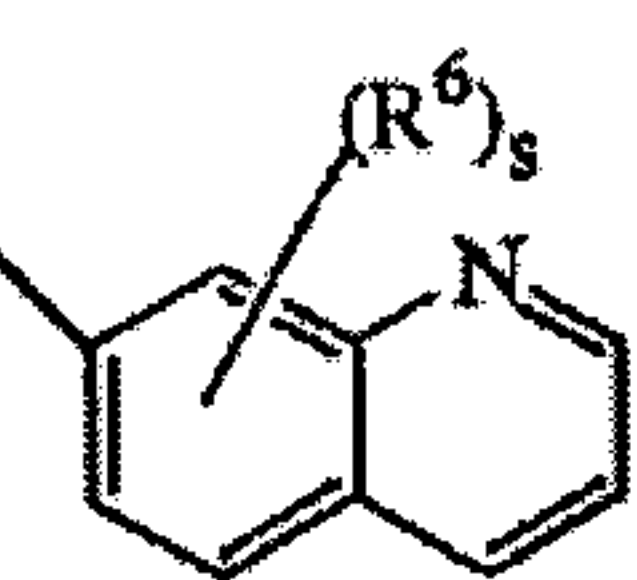
(a-20)



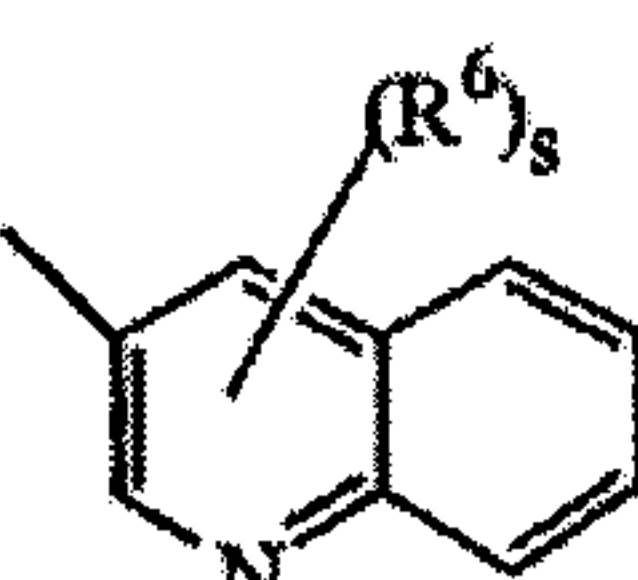
(a-21)



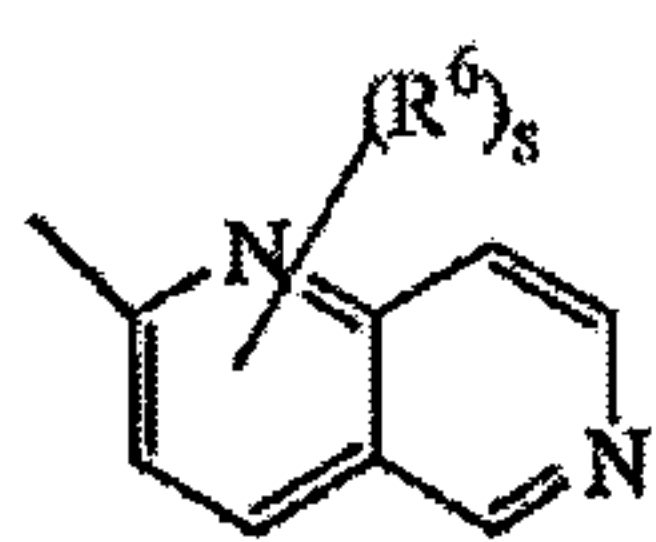
(a-22)



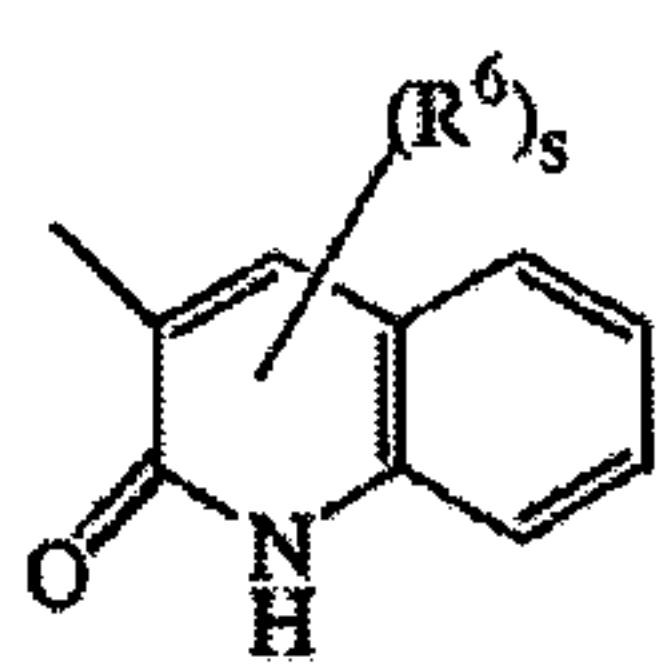
(a-23)



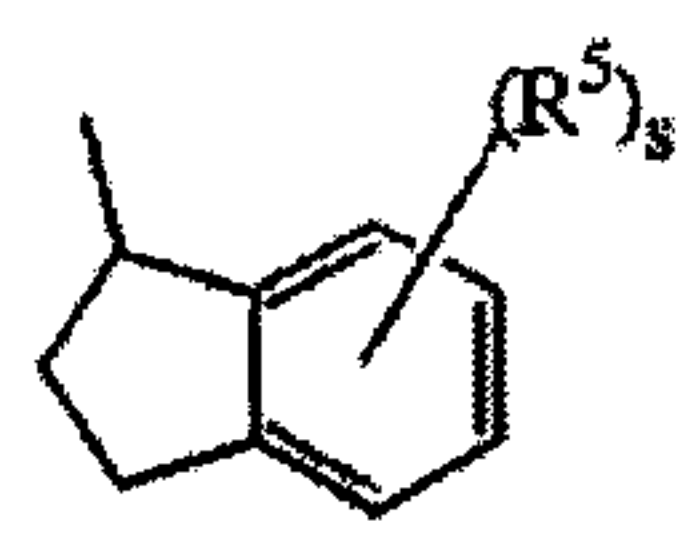
(a-24)



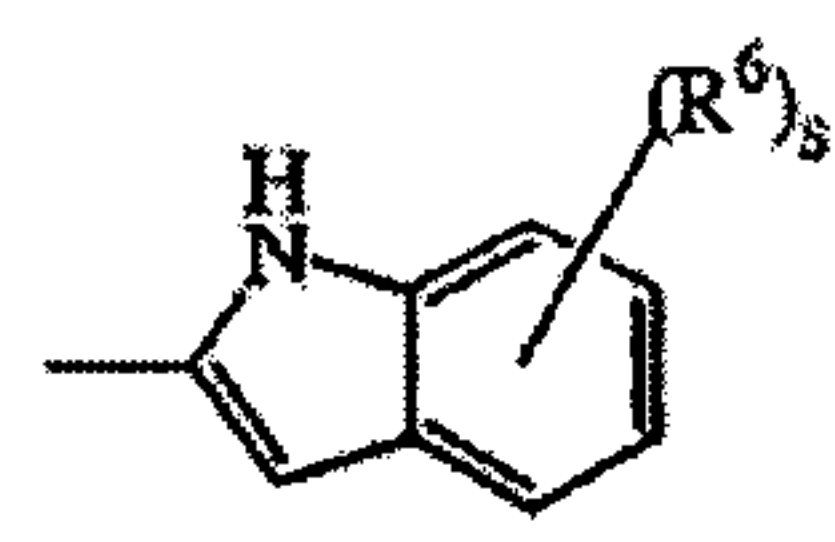
(a-25)



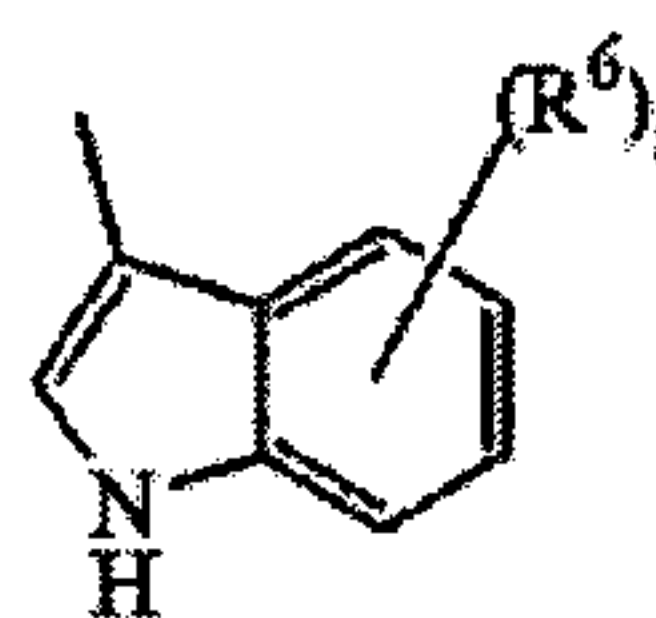
(a-26)



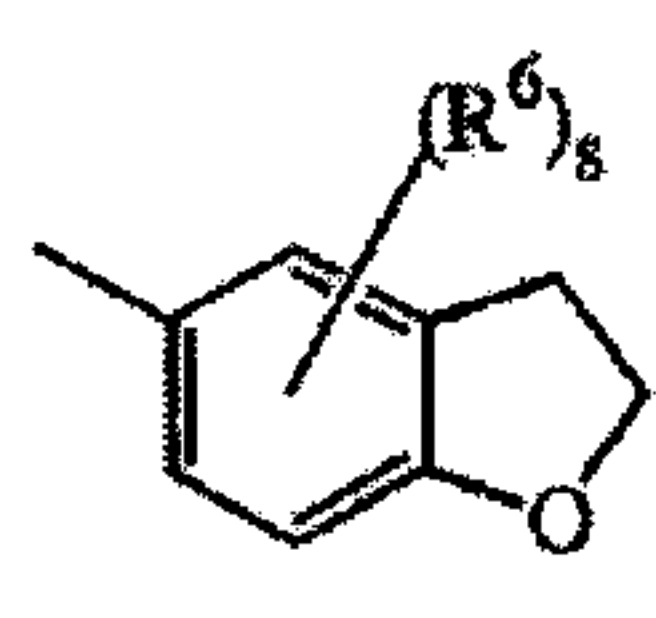
(a-27)



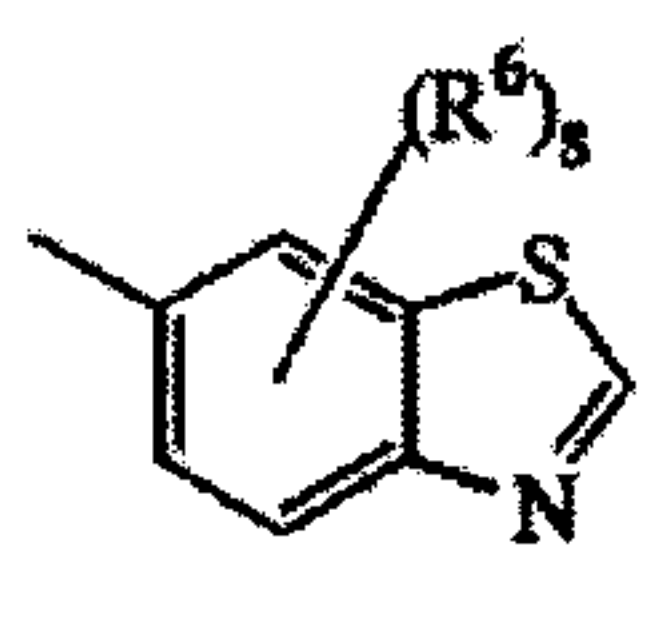
(a-28)



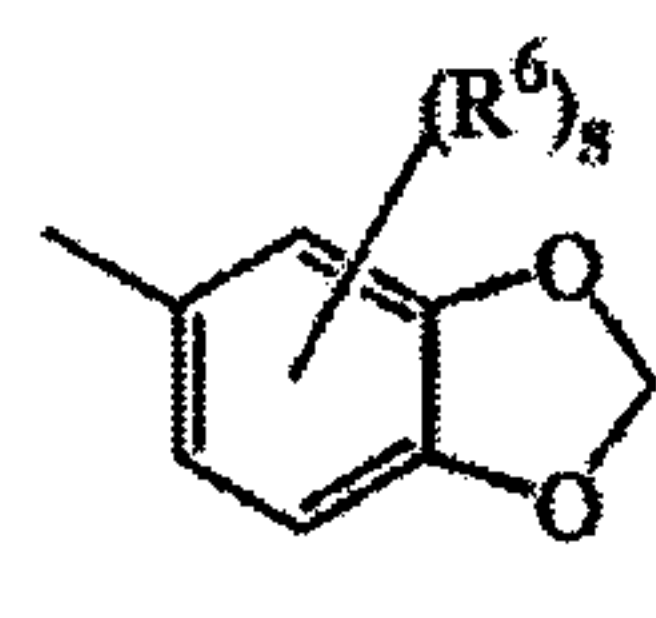
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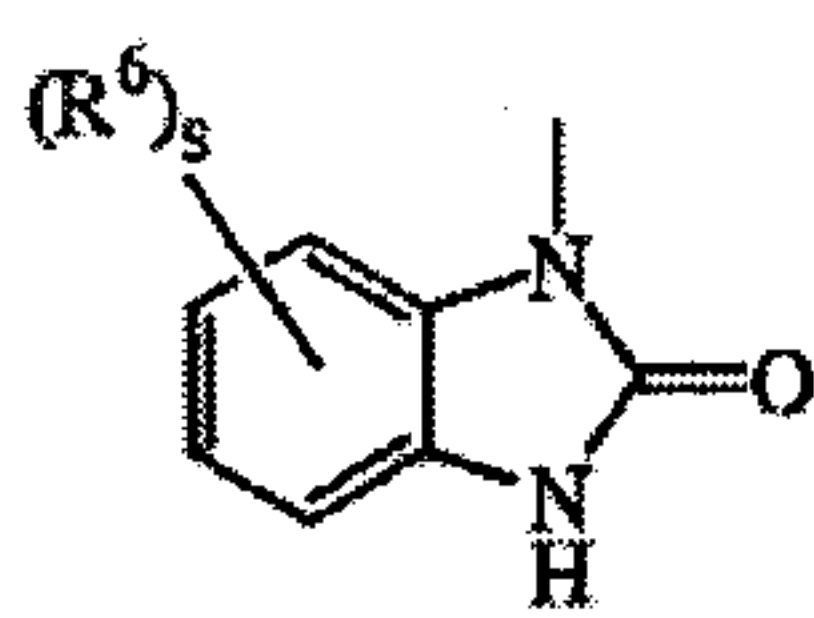
(a-30)



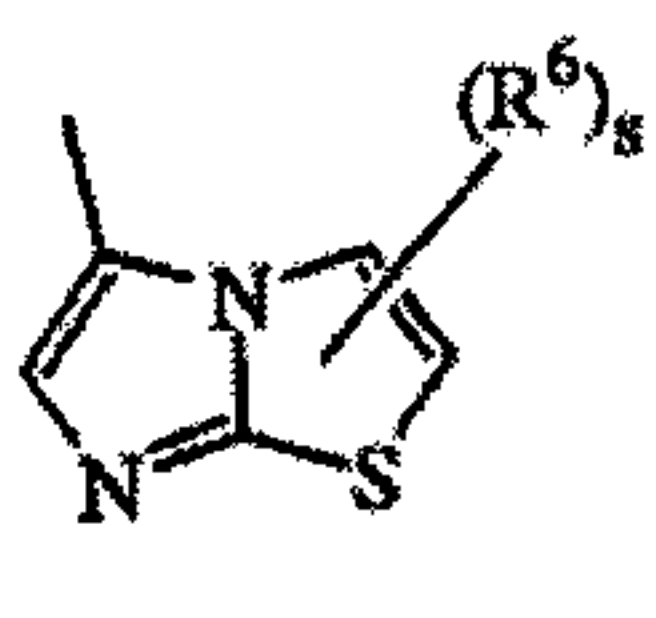
(a-31)



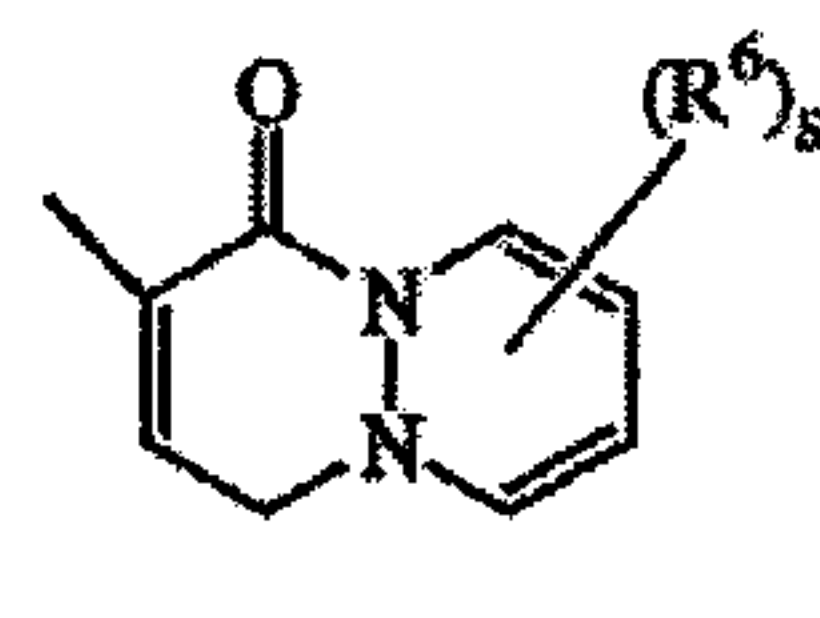
(a-32)



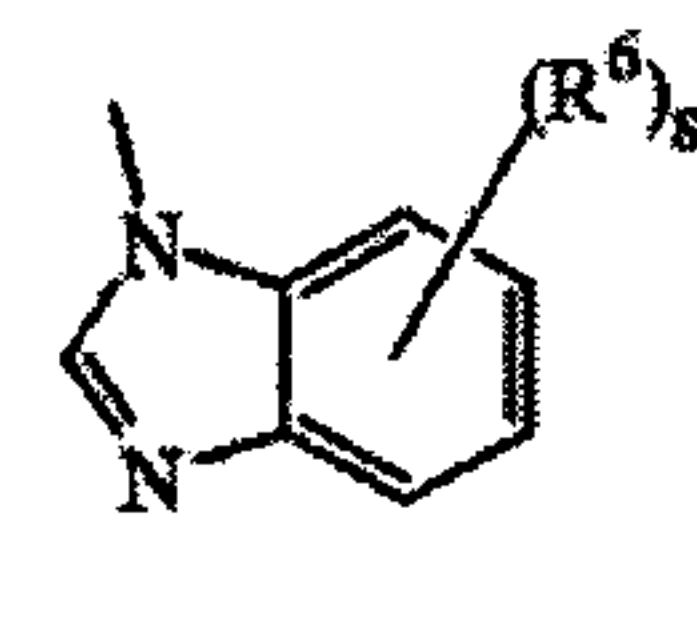
(a-33)



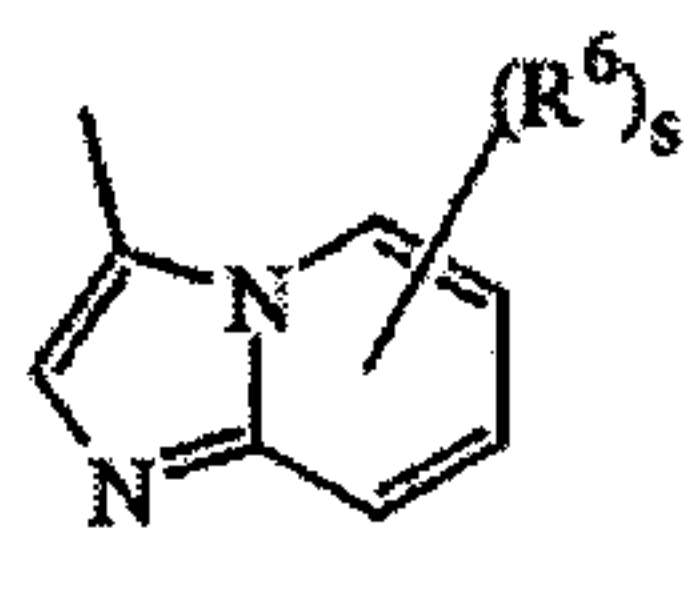
(a-34)



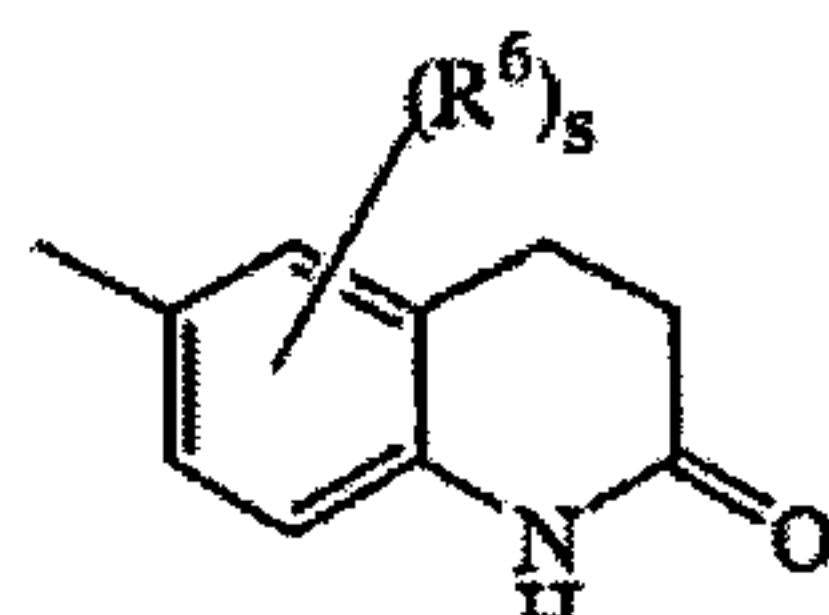
(a-35)



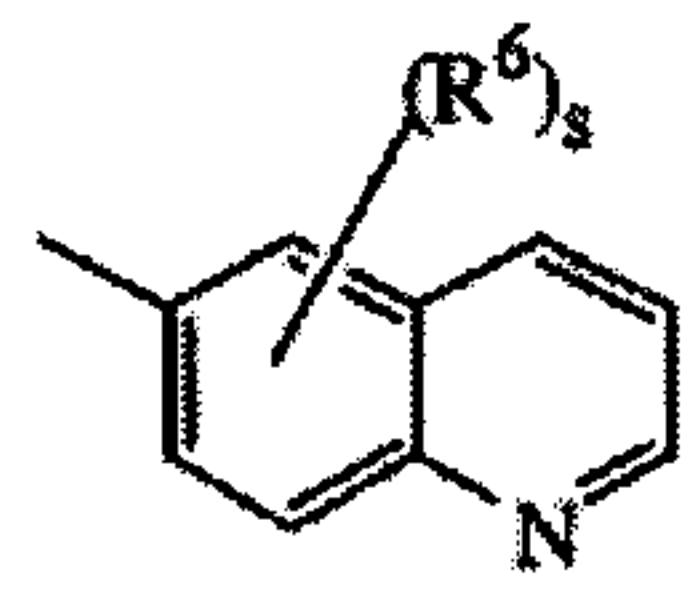
(a-36)



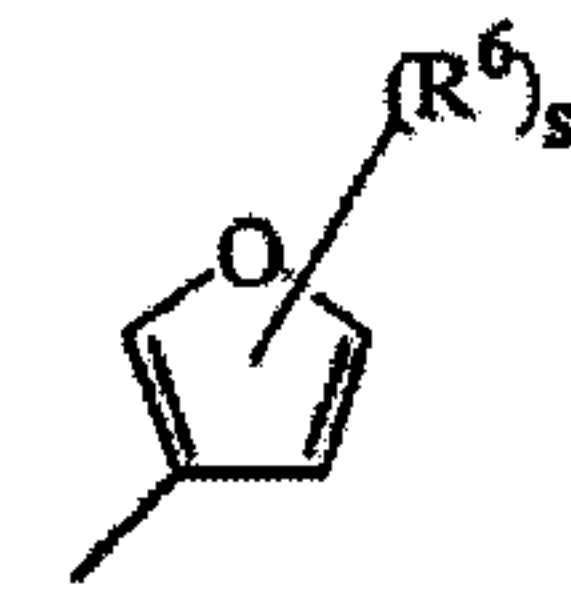
(a-37)



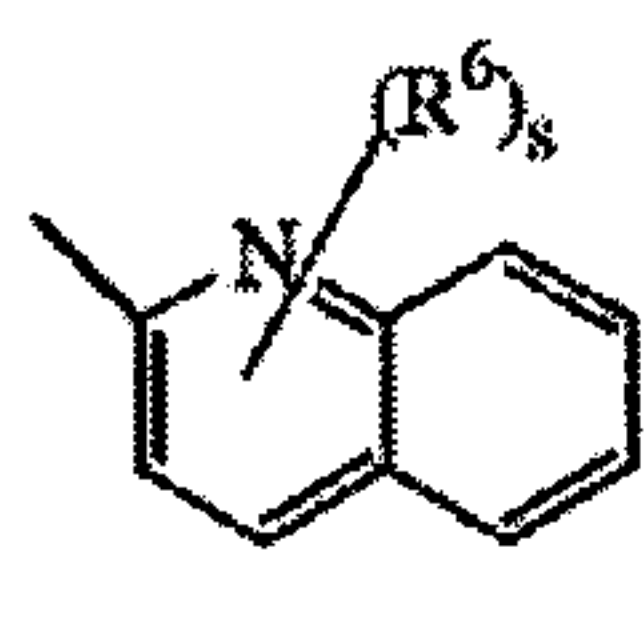
(a-38)



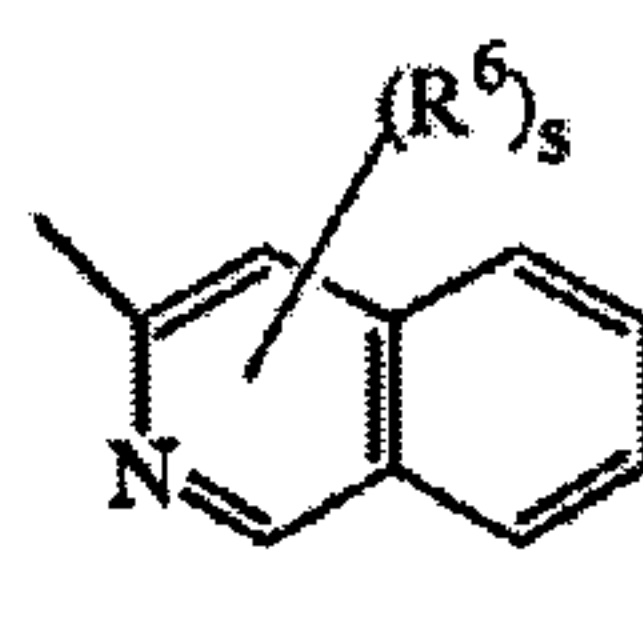
(a-39)



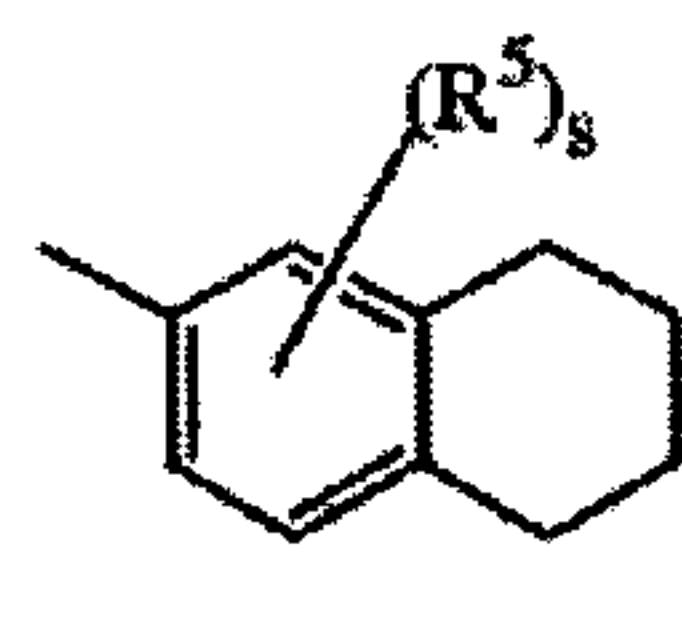
(a-40)



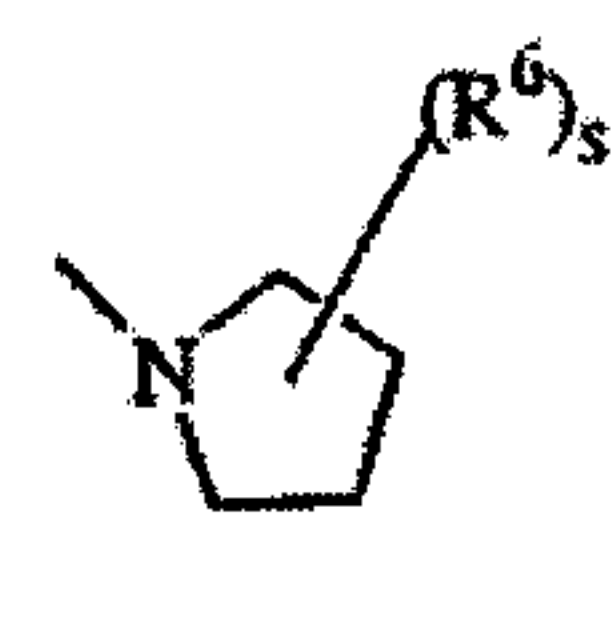
(a-41)



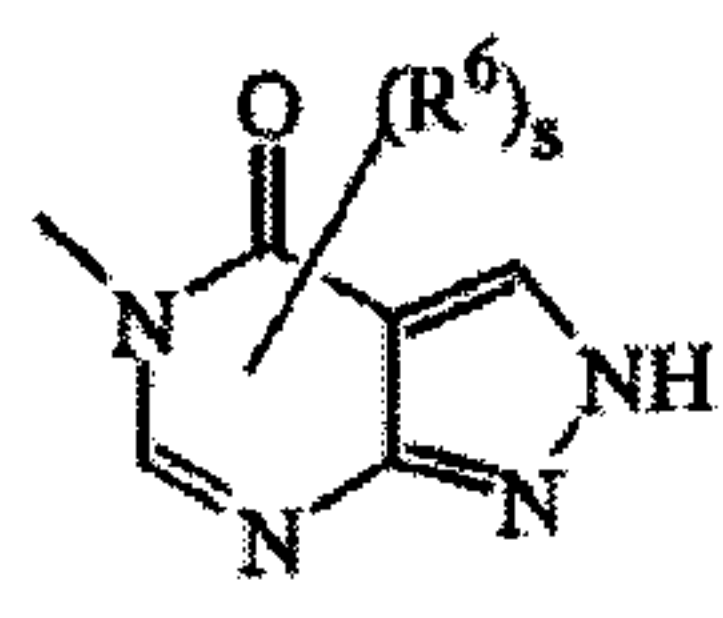
(a-42)



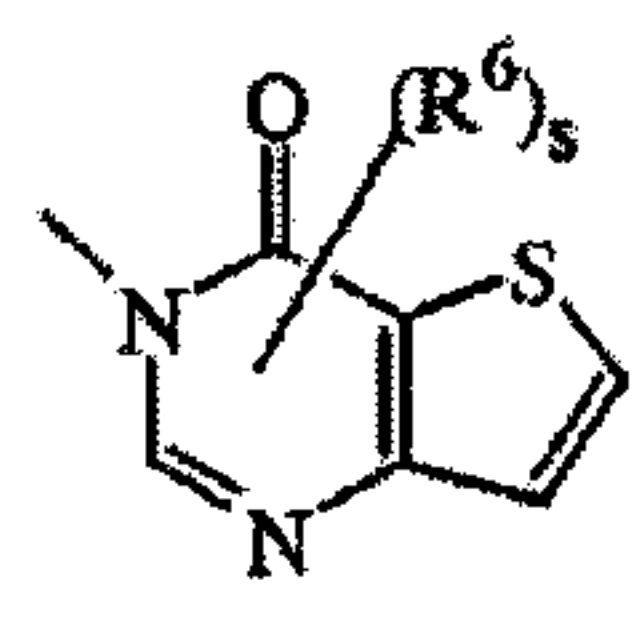
(a-43)



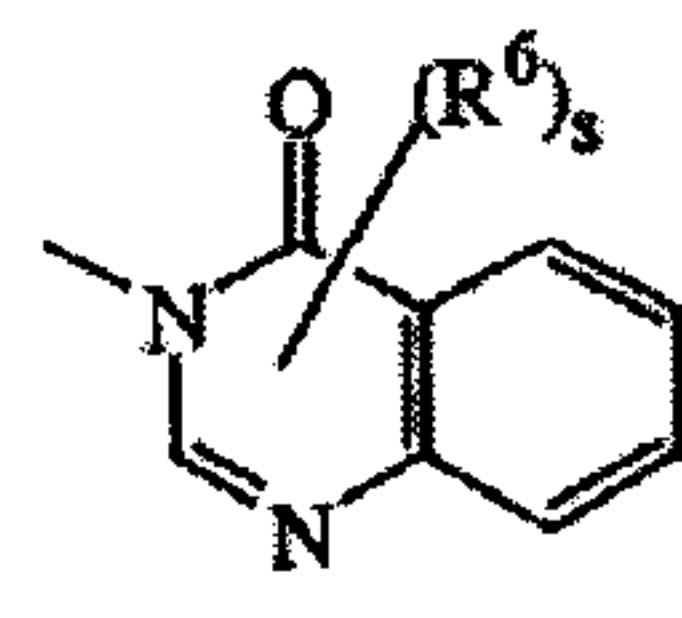
(a-44)



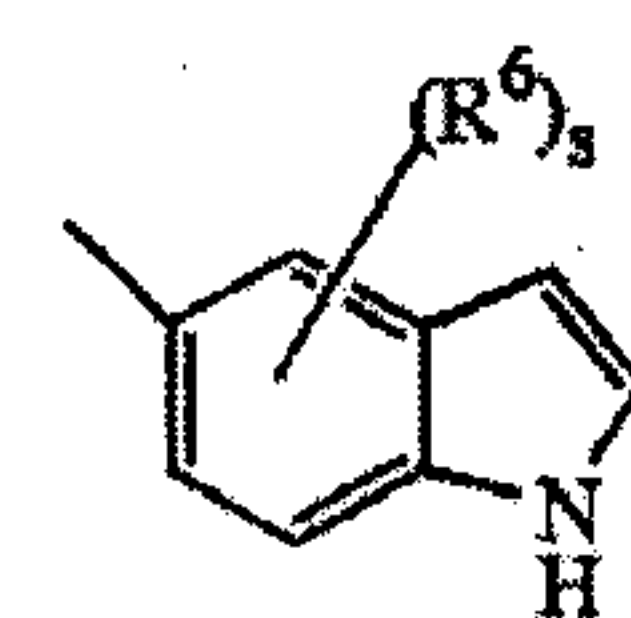
(a-45)



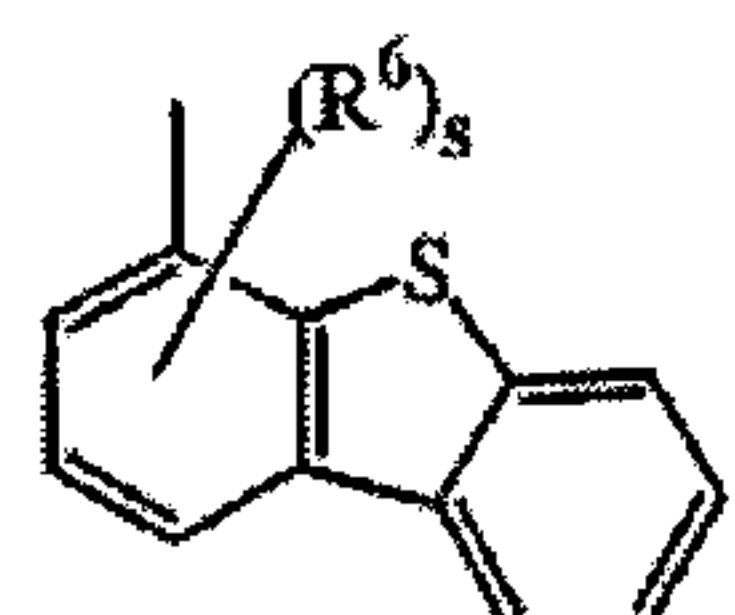
(a-46)



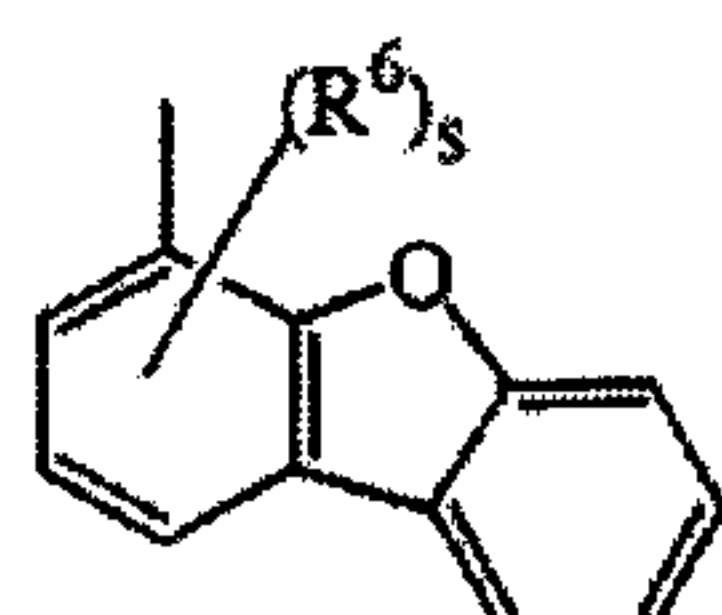
(a-47)



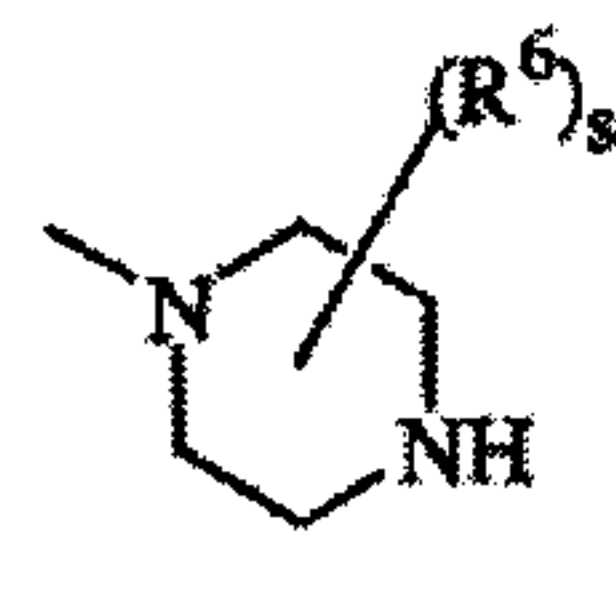
(a-48)



(a-49)



(a-50)



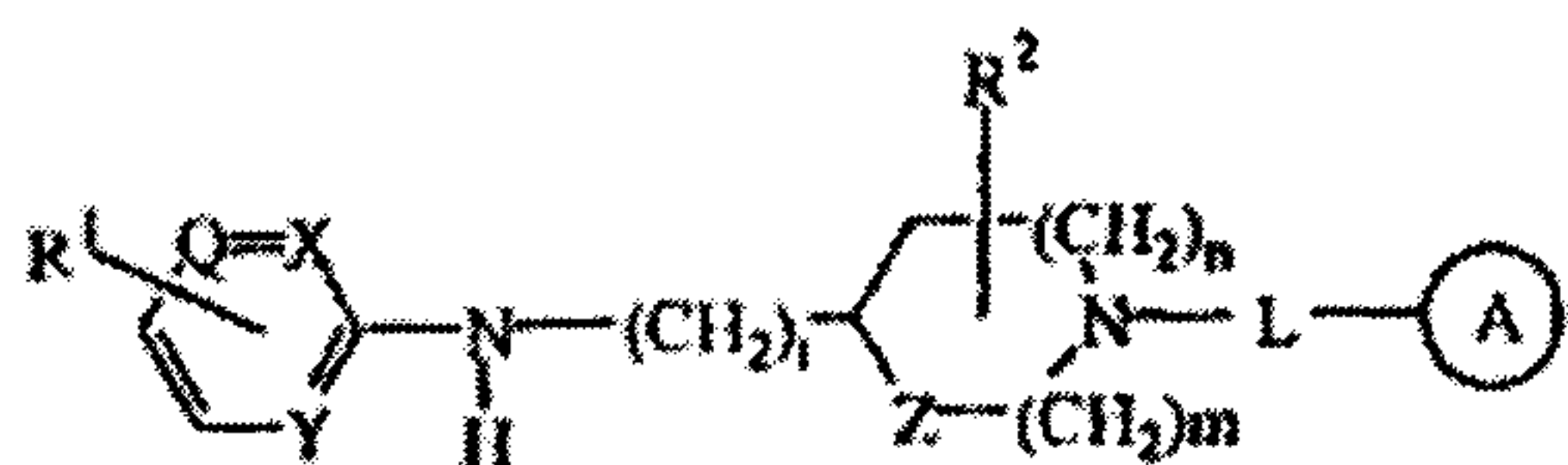
(a-51)

wherein each s is independently 0, 1, 2, 3, 4 or 5; each R⁵ and R⁶ are independently selected from hydrogen; halo; hydroxy; amino; nitro; trihaloC₁₋₆alkyl; trihaloC₁₋₆alkyloxy; C₁₋₆alkyl; C₁₋₆alkyl substituted with aryl and C₃₋₁₀cycloalkyl; C₁₋₆alkyloxy; C₁₋₆alkyloxyC₁₋₆alkyloxy; C₁₋₆alkylcarbonyl; C₁₋₆alkyloxycarbonyl; C₁₋₆alkylsulfonyl; cyanoC₁₋₆alkyl; hydroxyC₁₋₆alkyl; hydroxyC₁₋₆alkyloxy; hydroxyC₁₋₆alkylamino; aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminocarbonyl; di(hydroxyC₁₋₆alkyl)amino; (aryl)(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)amino C₁₋₆alkyloxy; di(C₁₋₆alkyl)amino C₁₋₆alkylamino; di(C₁₋₆alkyl)amino C₁₋₆alkylamino C₁₋₆alkyl; arylsulfonyl; arylsulfonylamino; aryloxy; aryloxy C₁₋₆alkyl; arylC₂₋₆alkenediyl; di(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)amino C₁₋₆alkyl; di(C₁₋₆alkyl)amino(C₁₋₆alkyl) amino; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)amino C₁₋₆alkyl; di(C₁₋₆alkyl)amino C₁₋₆alkyl(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)amino C₁₋₆alkyl; aminosulfonylamino (C₁₋₆alkyl)amino; aminosulfonylamino(C₁₋₆alkyl)amino C₁₋₆alkyl; di(C₁₋₆alkyl) aminosulfonylamino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)amino C₁₋₆alkyl; cyano; thiophenyl; thiophenyl substituted with di(C₁₋₆alkyl)amino C₁₋₆alkyl(C₁₋₆alkyl)amino C₁₋₆alkyl, di(C₁₋₆alkyl)amino C₁₋₆alkyl, C₁₋₆alkylpiperazinyl C₁₋₆alkyl, hydroxy C₁₋₆alkylpiperazinyl C₁₋₆alkyl, hydroxy C₁₋₆alkyloxy C₁₋₆alkylpiperazinyl C₁₋₆alkyl, di(C₁₋₆alkyl)aminosulfonylpiperazinyl C₁₋₆alkyl, C₁₋₆alkyloxypiperidinyl, C₁₋₆alkyloxypiperidinyl C₁₋₆alkyl, morpholinyl C₁₋₆alkyl, hydroxy C₁₋₆alkyl(C₁₋₆alkyl)amino C₁₋₆alkyl, or di(hydroxy C₁₋₆alkyl)amino C₁₋₆alkyl; furanyl; furanyl substituted with hydroxy C₁₋₆alkyl; benzofuranyl; imidazolyl; oxazolyl; oxazolyl substituted with aryl and C₁₋₆alkyl; C₁₋₆alkyltriazolyl; tetrazolyl; pyrrolidinyl; pyrrolyl; piperidinyl C₁₋₆alkyloxy; morpholinyl; C₁₋₆alkylmorpholinyl; morpholinyl C₁₋₆alkyloxy; morpholinyl C₁₋₆alkyl; morpholinyl C₁₋₆alkylamino; morpholinylC₁₋₆alkylamino C₁₋₆alkyl; piperazinyl; C₁₋₆alkylpiperazinyl; C₁₋₆alkylpiperazinyl C₁₋₆alkyloxy, piperazinyl C₁₋₆alkyl; naphtalenylsulfonylpiperazinyl; naphtalenylsulfonylpiperidinyl; naphtalenylsulfonyl; C₁₋₆alkylpiperazinyl C₁₋₆alkyl; C₁₋₆alkylpiperazinyl C₁₋₆alkylamino; C₁₋₆alkylpiperazinyl C₁₋₆alkylamino C₁₋₆alkyl; C₁₋₆alkylpiperazinylsulfonyl; aminosulfonylpiperazinyl C₁₋₆alkyloxy; aminosulfonylpiperazinyl; aminosulfonylpiperazinyl C₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylpiperazinyl; di(C₁₋₆alkyl)aminosulfonylpiperazinyl C₁₋₆alkyl; hydroxy C₁₋₆alkylpiperazinyl; hydroxy C₁₋₆alkylpiperazinyl C₁₋₆alkyl; C₁₋₆alkyloxypiperidinyl; C₁₋

- ₆alkyloxypiperidinyl C₁₋₆alkyl; piperidinylamino C₁₋₆alkylamino; piperidinylamino C₁₋₆alkylaminoC₁₋₆alkyl; (C₁₋₆alkylpiperidyl)(hydroxyC₁₋₆alkyl)amino C₁₋₆alkylamino; (C₁₋₆alkylpiperidinyl)(hydroxy C₁₋₆alkyl)amino C₁₋₆alkylamino C₁₋₆alkyl; hydroxy C₁₋₆alkyloxy C₁₋₆alkylpiperazinyl; hydroxy C₁₋₆alkyloxy C₁₋₆alkylpiperazinyl C₁₋₆alkyl;
- 5 (hydroxy C₁₋₆alkyl)(C₁₋₆alkyl)amino; (hydroxy C₁₋₆alkyl)(C₁₋₆alkyl)aminoC₁₋₆alkyl; hydroxy C₁₋₆alkylamino C₁₋₆alkyl; di(hydroxy C₁₋₆alkyl)amino C₁₋₆alkyl; pyrrolidinyl C₁₋₆alkyl; pyrrolidinylC₁₋₆alkyloxy; pyrazolyl; thiopyrazolyl; pyrazolyl substituted with two substituents selected from C₁₋₆alkyl or trihaloC₁₋₆alkyl; pyridinyl; pyridinyl substituted with C₁₋₆alkyloxy, aryloxy or aryl; pyrimidinyl; tetrahydropyrimidinylpiperazinyl;
- 10 tetrahydropyrimidinylpiperazinylC₁₋₆alkyl; quinolinyl; indole; phenyl; phenyl substituted with one, two or three substituents independently selected from halo, amino, nitro, C₁₋₆alkyl, C₁₋₆alkyloxy, hydroxyC₁₋₄alkyl, trifluoromethyl, trifluoromethyloxy, hydroxyC₁₋₄alkyloxy, C₁₋₄alkylsulfonyl, C₁₋₄alkyloxyC₁₋₄alkyloxy, C₁₋₄alkyloxycarbonyl, amino C₁₋₄alkyloxy, di(C₁₋₄alkyl)amino C₁₋₄alkyloxy, di(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminocarbonyl, di(C₁₋₄alkyl)amino C₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylamino C₁₋₄alkyl, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl) amino(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)amino C₁₋₄alkyl(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)amino C₁₋₄alkyl(C₁₋₄alkyl)amino C₁₋₄alkyl, aminosulfonylamino(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄alkyl) amino C₁₋₄alkyl, di(C₁₋₄alkyl)aminosulfonylamino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminosulfonylamino(C₁₋₄alkyl)amino C₁₋₆alkyl, cyano, piperidinyl C₁₋₄alkyloxy, pyrrolidinyl C₁₋₄alkyloxy, aminosulfonylpiperazinyl, aminosulfonylpiperazinyl C₁₋₄alkyl, di(C₁₋₄alkyl) aminosulfonylpiperazinyl, di(C₁₋₄alkyl)aminosulfonylpiperazinyl C₁₋₄alkyl, hydroxyC₁₋₄alkylpiperazinyl, hydroxy C₁₋₄alkylpiperazinyl C₁₋₄alkyl, C₁₋₄alkyloxypiperidinyl, C₁₋₄alkyloxypiperidinylC₁₋₄alkyl, hydroxy C₁₋₄alkyloxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)amino, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)aminoC₁₋₄alkyl, hydroxyC₁₋₄alkylaminoC₁₋₄alkyl, di(hydroxyC₁₋₄alkyl) aminoC₁₋₄alkyl, furanyl, furanyl substituted with -CH=CH-CH=CH-, pyrrolidinylC₁₋₄alkyl, pyrrolidinylC₁₋₄alkyloxy, morpholinyl, morpholinylC₁₋₄alkyloxy, morpholinylC₁₋₄alkyl, morpholinylC₁₋₄alkylamino, morpholinylC₁₋₄alkylaminoC₁₋₄alkyl, piperazinyl, C₁₋₄alkylpiperazinyl, C₁₋₄alkylpiperazinylC₁₋₄alkyloxy, piperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkylamino,
- 30

C₁₋₄alkylpiperazinylC₁₋₄alkylamino C₁₋₆alkyl, pyrimidinylpiperazinyl,
 pyrimidinylpiperazinylC₁₋₄alkyl, piperidinylaminoC₁₋₄alkylamino, piperidinylaminoC₁₋₄alkylaminoC₁₋₄alkyl, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylamino, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl) aminoC₁₋₄alkylaminoC₁₋₄alkyl, pyridinylC₁₋₄alkyloxy, hydroxyC₁₋₄alkylamino, di(hydroxyC₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminoC₁₋₄alkylamino, aminothiadiazolyl, aminosulfonylpiperazinylC₁₋₄alkyloxy, or thiophenylC₁₋₄alkylamino; each R⁵ and R⁶ can be placed on the nitrogen in replacement of the hydrogen; aryl in the above is phenyl, or phenyl substituted with one or more substituents each independently selected from halo, C₁₋₆alkyl, C₁₋₆alkyloxy, trifluoromethyl, cyano or hydroxycarbonyl.

In one aspect, the inhibitor of histone deacetylase activity may be a compound of the general formula:



the *N*-oxide forms, the pharmaceutically acceptable addition salts and the stereo-chemically isomeric forms thereof, wherein n is 0, 1, 2 or 3 and when n is 0 then a direct bond is intended; m is 0, 1, 2 or 3 and when m is 0 then a direct bond is intended; t is 0 or 1 and when t is 0 then a direct bond is intended;

each Q is nitrogen or ;

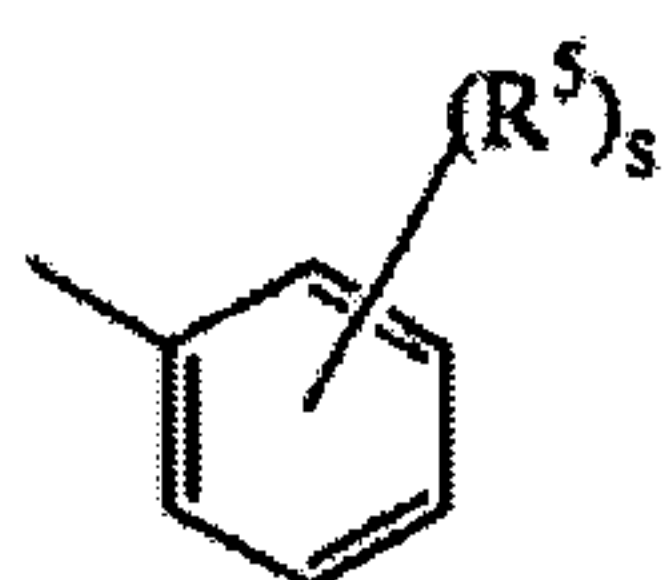
each X is nitrogen or ;

each Y is nitrogen or ;

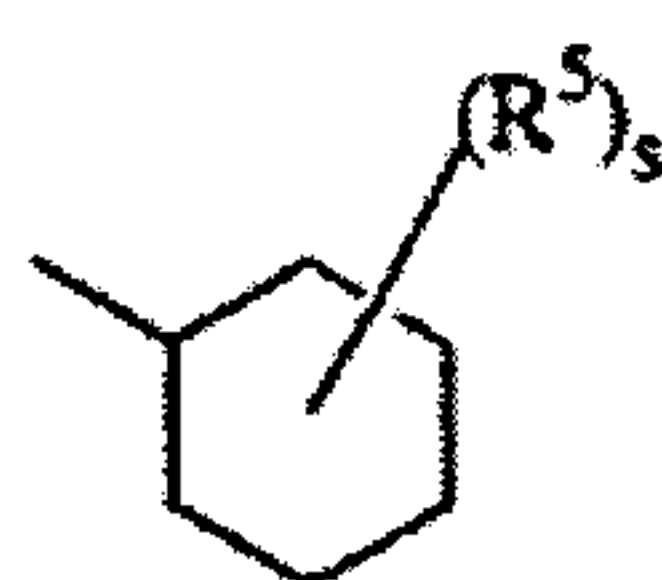
each Z is -CH₂- or -O-;

R^1 is $-C(O)NR^3R^4$, $-N(H)C(O)R^7$, $-C(O)-C_{1-6}alkanediyISR^7$, $-NR^8C(O)N(OH)R^7$, $-NR^8C(O)C_{1-6}alkanediyISR^7$, $-NR^3C(O)C=N(OH)R^7$ or another Zn-chelating-group wherein R^3 and R^4 are each independently selected from hydrogen, hydroxy, $C_{1-6}alkyl$, hydroxy $C_{1-6}alkyl$, amino $C_{1-6}alkyl$ or aminoaryl; R^7 is independently selected from
5 hydrogen, $C_{1-6}alkyl$, $C_{1-6}alkylcarbonyl$, $arylC_{1-6}alkyl$, $C_{1-6}alkylpyrazinyl$, pyridinone, pyrrolidinone or methylimidazolyl; R^8 is independently selected from hydrogen or $C_{1-6}alkyl$; R^2 is hydrogen, hydroxy, amino, hydroxy $C_{1-6}alkyl$, $C_{1-6}alkyl$, $C_{1-6}alkyloxy$, $arylC_{1-6}alkyl$, aminocarbonyl, hydroxycarbonyl, amino $C_{1-6}alkyl$, aminocarbonyl $C_{1-6}alkyl$, hydroxycarbonyl $C_{1-6}alkyl$, hydroxyaminocarbonyl, $C_{1-6}alkyloxycarbonyl$, $C_{1-6}alkylaminoC_{1-6}alkyl$ or $di(C_{1-6}alkyl)aminoC_{1-6}alkyl$; -L- is a bivalent radical selected
10 from $C_{1-6}alkanediyI$, carbonyl, sulfonyl, or $C_{1-6}alkanediyI$ substituted with phenyl

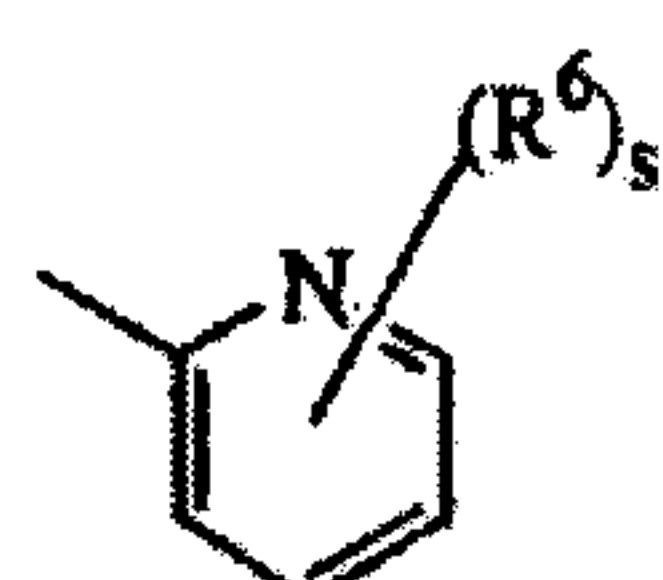
—(A) is a radical selected from



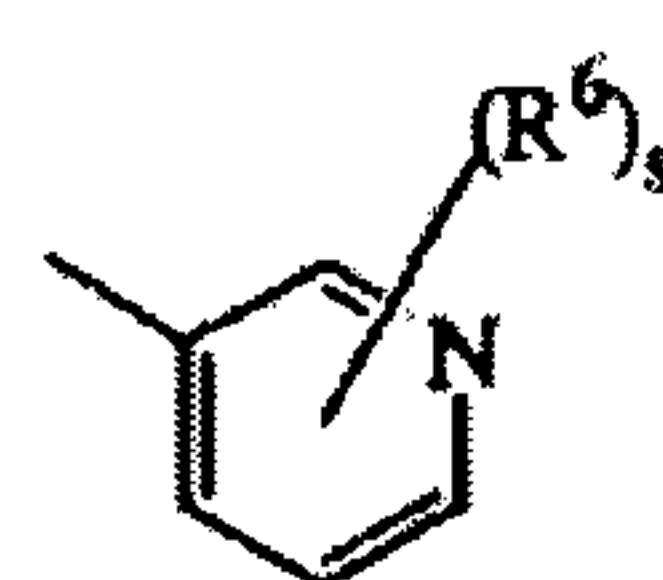
(a-1)



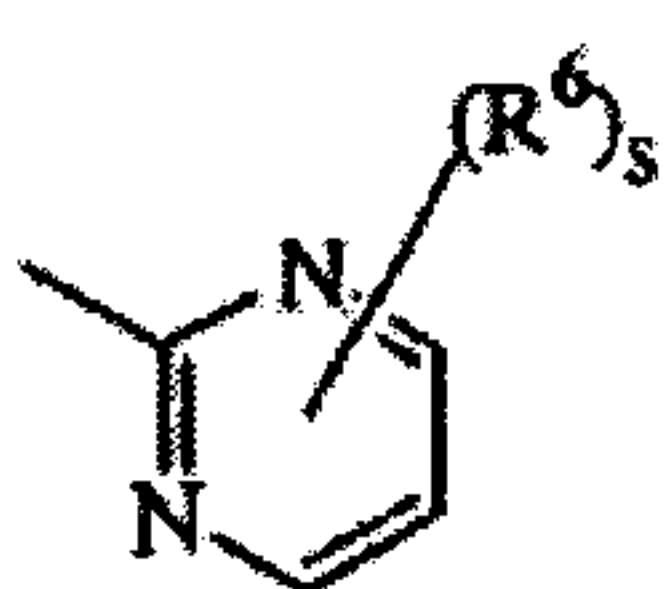
(a-2)



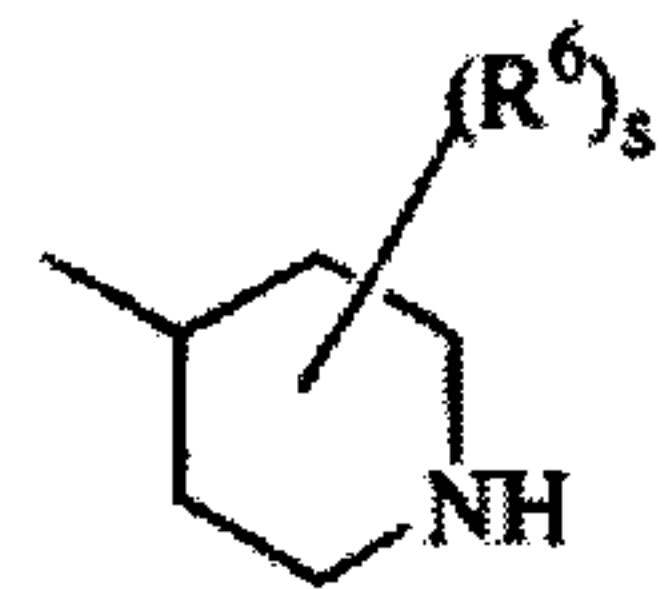
(a-3)



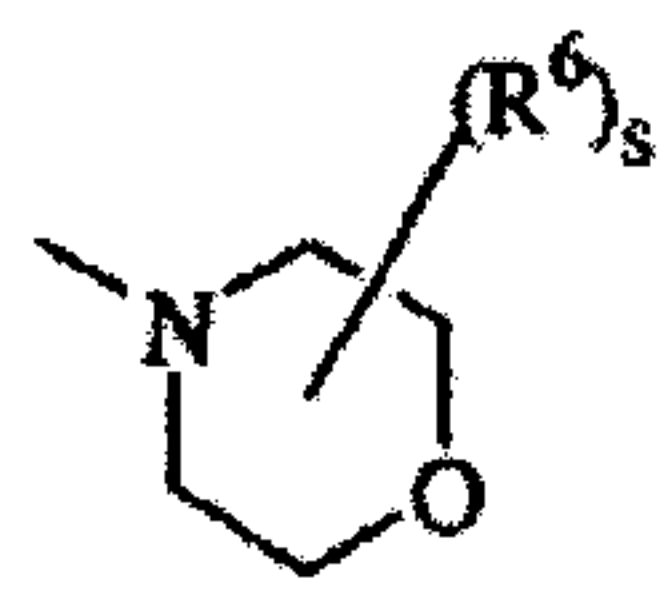
(a-4)



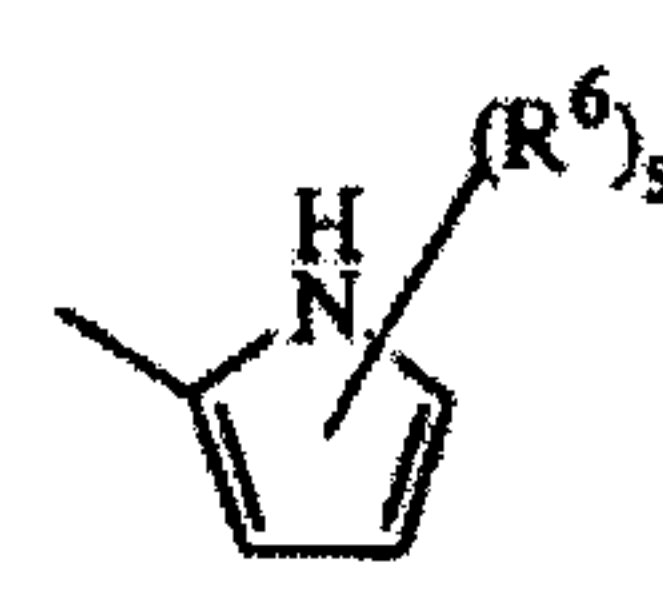
(a-5)



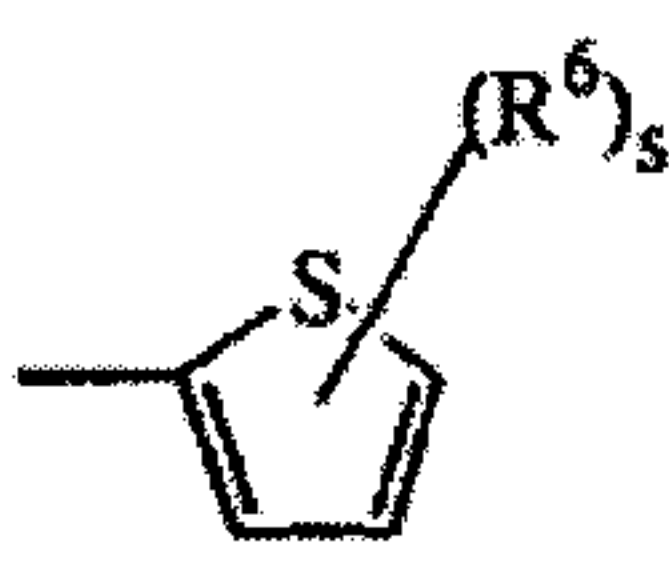
(a-6)



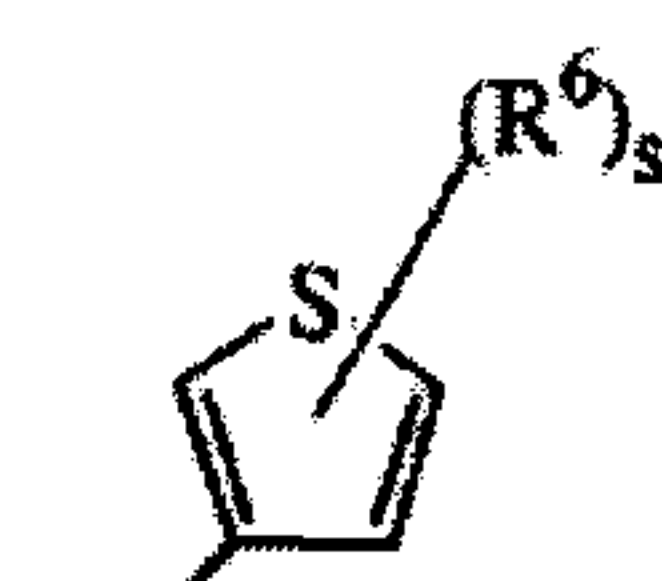
(a-7)



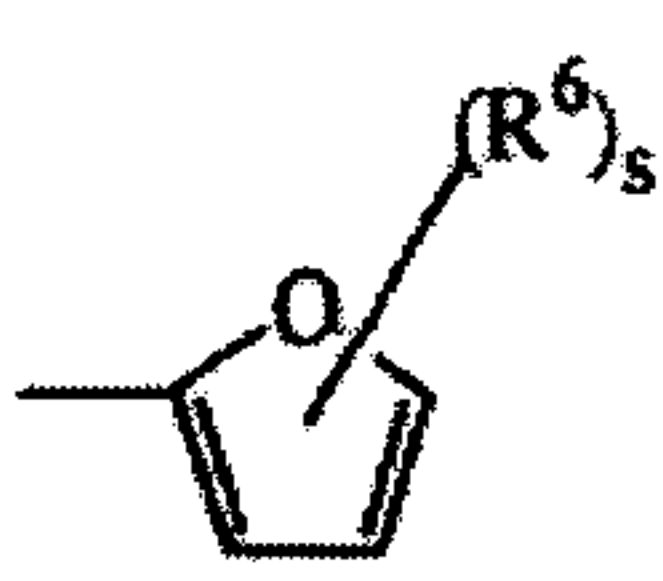
(a-8)



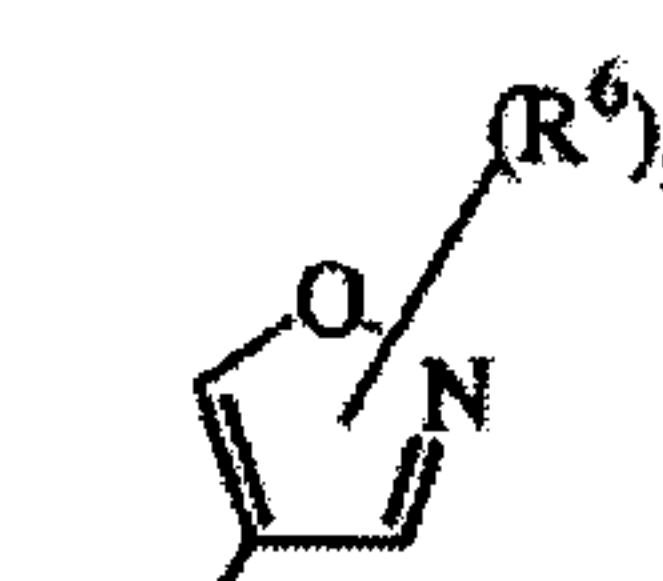
(a-9)



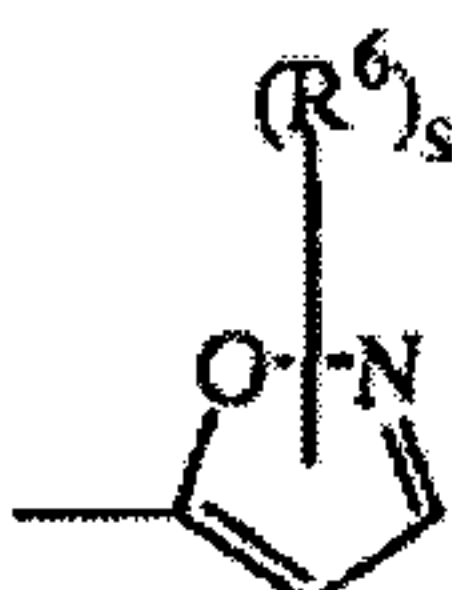
(a-10)



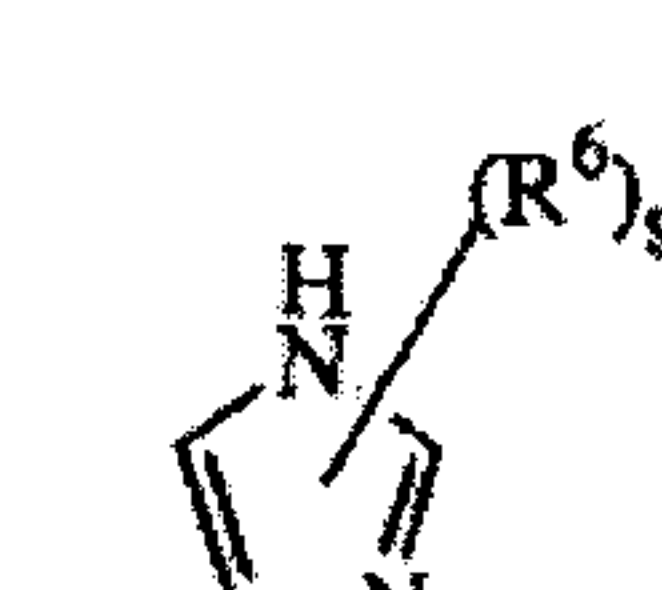
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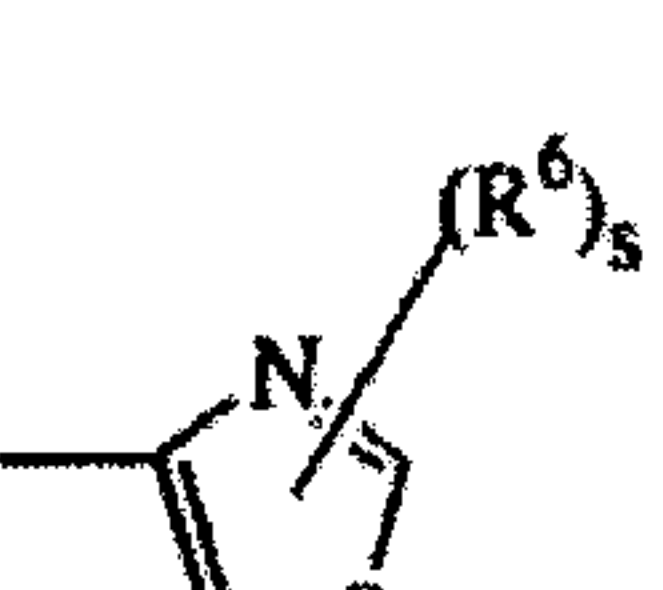
(a-12)



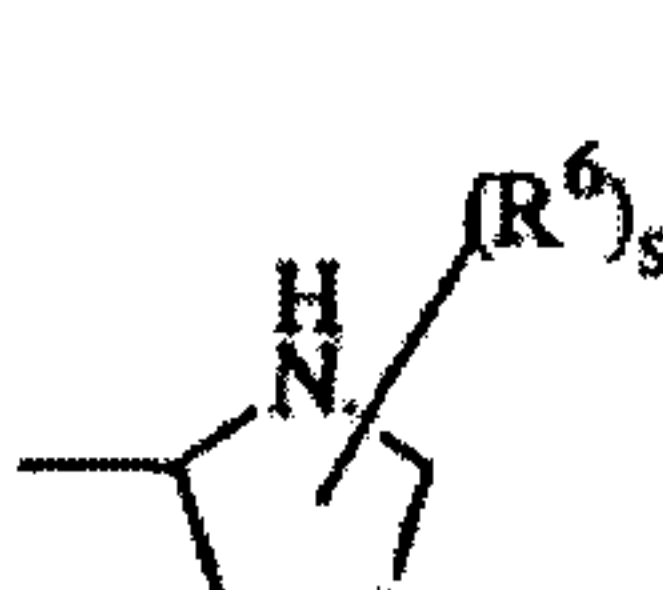
(a-13)



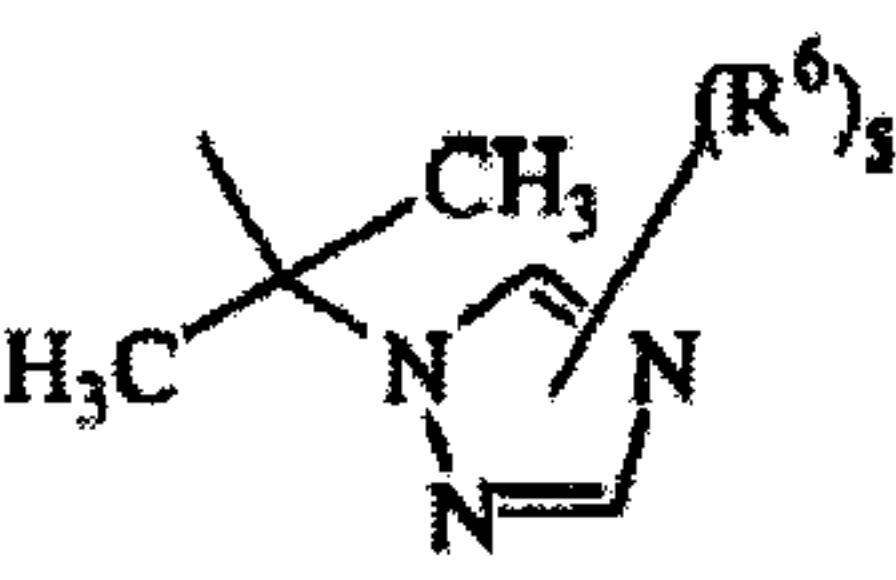
(a-14)



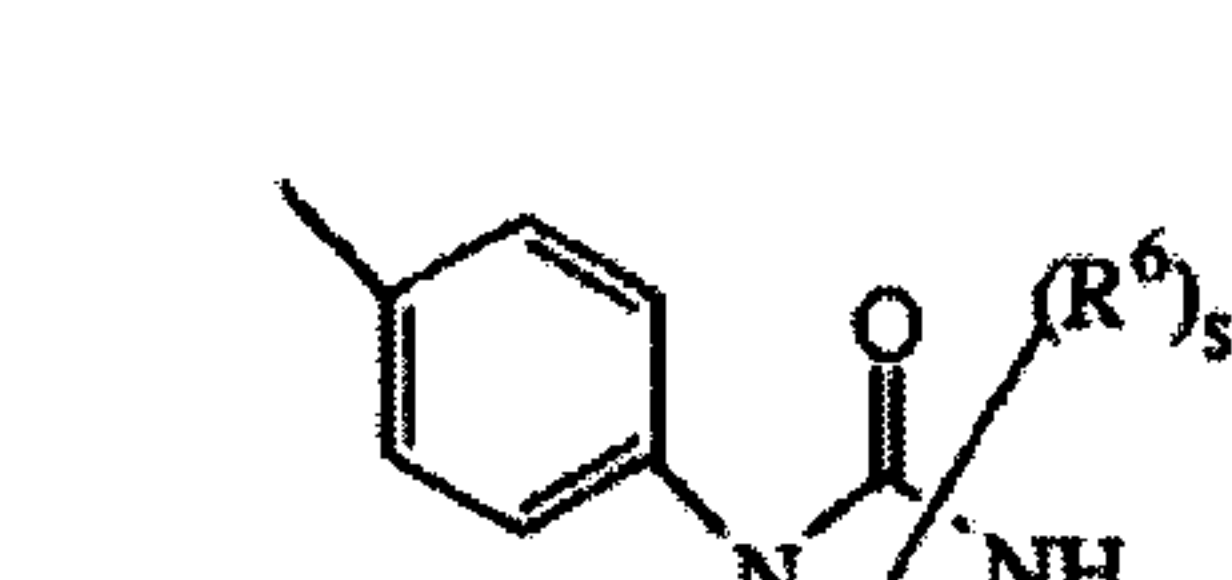
(a-15)



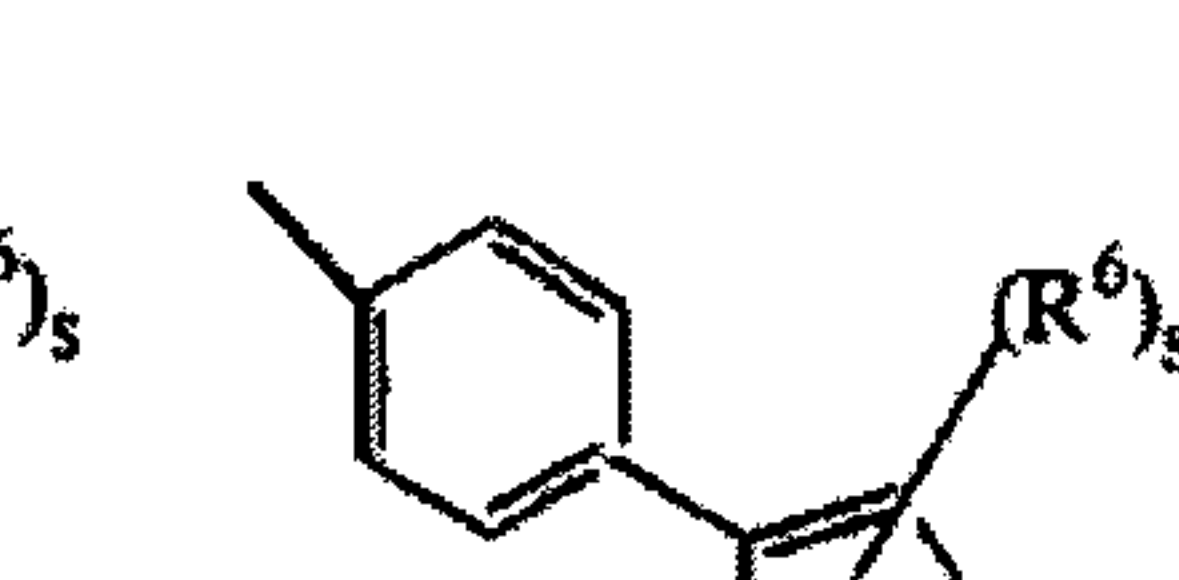
(a-16)



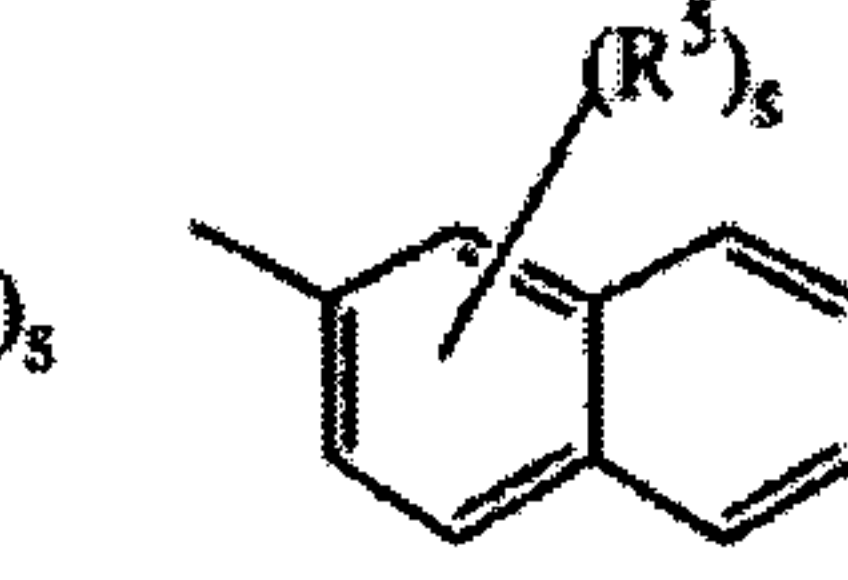
(a-17)



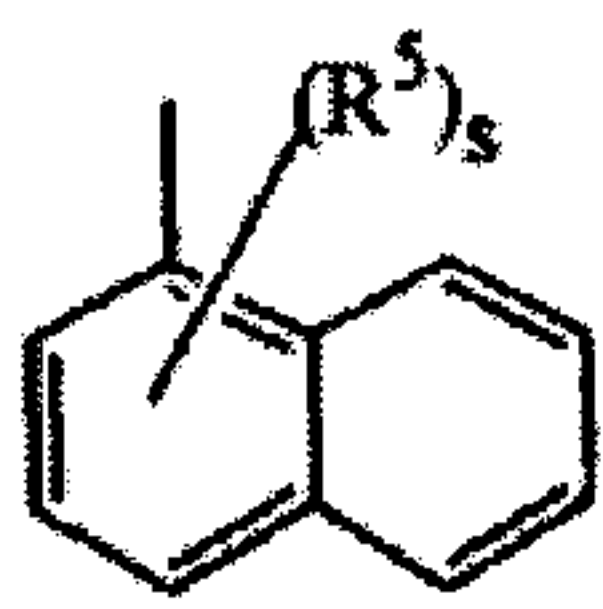
(a-18)



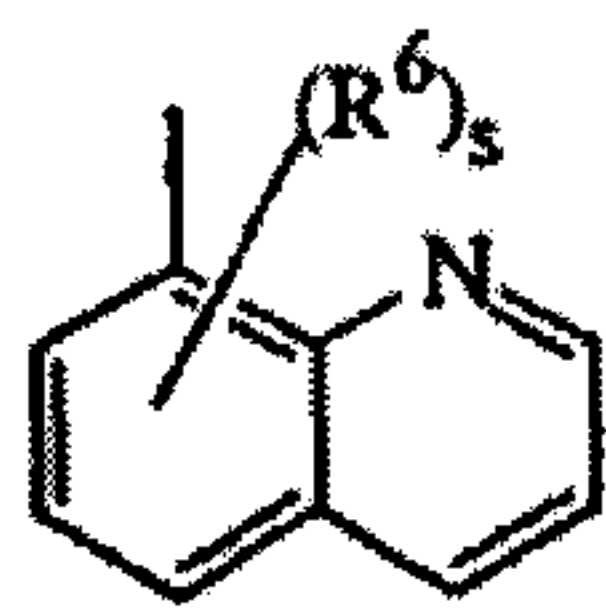
(a-19)



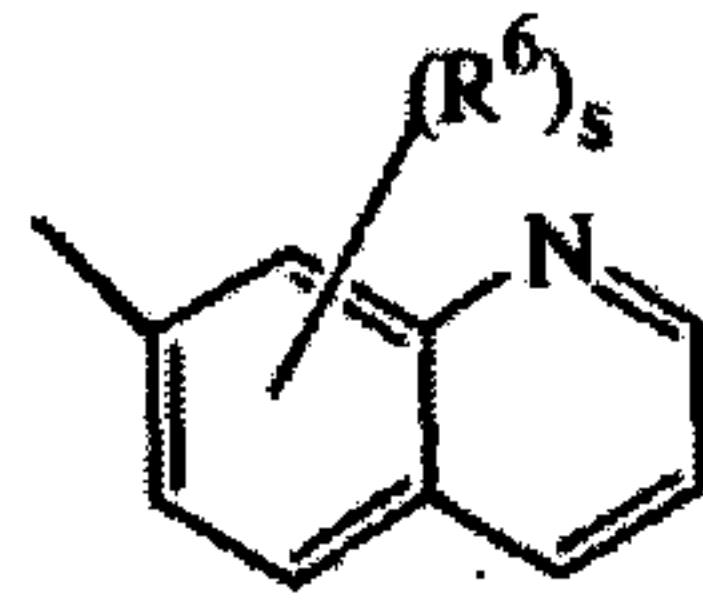
(a-20)



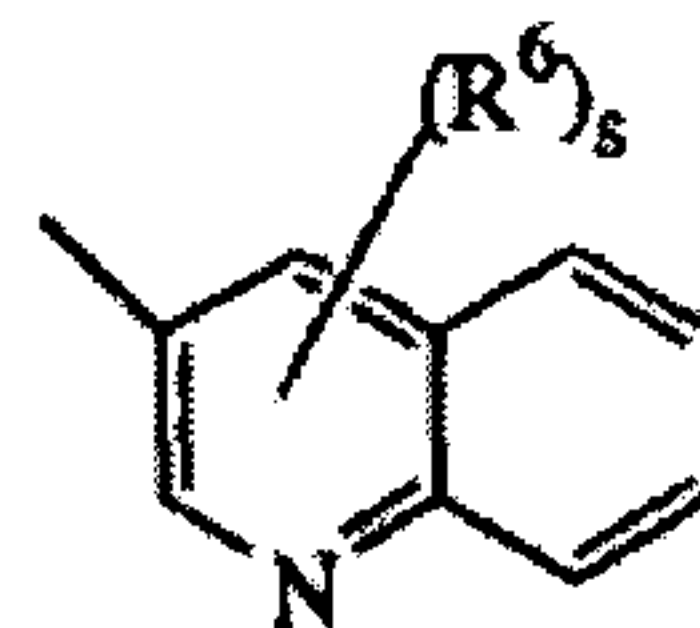
(a-21)



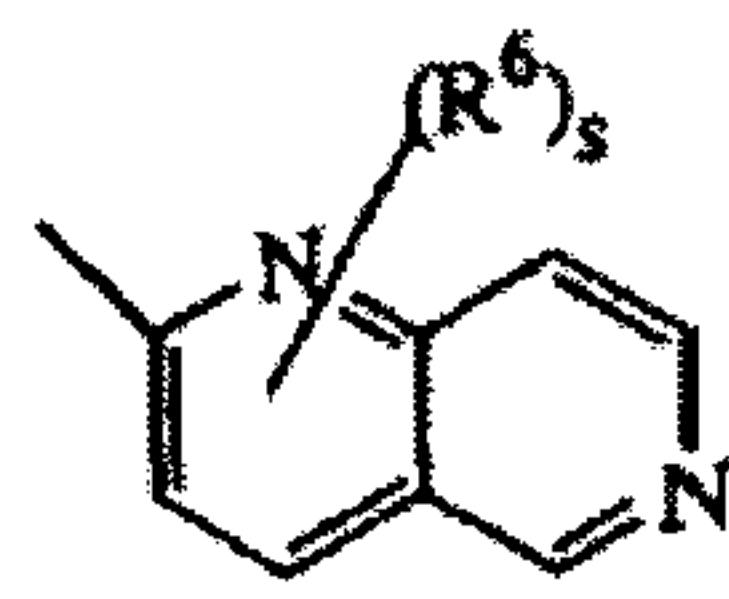
(a-22)



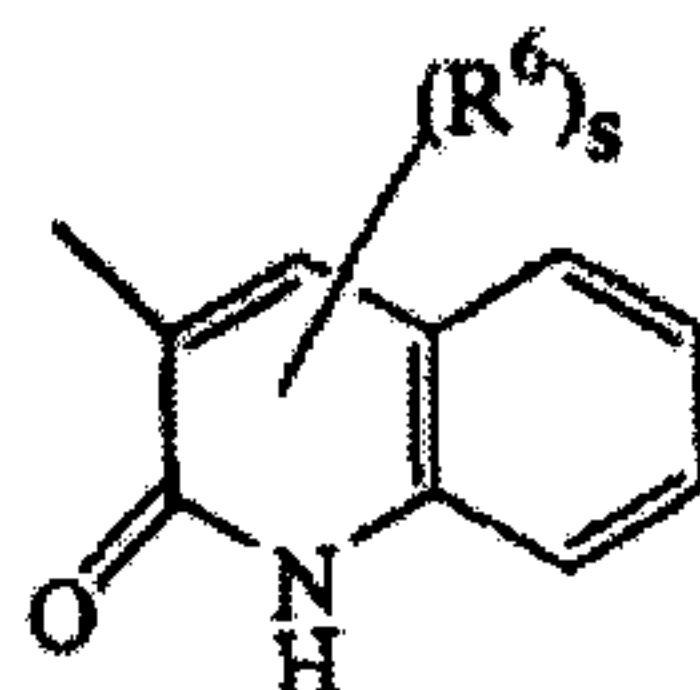
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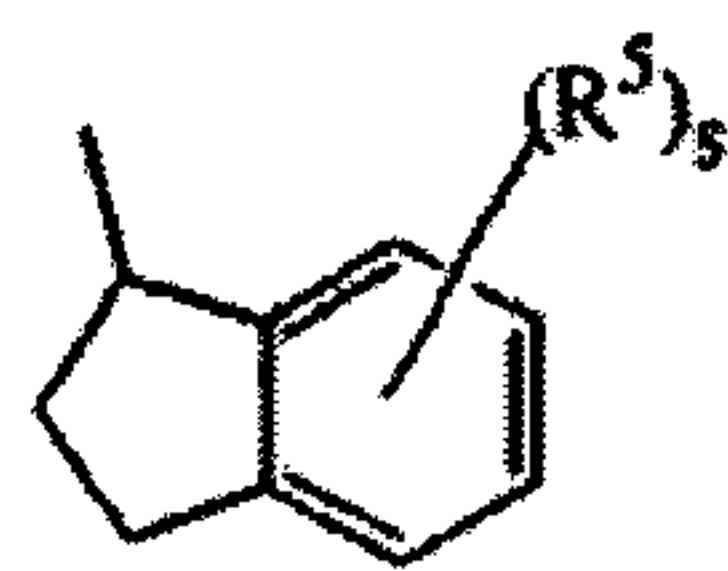
(a-24)



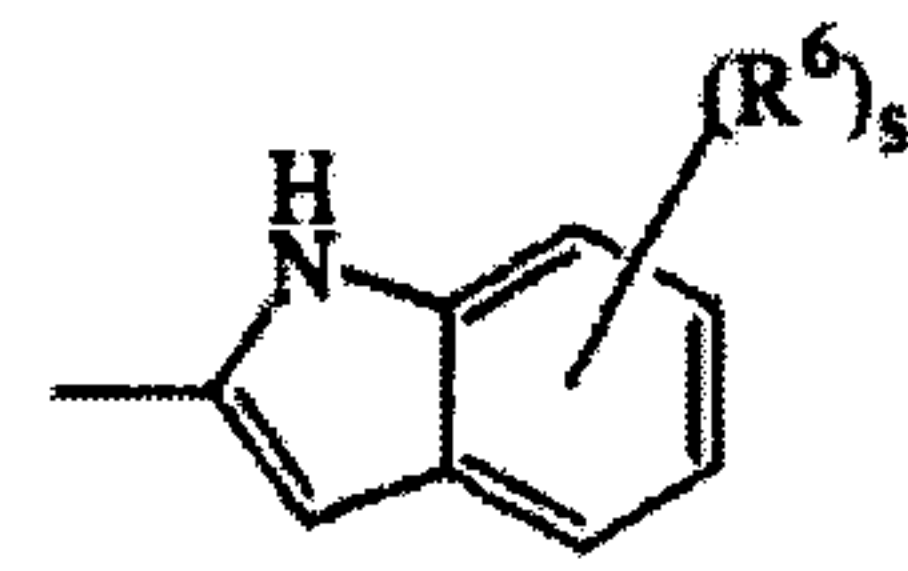
(a-25)



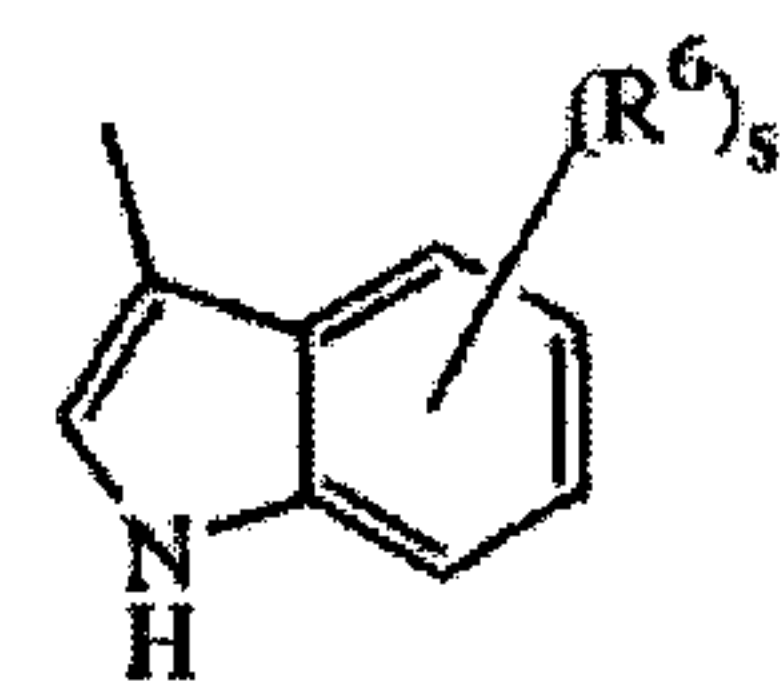
(a-26)



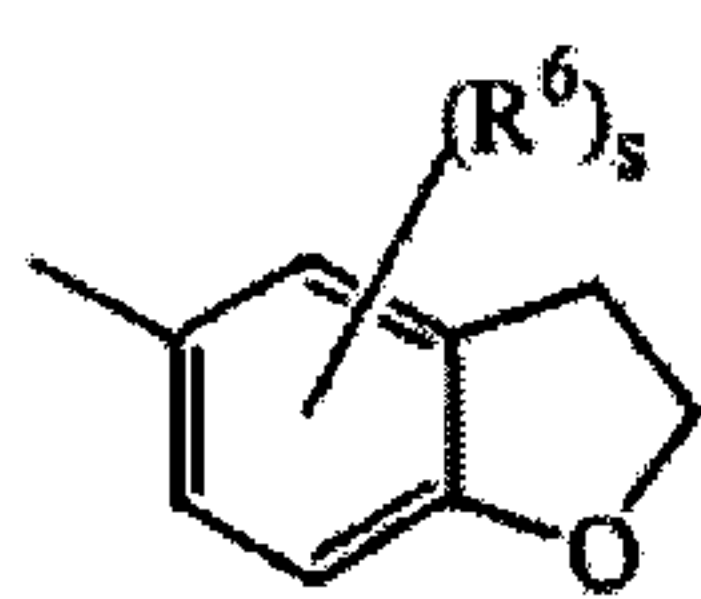
(a-27)



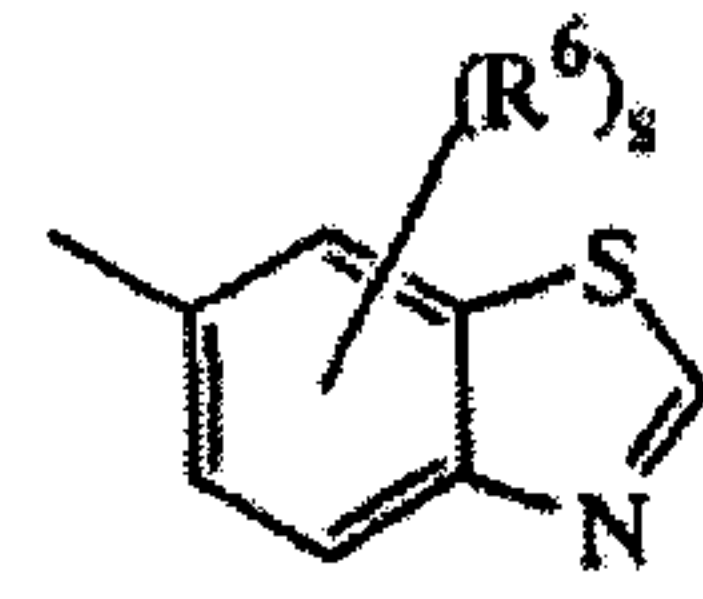
(a-28)



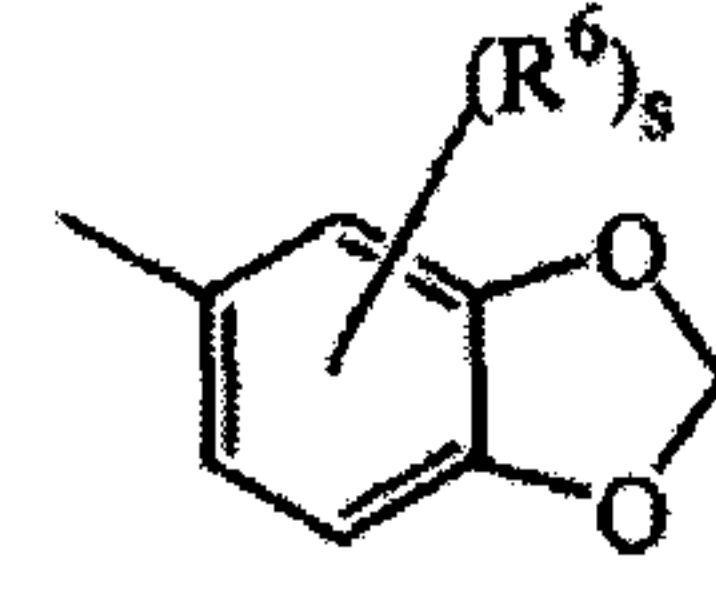
(a-29)



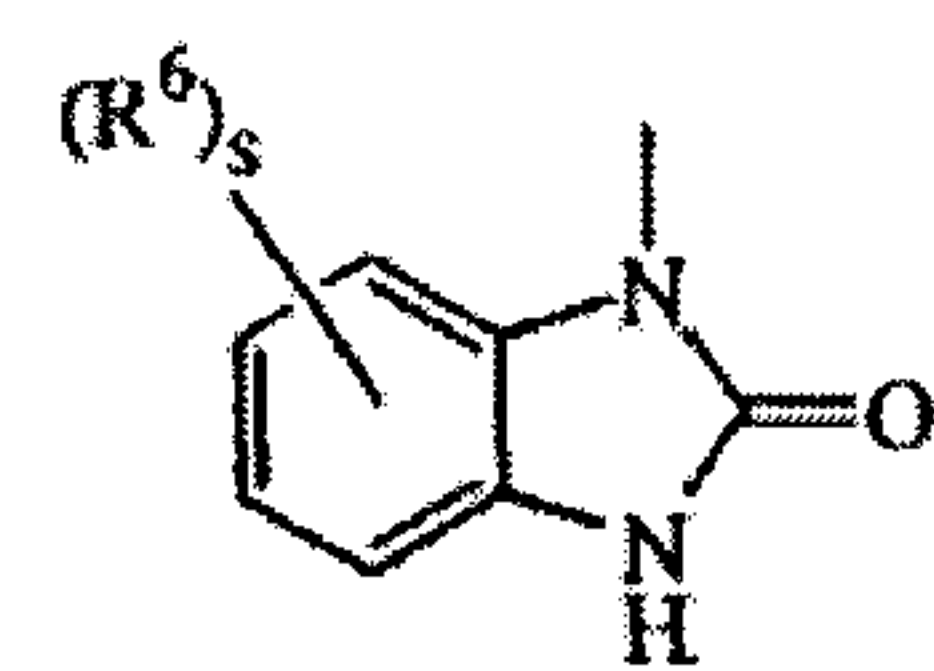
(a-30)



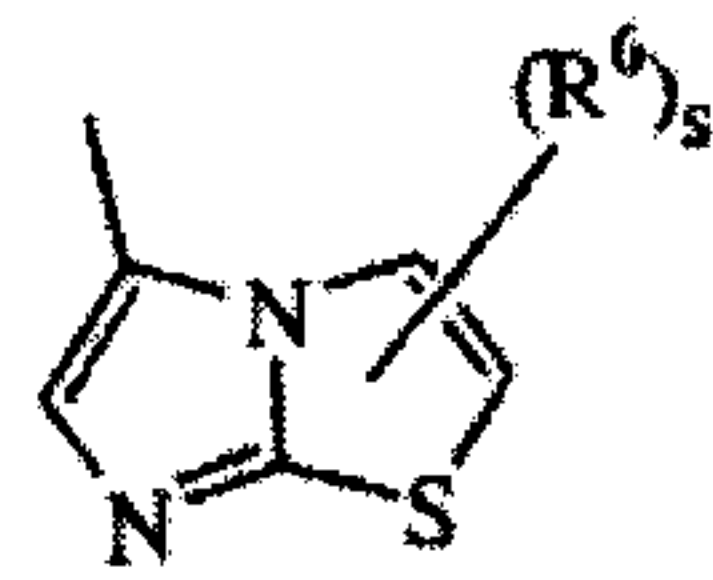
(a-31)



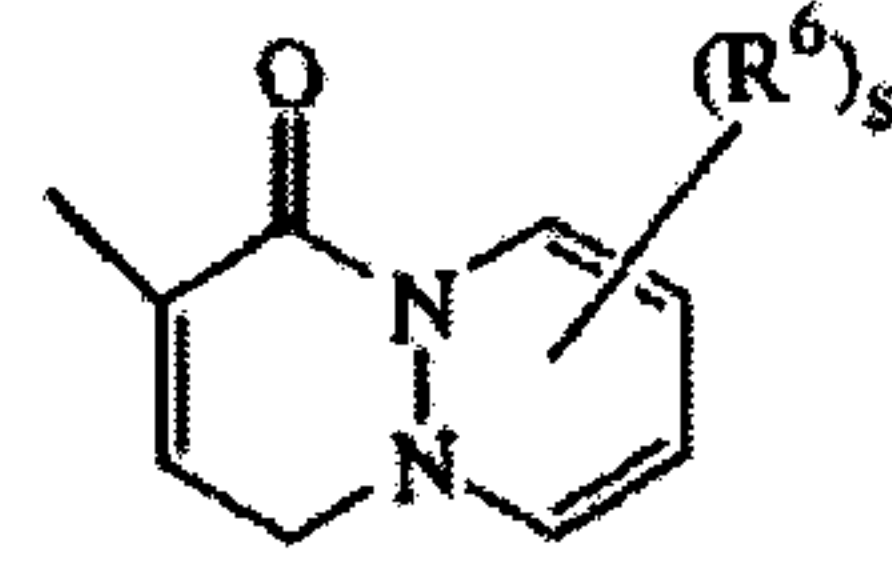
(a-32)



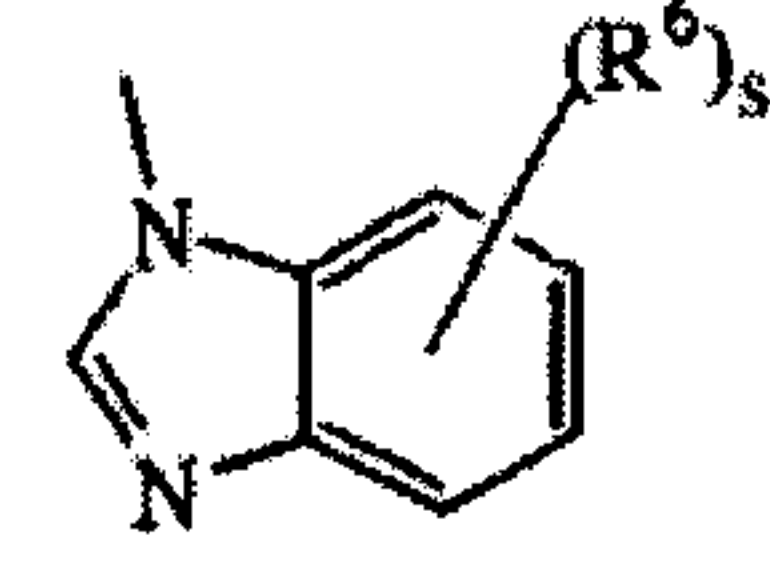
(a-33)



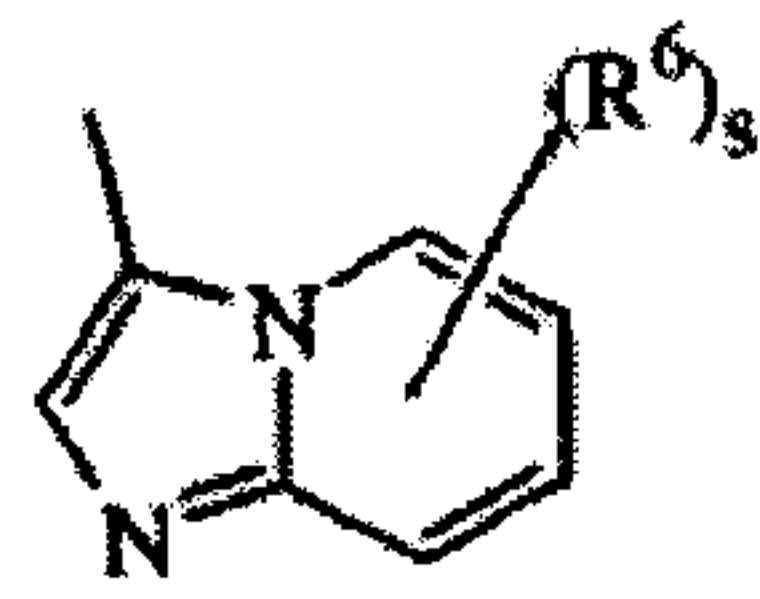
(a-34)



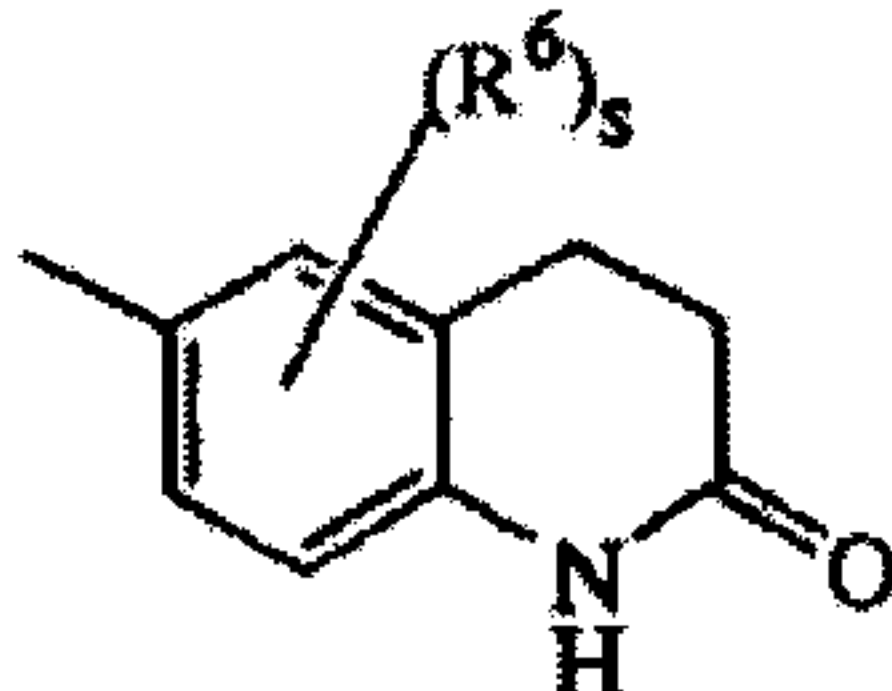
(a-35)



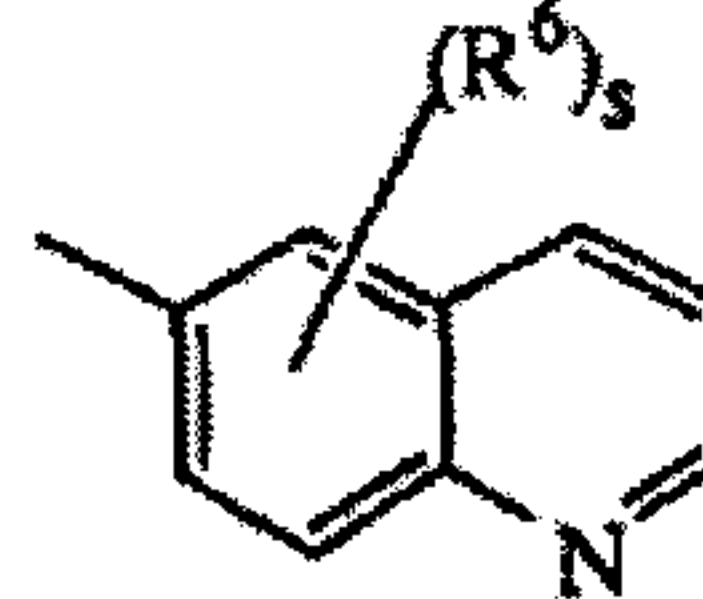
(a-36)



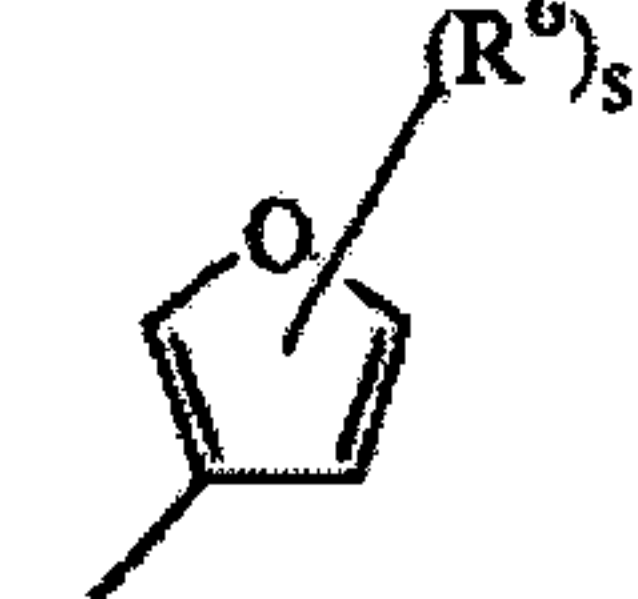
(a-37)



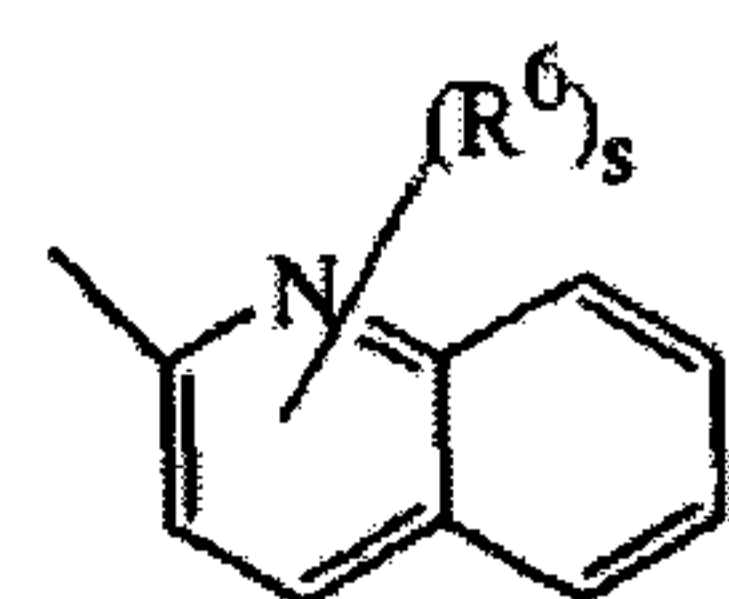
(a-38)



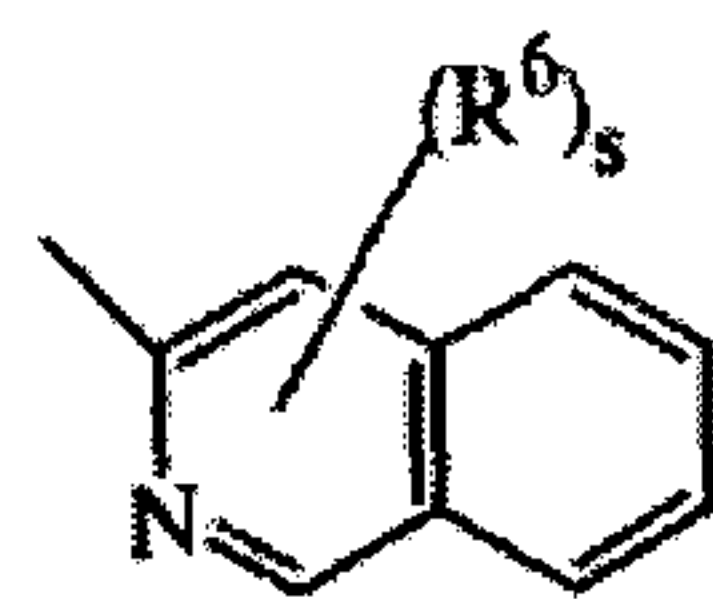
(a-39)



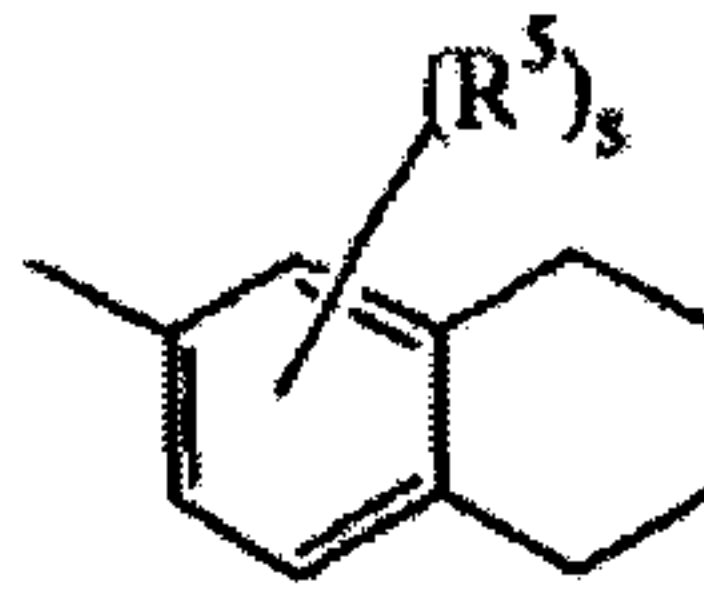
(a-40)



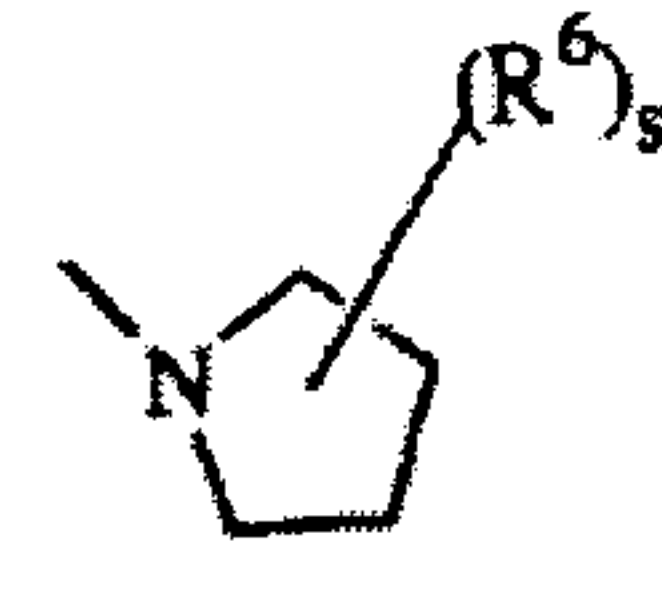
(a-41)



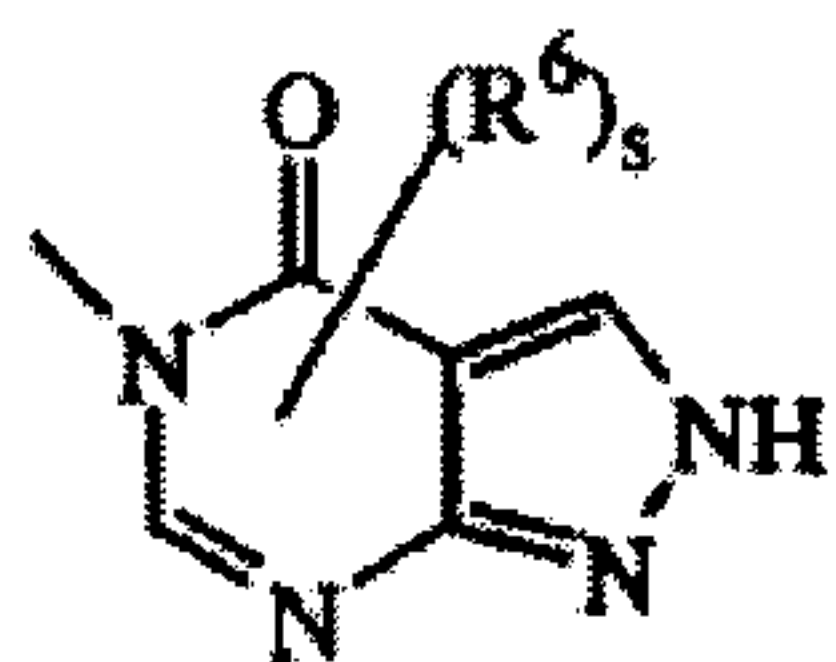
(a-42)



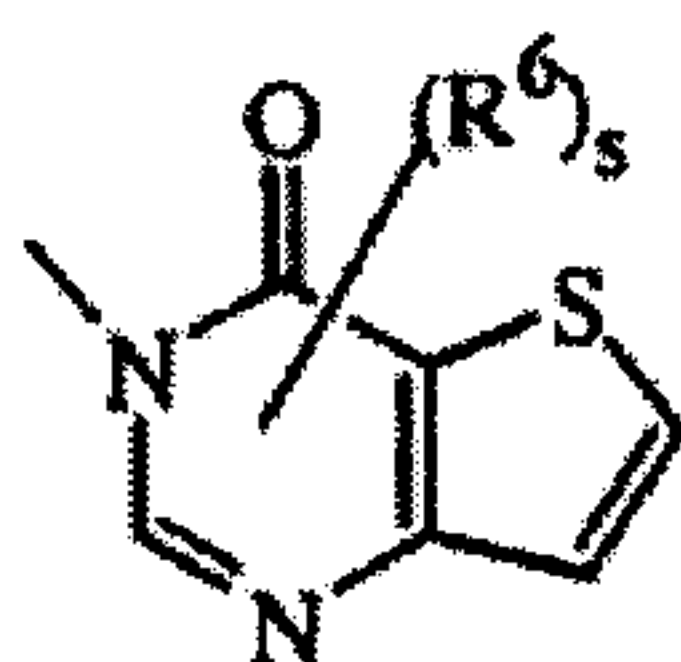
(a-43)



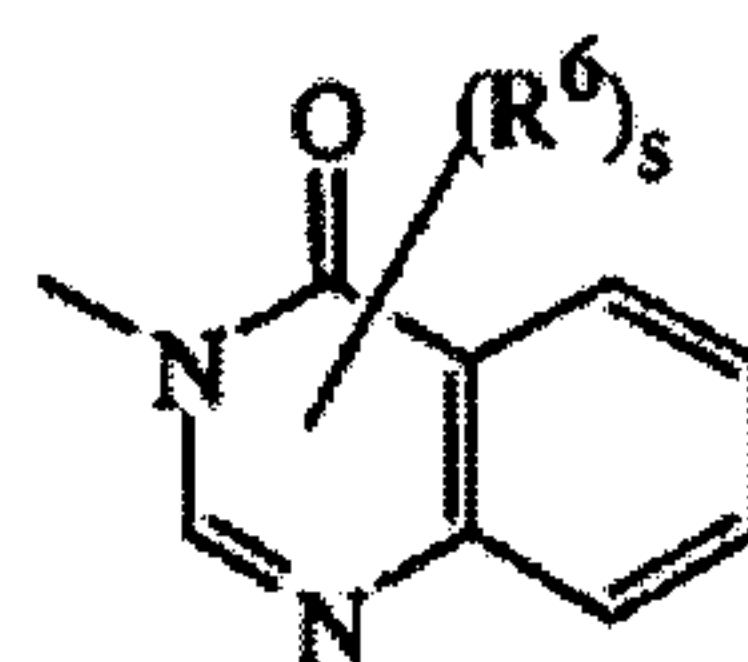
(a-44)



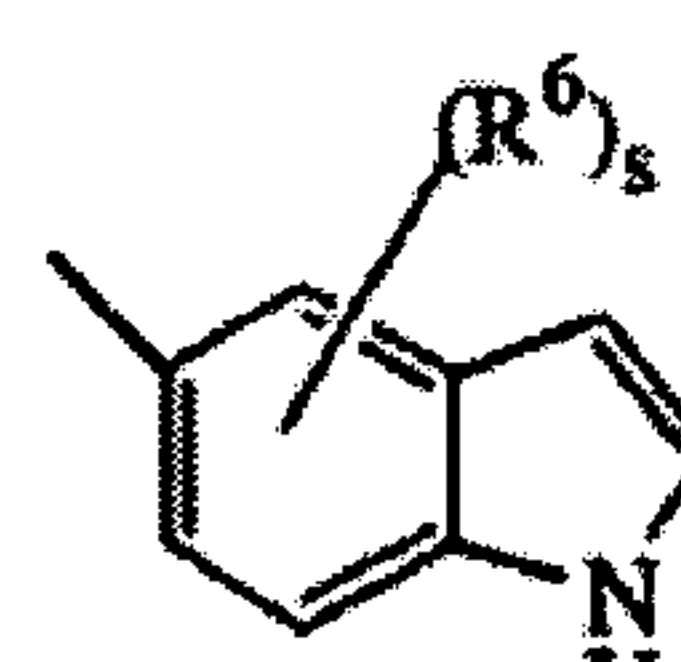
(a-45)



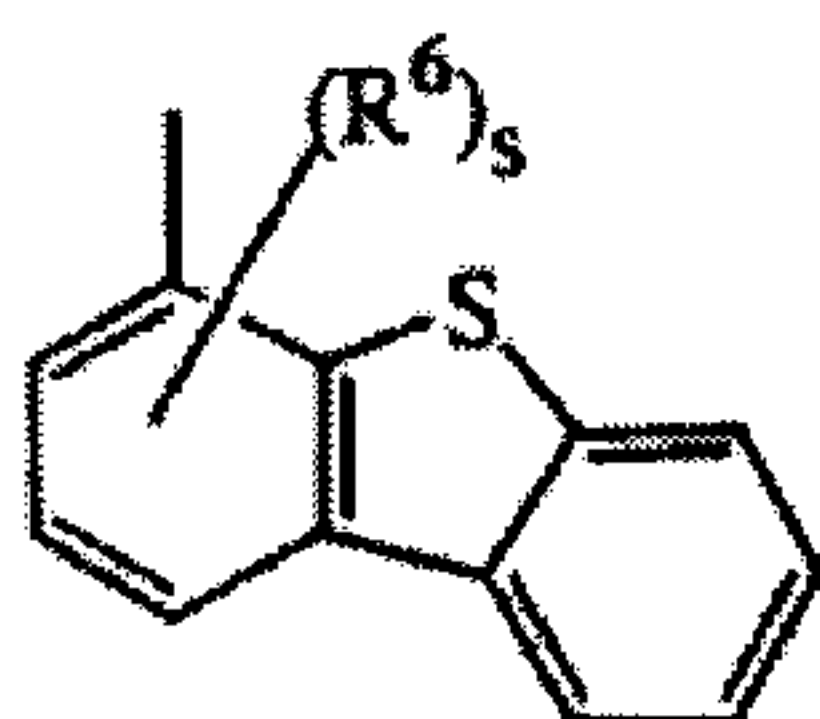
(a-46)



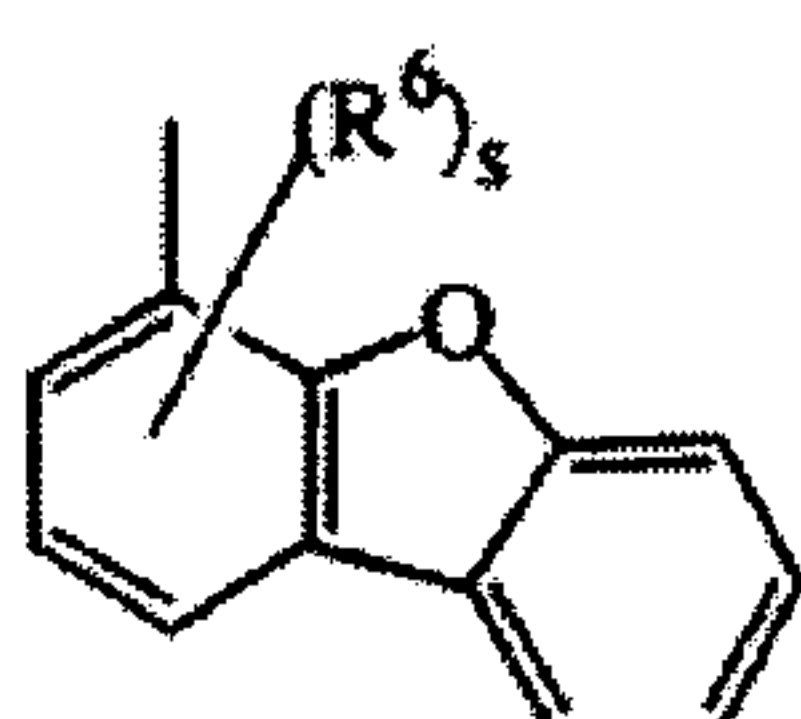
(a-47)



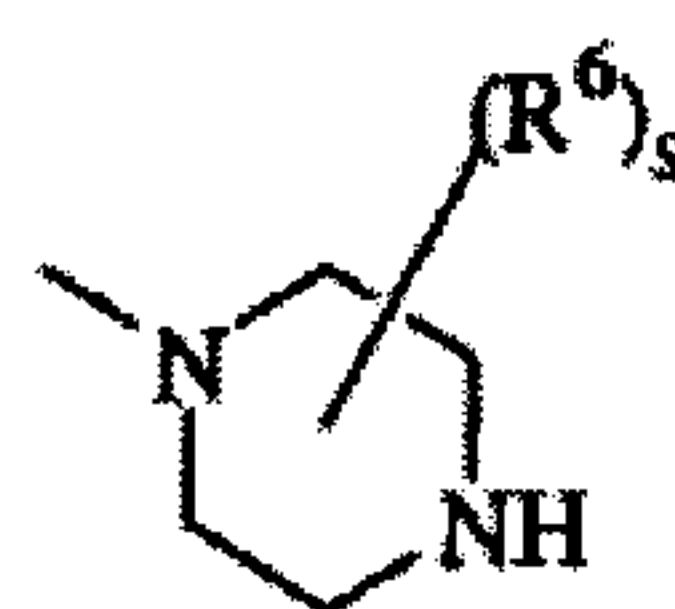
(a-48)



(a-49)



(a-50)



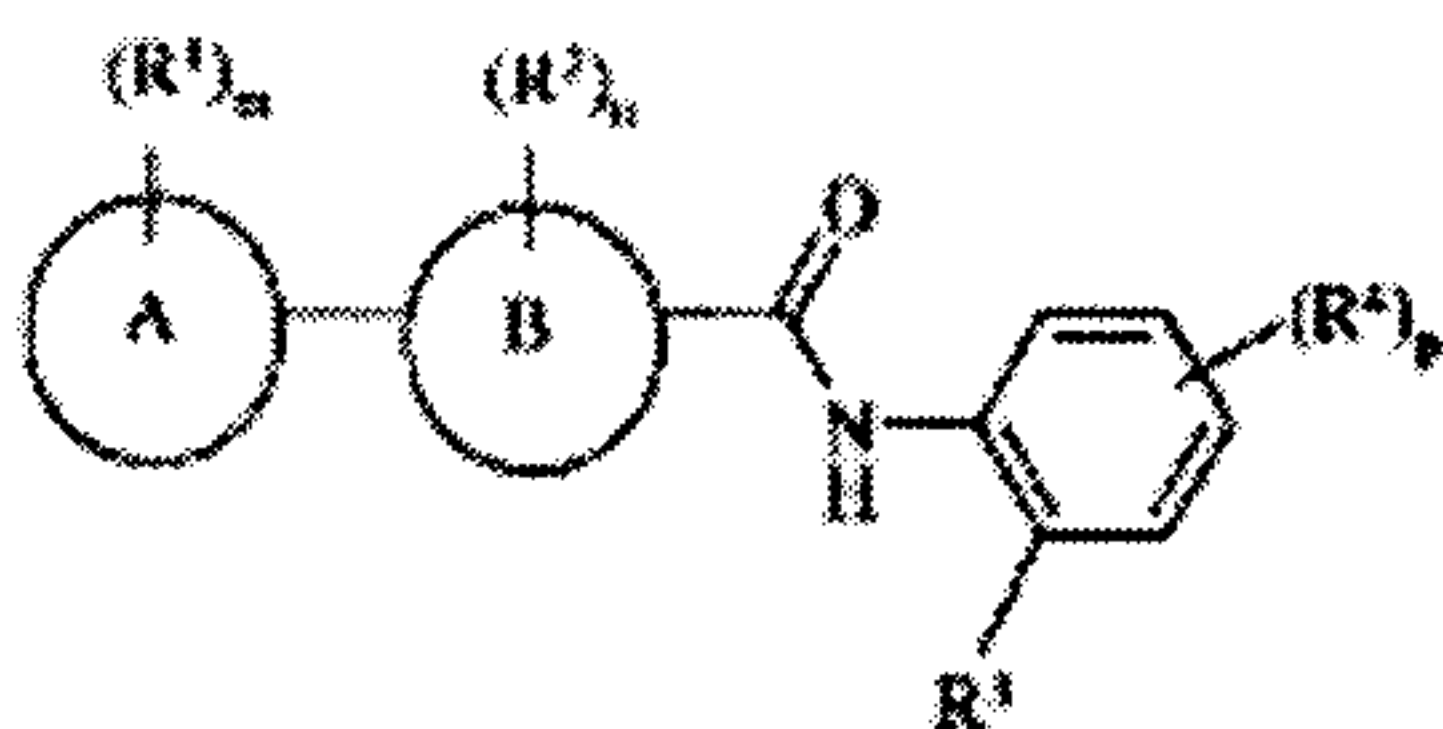
(a-51)

- wherein each s is independently 0, 1, 2, 3, 4 or 5; each R^5 and R^6 are independently selected from hydrogen; halo; hydroxy; amino; nitro; trihaloC₁₋₆alkyl; trihaloC₁₋₆alkyloxy; C₁₋₆alkyl; C₁₋₆alkyl substituted with aryl and C₃₋₁₀cycloalkyl; C₁₋₆alkyloxy; C₁₋₆alkyloxyC₁₋₆alkyloxy; C₁₋₆alkylcarbonyl; C₁₋₆alkyloxycarbonyl; C₁₋₆alkylsulfonyl; cyanoC₁₋₆alkyl; hydroxyC₁₋₆alkyl; hydroxyC₁₋₆alkyloxy; hydroxyC₁₋₆alkylamino; aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminocarbonyl; di(hydroxyC₁₋₆alkyl)amino; (aryl)(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminoC₁₋₆alkylamino; di(C₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; arylsulfonyl; arylsulfonylamino; aryloxy; aryloxyC₁₋₆alkyl; arylC₂₋₆alkenediyl; di(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)amino C₁₋₆alkyl; di(C₁₋₆alkyl)amino C₁₋₆alkyl (C₁₋₆alkyl)amino; di(C₁₋₆alkyl)amino C₁₋₆alkyl (C₁₋₆alkyl)amino C₁₋₆alkyl; aminosulfonylamino(C₁₋₆alkyl)amino; aminosulfonylamino(C₁₋₆alkyl)amino C₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)amino C₁₋₆alkyl; cyano; thiophenyl; thiophenyl substituted with di(C₁₋₆alkyl)amino C₁₋₆alkyl(C₁₋₆alkyl)amino C₁₋₆alkyl, di(C₁₋₆alkyl)amino C₁₋₆alkyl, C₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxy C₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, di(C₁₋₆alkyl)aminosulfonylpiperazinylC₁₋₆alkyl, C₁₋₆alkyloxypiperidinyl, C₁₋₆alkyloxypiperidinylC₁₋₆alkyl, morpholinylC₁₋₆alkyl, hydroxyC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, or di(hydroxyC₁₋₆alkyl) aminoC₁₋₆alkyl; furanyl; furanyl substituted with hydroxyC₁₋₆alkyl; benzofuranyl; imidazolyl; oxazolyl;

oxazolyl substituted with aryl and C₁₋₆alkyl; C₁₋₆alkyltriazolyl; tetrazolyl; pyrrolidinyl;
 pyrrolyl; piperidinylC₁₋₆alkyloxy; morpholinyl; C₁₋₆alkylmorpholinyl; morpholinylC₁₋₆
 alkyloxy; morpholinylC₁₋₆alkyl; morpholinylC₁₋₆alkylamino; morpholinylC₁₋₆
 alkylaminoC₁₋₆alkyl; piperazinyl; C₁₋₆alkylpiperazinyl; C₁₋₆alkylpiperazinylC₁₋₆alkyloxy;
 5 piperazinylC₁₋₆alkyl; naphthalenylsulfonylpiperazinyl; naphthalenylsulfonylpiperidinyl;
 naphthalenylsulfonyl: C₁₋₆alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkylpiperazinylC₁₋₆alkylamino;
 C₁₋₆alkylpiperazinylC₁₋₆alkylaminoC₁₋₆alkyl; C₁₋₆alkylpiperazinylsulfonyl;
 aminosulfonylpiperazinylC₁₋₆alkyloxy; aminosulfonylpiperazinyl;
 aminosulfonylpiperazinylC₁₋₆alkyl; di(C₁₋₆alkyl) aminosulfonylpiperazinyl; di(C₁₋₆
 10 alkyl)aminosulfonylpiperazinylC₁₋₆alkyl; hydroxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆
 alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkyloxypiperidinyl; C₁₋₆alkyloxypiperidinylC₁₋₆alkyl;
 piperidinylaminoC₁₋₆alkylamino; piperidinylaminoC₁₋₆alkylaminoC₁₋₆alkyl; (C₁₋₆
 alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylamino; (C₁₋₆
 alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; hydroxyC₁₋₆
 15 alkyloxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinyl C₁₋₆alkyl;
 (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)amino; (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)aminoC₁₋₆alkyl;
 hydroxyC₁₋₆alkylamino C₁₋₆alkyl; di(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkyl; pyrrolidinylC₁₋₆
 alkyl; pyrrolidinylC₁₋₆alkyloxy; pyrazolyl; thiopyrazolyl; pyrazolyl substituted with two
 substituents selected from C₁₋₆alkyl or trihaloC₁₋₆alkyl; pyridinyl; pyridinyl substituted
 20 with C₁₋₆alkyloxy, aryloxy or aryl; pyrimidinyl; tetrahydropyrimidinylpiperazinyl;
 tetrahydropyrimidinylpiperazinylC₁₋₆alkyl; quinolinyl; indolyl; phenyl; phenyl substituted
 with one, two or three substituents independently selected from halo, amino, nitro, C₁₋₆
 alkyl, C₁₋₆alkyloxy, hydroxyC₁₋₄alkyl, trifluoromethyl, trifluoromethyloxy, hydroxyC₁₋₄
 alkyloxy, C₁₋₄alkylsulfonyl, C₁₋₄alkyloxyC₁₋₄alkyloxy, C₁₋₄alkyloxycarbonyl, aminoC₁₋₄
 25 alkyloxy, di(C₁₋₄alkyl)aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)amino, di(C₁₋₄
 alkyl)aminocarbonyl, di(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄
 alkyl, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)aminoC₁₋₄alkyl,
 di(C₁₋₄alkyl) aminoC₁₋₄alkyl (C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄alkyl)
 aminoC₁₋₄alkyl, aminosulfonylamino(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄
 30 alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl) aminosulfonylamino(C₁₋₄alkyl)amino, di(C₁₋₄
 alkyl)aminosulfonylamino(C₁₋₄alkyl)amino C₁₋₆alkyl, cyano, piperidinylC₁₋₄alkyloxy,

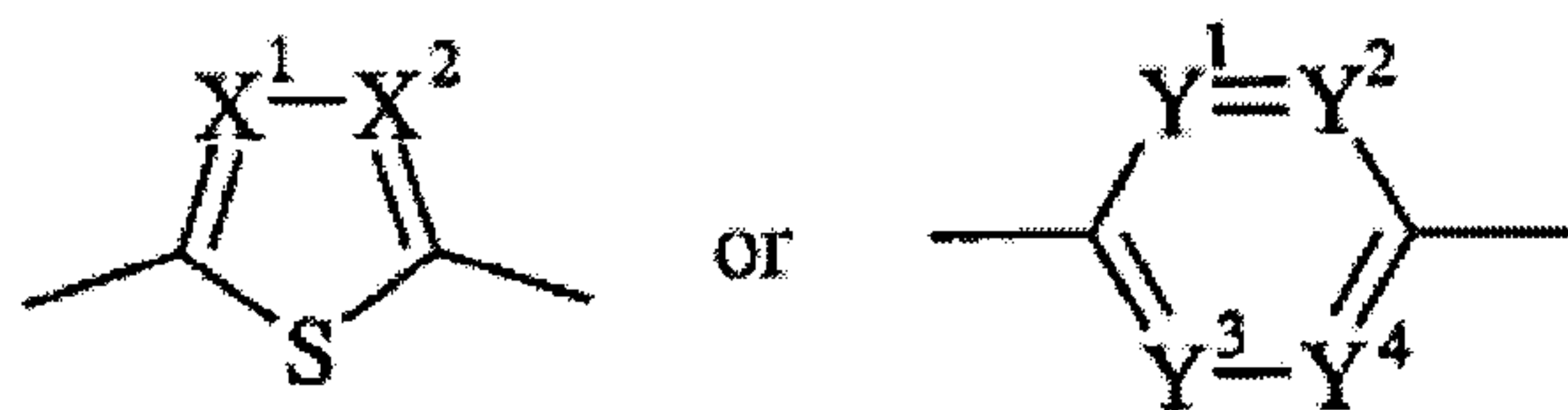
pyrrolidinylC₁₋₄alkyloxy, aminosulfonylpiperazinyl, aminosulfonylpiperazinylC₁₋₄alkyl, di(C₁₋₄alkyl) aminosulfonylpiperazinyl, di(C₁₋₄alkyl)aminosulfonylpiperazinylC₁₋₄alkyl, hydroxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkylpiperazinyl C₁₋₄alkyl, C₁₋₄alkyloxypiperidinyl, C₁₋₄alkyloxypiperidinylC₁₋₄alkyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)amino, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(hydroxyC₁₋₄alkyl)amino, di(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkyl, furanyl, furanyl substituted with -CH=CH-CH=CH-, pyrrolidinylC₁₋₄alkyl, pyrrolidinylC₁₋₄alkyloxy, morpholinyl, morpholinylC₁₋₄alkyloxy, morpholinylC₁₋₄alkyl, morpholinylC₁₋₄alkylamino, morpholinylC₁₋₄alkylaminoC₁₋₄alkyl, piperazinyl, C₁₋₄alkylpiperazinyl, C₁₋₄alkylpiperazinylC₁₋₄alkyloxy, piperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkylamino, C₁₋₄alkylpiperazinylC₁₋₄alkylaminoC₁₋₆alkyl, tetrahydropyrimidinylpiperazinyl, tetrahydropyrimidinylpiperazinylC₁₋₄alkyl, piperidinylaminoC₁₋₄alkylamino, piperidinylaminoC₁₋₄alkylaminoC₁₋₄alkyl, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylamino, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄alkyl, pyridinylC₁₋₄alkyloxy, hydroxyC₁₋₄alkylamino, hydroxyC₁₋₄alkylaminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylamino, aminothiadiazolyl, aminosulfonylpiperazinylC₁₋₄alkyloxy, or thiophenylC₁₋₄alkylamino; each R⁵ and R⁶ can be placed on the nitrogen in replacement of the hydrogen; aryl in the above is phenyl, or phenyl substituted with one or more substituents each independently selected from halo, C₁₋₆alkyl, C₁₋₆alkyloxy, trifluoromethyl, cyano or hydroxycarbonyl. See, for example, compounds disclosed in WO2003076430.

In one aspect, the inhibitor of histone deacetylase activity may be a compound of the general formula:



wherein: Ring A is a heterocyclyl, wherein if said heterocyclyl contains an -NH- moiety
 that nitrogen may be optionally substituted by a group selected from G; R¹ is a
 substituent on carbon and is selected from halo, nitro, cyano, hydroxy, oxo,
 trifluoromethyl, trifluoromethoxy, amino, carboxy, carbamoyl, mercapto, sulphamoyl, C₁-
 5 C₆alkyl, C₂-₆alkenyl, C₂-₆alkynyl, C₁-₆alkoxy, C₁-₆alkanoyl, C₁-₆alkanoyloxy, N-(C₁-
 C₆alkyl)amino, N,N-(C₁-₆alkyl)₂amino, C₁-₆alkanoylamino, N-(C₁-₆alkyl)carbamoyl, N,N-
 (C₁-₆alkyl)₂carbamoyl, C₁-₆alkylS(O)_a wherein a is 0 to 2, C₁-₆alkoxycarbonyl, N-(C₁-
 C₆alkyl)sulphamoyl, N,N-(C₁-₆alkyl)₂sulphamoyl, aryl, aryloxy, arylC₁-₆alkyl, heterocyclic
 group, (heterocyclic group)C₁-₆alkyl or a group (D-E-); wherein R¹, including group (D-
 10 E-), may be optionally substituted on carbon by one or more V; and wherein, if said
 heterocyclic group contains an -NH- moiety that nitrogen may be optionally substituted
 by a group selected from J; V is halo, nitro, cyano, hydroxy, oxo, trifluoromethyl,
 trifluoromethoxy, amino, carboxy, carbamoyl, mercapto, sulphamoyl, C₁-₆alkyl, C₂-
 C₆alkenyl, C₂-₆alkynyl, C₁-₆alkoxy, C₁-₆alkanoyl, C₁-₆alkanoyloxy, N-(C₁-₆alkyl)amino,
 15 N,N-(C₁-₆alkyl)₂amino, C₁-₆alkanoylamino, N-(C₁-₆alkyl)carbamoyl, N,N-(C₁-
 C₆alkyl)₂carbamoyl, C₁-₆alkylS(O)_a wherein a is 0 to 2, C₁-₆alkoxycarbonyl, N-(C₁-
 C₆alkyl)sulphamoyl, N,N-(C₁-₆alkyl)₂sulphamoyl or a group (D'-E'-); wherein V, including
 group (D'-E'-), may be optionally substituted on carbon by one or more W; W and Z are
 independently selected from halo, nitro, cyano, hydroxy, oxo, trifluoromethyl,
 20 trifluoromethoxy, amino, carboxy, carbamoyl, mercapto, sulphamoyl, C₁-₆alkyl, C₂-
 C₆alkenyl, C₂-₆alkynyl, C₁-₆alkoxy, C₁-₆alkanoyl, C₁-₆alkanoyloxy, N-(C₁-₆alkyl)amino,
 N,N-(C₁-₆alkyl)₂amino, C₁-₆alkanoylamino, N-(C₁-₆alkyl)carbamoyl, N,N-(C₁-
 C₆alkyl)₂carbamoyl, C₁-₆alkylS(O)_a wherein a is 0 to 2, C₁-₆alkoxycarbonyl, N-(C₁-
 C₆alkyl)sulphamoyl or N,N-(C₁-₆alkyl)₂sulphamoyl; G, J and K are independently selected
 25 from C₁-₈alkyl, C₂-₈alkenyl, C₂-₈alkynyl, C₁-₈alkanoyl, C₁-₆alkylsulphonyl, C₁-
 C₈alkoxycarbonyl, carbamoyl, N-(C₁-₈alkyl)carbamoyl, N,N-(C₁-₈alkyl) carbamoyl,
 benzyloxycarbonyl, benzoyl and phenylsulphonyl, aryl, arylC₁-₆alkyl or (heterocyclic
 group)C₁-₆alkyl; wherein G, J and K may be optionally substituted on carbon by one or
 more Q; and wherein if said heterocyclic group contains an - NH- moiety that nitrogen
 30 may be optionally substituted by a group selected from hydrogen or C₁-₆alkyl; Q is halo,
 nitro, cyano, hydroxy, oxo, trifluoromethyl, trifluoromethoxy, amino, carboxy,

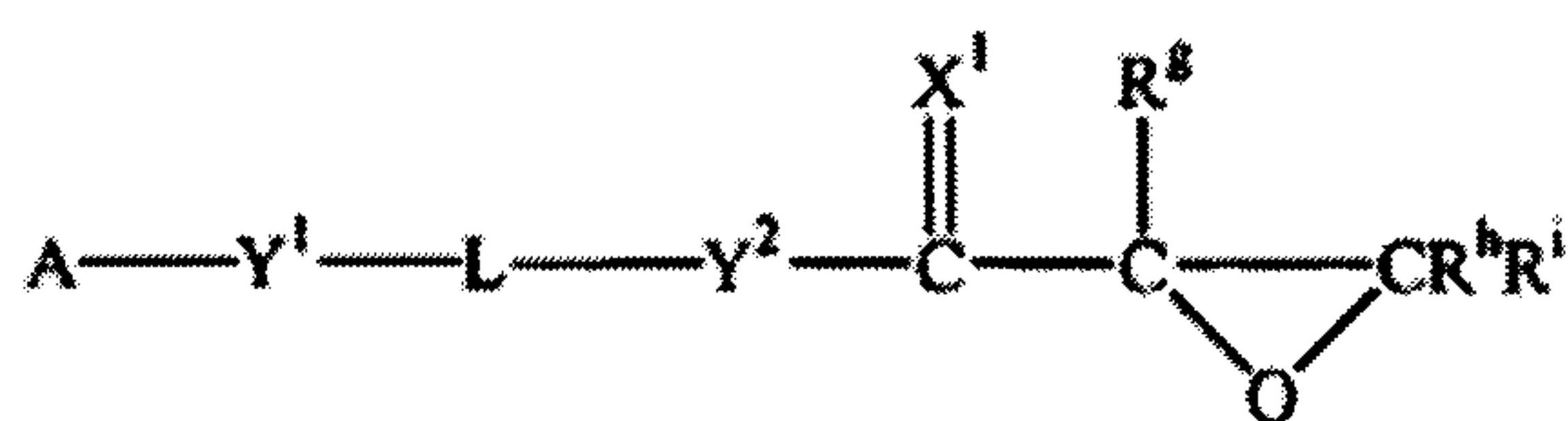
carbamoyl, mercapto, sulphamoyl, C₁₋₆alkyl, C₂₋₆alkenyl, C₂₋₆alkynyl, C₁₋₆alkoxy, C₁₋₆alkanoyl, C₁₋₆alkanoyloxy, N-(C₁₋₆alkyl)amino, N,N-(C₁₋₆alkyl)₂amino, C₁₋₆alkanoylamino, N-(C₁₋₆alkyl)carbamoyl, N,N-(C₁₋₆alkyl)₂carbamoyl, C₁₋₆alkylS(O)_a wherein a is 0 to 2, C₁₋₆alkoxycarbonyl, C₁₋₆alkoxycarbonylamino, N-(C₁₋₆alkyl)sulphamoyl, N,N-(C₁₋₆alkyl)₂sulphamoyl, aryl, aryloxy, arylC₁₋₆alkyl, arylC₁₋₆alkoxy, heterocyclic group, (heterocyclic group)C₁₋₆alkyl, (heterocyclic group)C₁₋₆alkoxy, or a group (D"-E"-); wherein Q, including group (D"-E"-), may be optionally substituted on carbon by one or more Z; D, D' and D" are independently selected from C₁₋₆alkyl, C₂₋₆alkenyl, C₂₋₆alkynyl, C₃₋₈cycloalkyl, C₃₋₈cycloalkylC₁₋₆alkyl, aryl, arylC₁₋₆alkyl, heterocyclic group, (heterocyclic group)C₁₋₆alkyl; wherein D, D' and D" may be optionally substituted on carbon by one or more F'; and wherein if said heterocyclic group contains an -NH- moiety that nitrogen may be optionally substituted by a group selected from K; E, E' and E" are independently selected from -N(R^a)-, -O-, -C(O)O-, -OC(O)-, -C(O)-, -N(R^a)C(O)-, -N(R^a)C(O)N(R^b)-, -N(R^a)C(O)O-, -OC(O)N(R^a)-, -C(O)N(R^a)-, -S(O)_r, -SO₂N(R^a)-, -N(R^a)SO₂-; wherein R^a and R^b are independently selected from hydrogen or C₁₋₆alkyl optionally substituted by one or more F and r is 0-2; F and F' are independently selected from halo, nitro, cyano, hydroxy, trifluoromethyl, trifluoromethoxy, amino, carboxy, carbamoyl, mercapto, sulphamoyl, C₁₋₆alkyl, C₂₋₆alkenyl, C₂₋₆alkynyl, C₁₋₆alkoxy, C₁₋₆alkanoyl, C₁₋₆alkanoyloxy, N-(C₁₋₆alkyl)amino, N,N-(C₁₋₆alkyl)₂amino, C₁₋₆alkanoylamino, N-(C₁₋₆alkyl)carbamoyl, N,N-(C₁₋₆alkyl)₂carbamoyl, C₁₋₆alkylS(O)_a wherein a is 0 to 2, C₁₋₆alkoxycarbonyl, N-(C₁₋₆alkyl)sulphamoyl and N,N-(C₁₋₆alkyl)₂sulphamoyl; m is 0, 1, 2, 3 or 4; wherein the values of R¹ may be the same or different; Ring B is a ring selected from



wherein, X¹ and X² are selected from CH or N. and Y¹, Y², Y³ and Y⁴ are selected from CH or N provided that at least one of Y¹, Y², Y³ and Y⁴ is N; R² is halo; n is 0, 1 or 2; wherein the values of R² may be the same or different; R³ is amino or hydroxy; R⁴ is

halo, nitro, cyano, hydroxy, trifluoromethyl, trifluoromethoxy, amino, carboxy, carbamoyl, mercapto, sulphamoyl, C₁₋₃alkyl, C₂₋₃alkenyl, C₂₋₃alkynyl, C₁₋₃alkoxy, C₁₋₃alkanoyl, C₁₋₃alkanoyloxy, N-(C₁₋₃alkyl)amino, N,N-(C₁₋₃alkyl)₂amino, C₁₋₃alkanoylamino, N-(C₁₋₃alkyl)carbamoyl, N,N-(C₁₋₃alkyl)₂carbamoyl, C₁₋₃alkylS(O)_a wherein a is 0 to 2, C₁₋₃alkoxycarbonyl, N-(C₁₋₃alkyl)sulphamoyl, N,N-(C₁₋₃alkyl)₂sulphamoyl; and p is 0, 1 or 2; wherein the values of R⁴ may be the same or different; or a pharmaceutically acceptable salt or *in vivo* hydrolysable ester or amide thereof. See for example, compounds disclosed in WO2003092686.

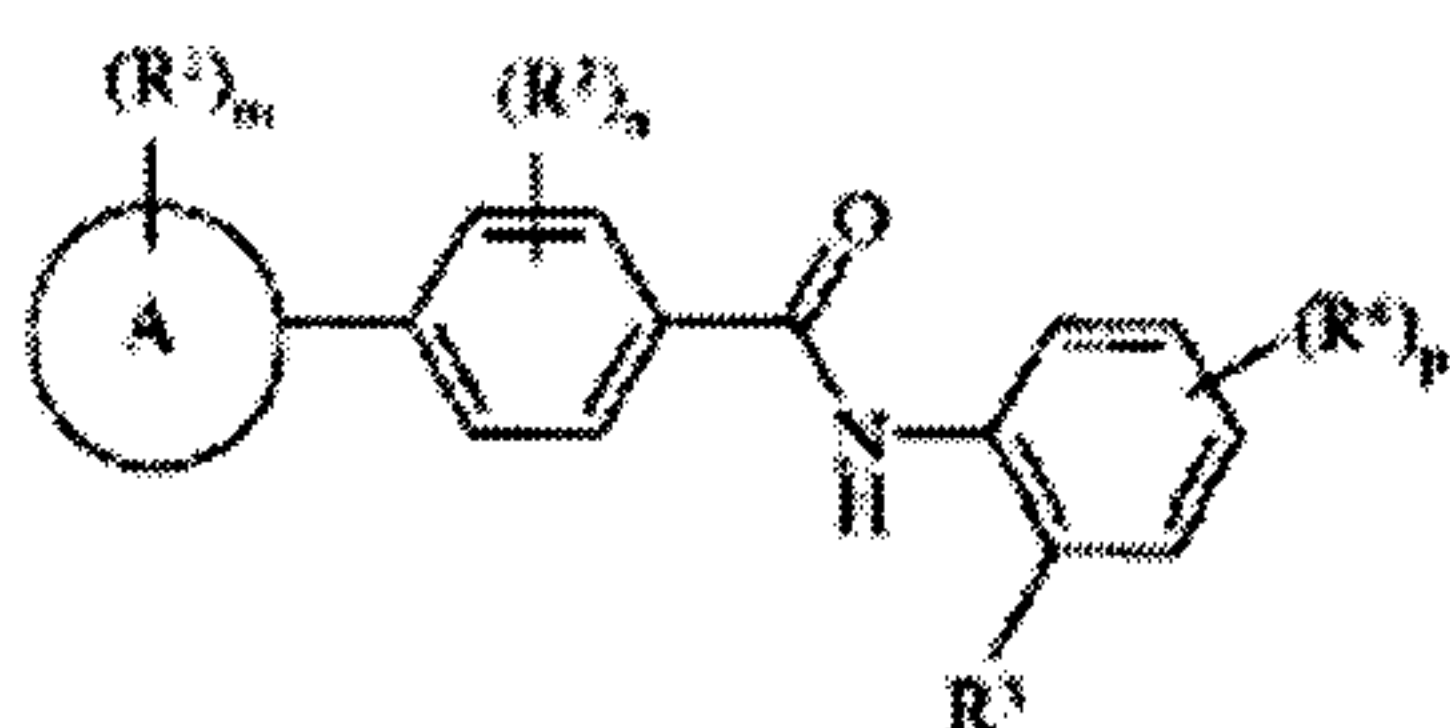
In one aspect, the inhibitor of histone deacetylase activity may be an alpha-ketoepoxide compound, such as, for example, compounds disclosed in WO2003099272, having the general formula:



Wherein A is a cyclic moiety selected from the group consisting of C₃₋₁₄cycloalkyl, 3-14 membered heterocycloalkyl, C₄₋₁₄cycloalkenyl, 3-8 membered heterocycloalkenyl, aryl, and heteroaryl; the cyclic moiety being optionally substituted with alkyl, alkenyl, alkynyl, alkoxy, hydroxyl, hydroxylalkyl, halo, haloalkyl, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, alkylcarbonyloxy, alkyloxycarbonyl, alkylcarbonyl, alkylsulfonylamino, aminosulfonyl, or alkylsulfonyl; or A is a saturated branched C₃₋₁₂hydrocarbon chain or an unsaturated branched C₃₋₁₂hydrocarbon chain optionally interrupted by -O-, -S-, -N(R^a)-, -C(O)-, -N(R^a)-SO₂-, -SO₂-N(R^a)-, -N(R^a)-C(O)-O-, -O-C(O)-N(R^a)-, -N(R^a)-C(O)-N(R^b)-, -O-C(O)-, -C(O)-O-, -O-SO₂-, -SO₂-O-, or -O-C(O)-O-, where each of R^a and R^b, independently, is hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; each of the saturated and the unsaturated branched hydrocarbon chain being optionally substituted with alkyl, alkenyl, alkynyl, alkoxy, hydroxyl, hydroxylalkyl, halo, haloalkyl, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, alkylcarbonyloxy, alkyloxycarbonyl, alkylcarbonyl,

- alkylsulfonylamino, aminosulfonyl, or alkylsulfonyl; each of Y^1 and Y^2 independently, is $-\text{CH}_2-$, $-\text{O}-$, $-\text{S}-$, $-\text{N}(\text{R}^c)-$, $-\text{N}(\text{R}^c)-\text{C}(\text{O})-\text{O}-$, $-\text{N}(\text{R}^c)-\text{C}(\text{O})-$, $-\text{C}(\text{O})-\text{N}(\text{R}^c)-$, $-\text{O}-\text{C}(\text{O})-\text{N}(\text{R}^c)-$, $-\text{N}(\text{R}^c)-\text{C}(\text{O})-\text{N}(\text{R}^d)-$, $-\text{C}(\text{O})-$, $-\text{C}(\text{NR}^c)-$, $-\text{O}-\text{C}(\text{O})-\text{O}-$, or a bond; each of R^c and R^d , independently, being hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; L is a straight C_{4-12} hydrocarbon chain optionally containing at least one double bond, at least one triple bond, or at least one double bond and one triple bond; the hydrocarbon chain being optionally substituted with C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} alkoxy, hydroxyl, halo, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, nitro, cyano, C_{3-5} cycloalkyl, 3-5 membered heterocycloalkyl, monocyclic aryl, 5-6 membered heteroaryl, C_{1-4} alkylcarbonyloxy, C_{1-4} alkyloxycarbonyl, C_{1-4} alkylcarbonyl, or formyl; and further being optionally interrupted by $-\text{O}-$, $-\text{N}(\text{R}^e)-$, $-\text{N}(\text{R}^e)-\text{C}(\text{O})-\text{O}-$, $-\text{O}-\text{C}(\text{O})-\text{N}(\text{R}^e)-$, $-\text{N}(\text{R}^e)-\text{C}(\text{O})-\text{N}(\text{R}^f)-$, or $-\text{O}-\text{C}(\text{O})-\text{O}-$; each of R^e and R^f , independently, being hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; X^1 is O or S; and each of R^g , R^h , and R^i , independently, is hydrogen or C_{1-6} alkyl; provided that when each of Y^1 and Y^2 independently, is a bond or CH_2 , A is unsubstituted phenyl or heterocyclyl, and L is C_{4-7} , L has at least one double bond or at least one triple bond, and when each of Y^1 and Y^2 is a bond, A is unsubstituted phenyl, and L is C_4 , L is not a diene; or a salt thereof.

- In one aspect, the inhibitor of histone deacetylase activity may be a benzamide derivative, such as, for example, compounds disclosed in WO2003087057, having the general formula:

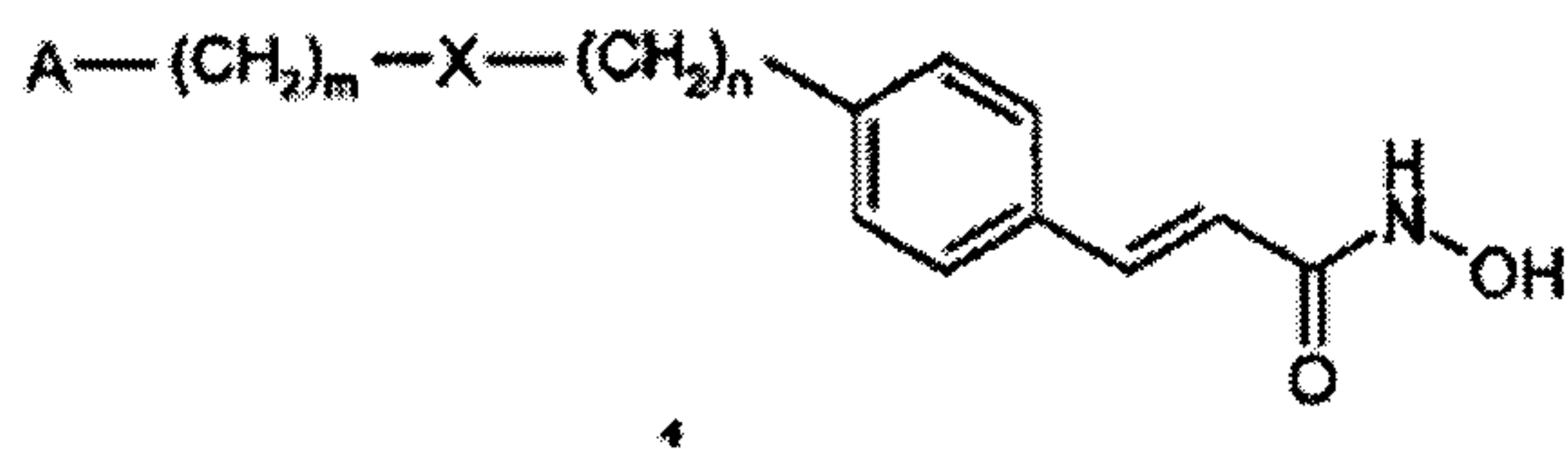


- Wherein Ring A is a heterocyclyl, wherein if said heterocyclyl contains an $-\text{NH}-$ moiety that nitrogen may be optionally substituted by a group selected from K; R^1 is a substituent on carbon and is selected from halo, nitro, cyano, hydroxy, trifluoromethyl, trifluoromethoxy, amino, carboxy, carbamoyl, mercapto, sulhamoyl, C_{1-6} alkyl, C_2 .

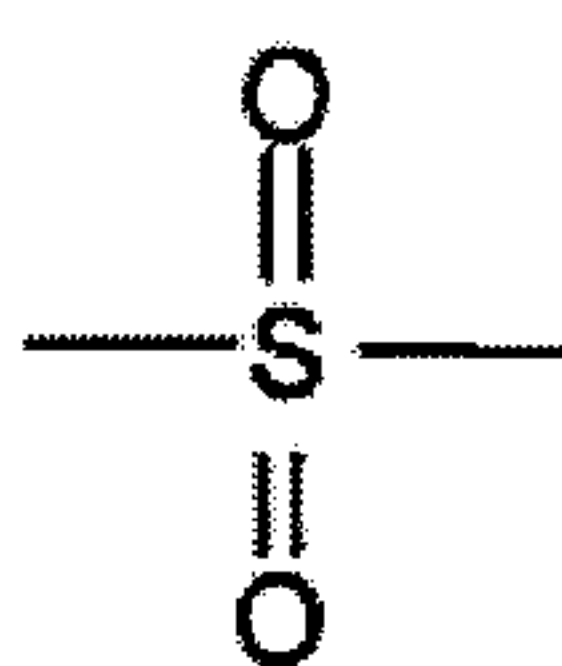
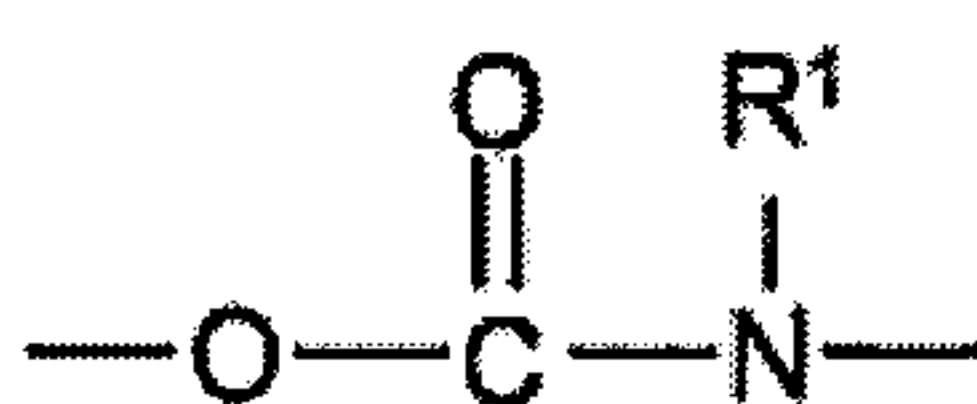
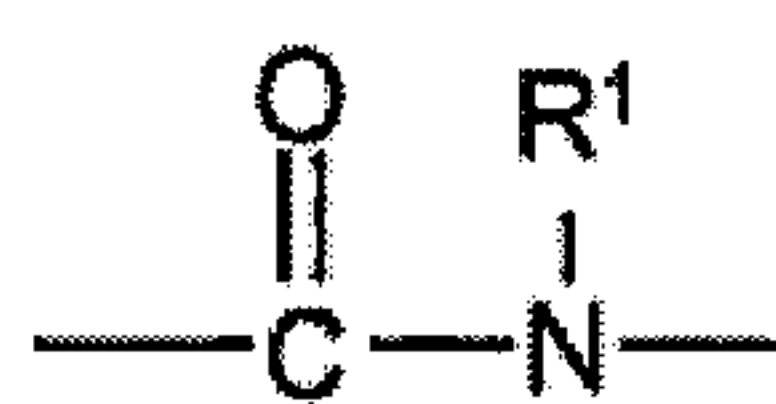
₆alkenyl, C₂₋₆alkynyl, C₁₋₆alkoxy, C₁₋₆alkanoyl, C₁₋₆alkanoyloxy, N-(C₁₋₆alkyl)amino,
 N,N-(C₁₋₆alkyl)₂amino, C₁₋₆alkanoylamino, N-(C₁₋₆alkyl)carbamoyl, N,N-(C₁₋₆alkyl)₂carbamoyl, C₁₋₆alkylS(O)_a wherein a is 0 to 2, C₁₋₆alkoxycarbonyl, N-(C₁₋₆alkyl)
 sulphamoyl, N,N-(C₁₋₆alkyl)₂sulphamoyl, aryl, aryloxy, arylC₁₋₆alkyl, heterocyclic group,
 5 (heterocyclic group)C₁₋₆alkyl, or a group (B-E-); wherein R¹, including group (B-E-),
 may be optionally substituted on carbon by one or more W; and wherein if said
 heterocyclic group contains an -NH- moiety that nitrogen may be optionally substituted
 by J; W is halo, nitro, cyano, hydroxy, trifluoromethyl, trifluoromethoxy, amino,
 carboxy, carbamoyl, mercapto, sulphamoyl, C₁₋₆alkyl, C₂₋₆alkenyl, C₂₋₆alkynyl, C₁₋₆alkoxy,
 10 C₁₋₆alkanoyl, C₁₋₆alkanoyloxy, N-(C₁₋₆alkyl)amino, N,N-(C₁₋₆alkyl)₂amino, C₁₋₆alkanoylamino,
 N-(C₁₋₆alkyl)carbamoyl, N,N-(C₁₋₆alkyl)₂carbamoyl, C₁₋₆alkylS(O)_a wherein a is 0 to 2, C₁₋₆alkoxycarbonyl,
 N-(C₁₋₆alkyl)sulphamoyl, N,N-(C₁₋₆alkyl)₂sulphamoyl, or a group (B'-E'-); wherein W including group (B'-E'-), may be
 optionally substituted on carbon by one or more Y; Y and Z are independently selected
 15 from halo, nitro, cyano, hydroxy, trifluoromethyl, trifluoromethoxy, amino, carboxy,
 carbamoyl, mercapto, sulphamoyl, C₁₋₆alkyl, C₂₋₆alkenyl, C₂₋₆alkynyl, C₁₋₆alkoxy, C₁₋₆alkanoyl,
 C₁₋₆alkanoyloxy, N-(C₁₋₆alkyl)amino, N,N-(C₁₋₆alkyl)₂amino, C₁₋₆alkanoylamino, N-(C₁₋₆alkyl)carbamoyl,
 N,N-(C₁₋₆alkyl)₂carbamoyl, C₁₋₆alkylS(O)_a wherein a is 0 to 2, C₁₋₆alkoxycarbonyl, N-(C₁₋₆alkyl)sulphamoyl or N,N-(C₁₋₆alkyl)₂sulphamoyl;
 20 G, J and K are independently selected from C₁₋₈alkyl, C₂₋₈alkenyl, C₁₋₈alkanoyl, C₁₋₈alkylsulphonyl,
 C₁₋₈alkoxycarbonyl, carbamoyl, N-(C₁₋₈alkyl)carbamoyl, N,N-(C₁₋₈alkyl)carbamoyl, benzyloxycarbonyl, benzoyl,
 phenylsulphonyl, aryl, arylC₁₋₆alkyl or (heterocyclic group)C₁₋₆alkyl; wherein G, J and K may be optionally
 substituted on carbon by one or more Q; and wherein if said heterocyclic group contains
 25 an -NH- moiety that nitrogen may be optionally substituted by hydrogen or C₁₋₆alkyl; Q is halo,
 nitro, cyano, hydroxy, trifluoromethyl, trifluoromethoxy, amino, carboxy, carbamoyl, mercapto,
 sulphamoyl, C₁₋₆alkyl, C₂₋₆alkenyl, C₂₋₆alkynyl, C₁₋₆alkoxy, C₁₋₆alkanoyl, C₁₋₆alkanoyloxy,
 N-(C₁₋₆alkyl)amino, N,N-(C₁₋₆alkyl)₂amino, C₁₋₆alkanoylamino, N-(C₁₋₆alkyl)carbamoyl,
 N,N-(C₁₋₆alkyl)₂carbamoyl, C₁₋₆alkylSO)_a wherein a is 0 to 2, C₁₋₆alkoxycarbonyl, C₁₋₆alkoxycarbonylamino,
 30 N-(C₁₋₆alkyl)sulphamoyl, N,N-(C₁₋₆alkyl)₂sulphamoyl, aryl, aryloxy, arylC₁₋₆alkyl, arylC₁₋

alkoxy, heterocyclic group, (heterocyclic group)C₁₋₆alkyl, (heterocyclic group)C₁₋₆alkoxy, or a group (B"-E"-); wherein Q, including group (B"-E"-), may be optionally substituted on carbon by one or more Z; B, B' and B" are independently selected from C₁₋₆alkyl, C₂₋₆alkenyl, C₂₋₆alkynyl, C₃₋₈cycloalkyl, C₃₋₈cycloalkylC₁₋₆alkyl, aryl, arylC₁₋₆alkyl, heterocyclic group, (heterocyclic group)C₁₋₆alkyl, phenyl or phenylC₁₋₆alkyl; wherein B, B' and B" may be optionally substituted on carbon by one or more D; and wherein if said heterocyclic group contains an -NH- moiety that nitrogen may be optionally substituted by a group selected from G; E, E' and E" are independently selected from -N(R^a)-, -O-, -C(O)O-, -OC(O)-, -C(O)-, -N(R^a)C(O)-, -N(R^a)C(O)N(R^b)-, -N(R^a)C(O)O-, -OC(O)N(R^a)-, -C(O)N(R^a)-, -S(O)_r-, -SO₂N(R^a)-, -N(R^a)SO₂-; wherein R^a and R^b are independently selected from hydrogen or C₁₋₆alkyl optionally substituted by one or more F and r is 0-2; D and F are independently selected from halo, nitro, cyano, hydroxy, trifluoromethyl, trifluoromethoxy, amino, carboxy, carbamoyl, mercapto, sulphamoyl, C₁₋₆alkyl, C₂₋₆alkenyl, C₂₋₆alkynyl, C₁₋₆alkoxy, C₁₋₆alkanoyl, C₁₋₆alkanoyloxy, N-(C₁₋₆alkyl)amino, N,N-(C₁₋₆alkyl)₂amino, C₁₋₆alkanoylamino, N-(C₁₋₆alkyl)carbamoyl, N,N-(C₁₋₆alkyl)₂carbamoyl, C₁₋₆alkylS(O)_a wherein a is 0 to 2, C₁₋₆alkoxycarbonyl, N-(C₁₋₆alkyl)sulphamoyl or N,N-(C₁₋₆alkyl)₂sulphamoyl; m is 0, 1, 2, 3 or 4; wherein the values of R¹ may be the same or different; R² is halo; n is 0, 1 or 2; wherein the values of R² may be the same or different; R³ is amino or hydroxy; R⁴ is halo, nitro, cyano, hydroxy, trifluoromethyl, trifluoromethoxy, amino, carboxy, carbamoyl, mercapto, sulphamoyl, C₁₋₃alkyl, C₂₋₃alkenyl, C₂₋₃alkynyl, C₁₋₃alkoxy, C₁₋₃alkanoyl, C₁₋₃alkanoyloxy, N-(C₁₋₃alkyl)amino, N,N-(C₁₋₃alkyl)₂amino, C₁₋₃alkanoylamino, N-(C₁₋₃alkyl)carbamoyl, N,N-(C₁₋₃alkyl)₂carbamoyl, C₁₋₃alkylS(O)_a wherein a is 0 to 2, C₁₋₃alkoxycarbonyl, N-(C₁₋₃alkyl)sulphamoyl, N,N-(C₁₋₃alkyl)₂sulphamoyl; p is 0, 1 or 2; wherein the values of R⁴ may be the same or different; or a pharmaceutically acceptable salt or *in vivo* hydrolysable ester or amide thereof; with the proviso that said compound is not N-(2-amino-6-hydroxyphenyl)-4-1-methylhomopiperazin-4-yl)benzamide; N-(2-amino-6-methylphenyl)-4-(1-methylhomopiperazin-4-yl) benzamide; N-(2-aminophenyl)-4-(1-t-butoxycarbonylhomopiperazin-4-yl) benzamide; or N-(2-aminophenyl)-4-(1-methylhomopiperazin-4-yl)benzamide.

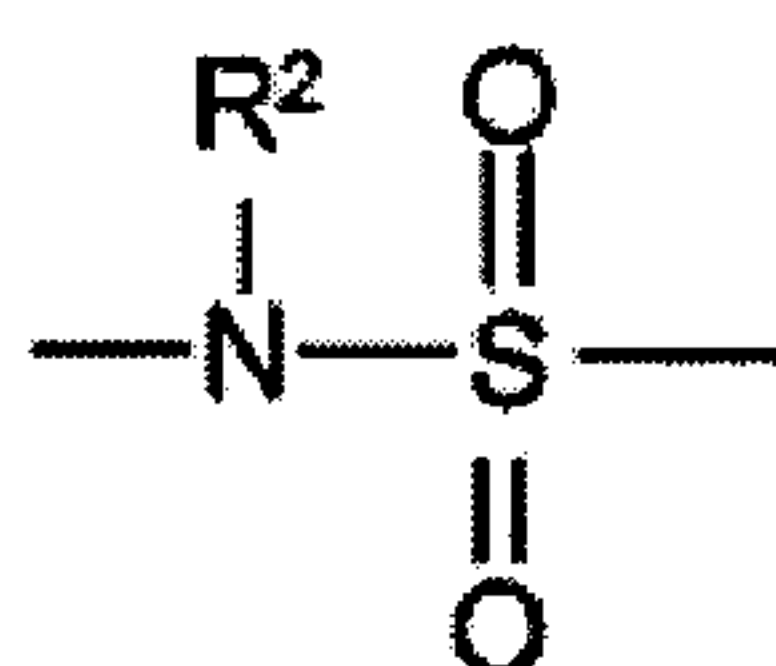
In one aspect, the inhibitor of histone deacetylase activity may be a hydroxamic acid derivative, such as, for example, compounds disclosed in WO2003087066, having the general formula:



- 5 Wherein A is an optionally substituted phenyl or aromatic heterocyclic group which has 1 to 4 substituents selected from the group consisting of a halogen atom, a hydroxyl group, an amino group, a nitro group, a cyano group, an alkyl group having 1 to 4 carbons, an alkoxy group having 1 to 4 carbons, an aminoalkyl group having 1 to 4 carbons, an alkylamino group having 1 to 4 carbons, an acyl group having 1 to 4 carbons, an acylamino group having 1 to 4 carbons, an alkylthio group having 1 to 4 carbons, a perfluoroalkyl group having 1 to 4 carbons, a perfluoroalkoxy group having 1 to 4 carbons, a carboxyl group, an alkoxycarbonyl group having 1 to 4 carbons, a phenyl group, an aromatic heterocyclic group and a heterocyclic group, said heterocyclic group being optionally substituted with an alkyl group having 1 to 4 carbons, a benzyl group, or a pyridylmethyl group; m is an integer of 0 to 4; n is an integer of 1 to 4; X is a moiety having a structure selected from those illustrated in formula

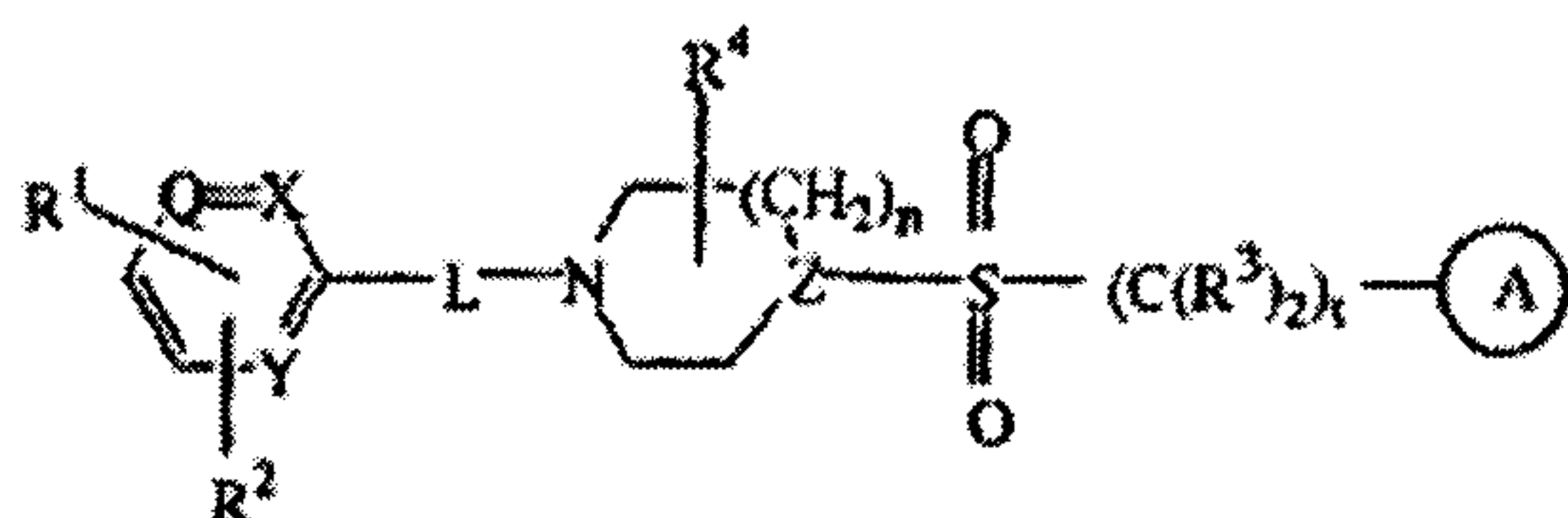


2



R^1 and R^2 are independently H or an optionally substituted alkyl group having 1 to 4 carbons; or a pharmaceutically acceptable salt thereof.

In one aspect, the inhibitor of histone deacetylase activity may be a sulfonyl derivative, such as, for example, compounds disclosed in WO2003076422, having the general formula:



- 5 the N-oxide forms, the pharmaceutically acceptable addition salts and the stereochemically isomeric forms thereof, wherein n is 0, 1, 2, or 3 and when n is 0 then a direct bond is intended; t is 0, 1, 2, 3, or 4 and when t is 0 then a direct bond is intended;

each Q is nitrogen or $-C \equiv$;

each X is nitrogen or $-C \equiv$;

each Y is nitrogen or $-C \equiv$;

each Z is nitrogen or $-CH \equiv$;

R^1 is $-C(O)NR^7R^8$, $-N(H)C(O)R^9$, $-C(O)-C_{1-6}alkanediyISR^9$, $-NR^{10}C(O)N(OH)R^9$, $-NR^{10}C(O)C_{1-6}alkanediyISR^9$, $-NR^{10}C(O)C=N(OH)R^9$ or another Zn chelating group

- 10 wherein R^7 and R^8 are each independently selected from hydrogen, hydroxy, $C_{1-6}alkyl$, hydroxy $C_{1-6}alkyl$, amino $C_{1-6}alkyl$ or aminoaryl; R^9 is independently selected hydrogen, $C_{1-6}alkyl$, $C_{1-6}alkylcarbonyl$, aryl $C_{1-6}alkyl$, $C_{1-6}alkylpyrazinyl$, pyridinone, pyrrolidinone or methylimidazolyl; R^{10} is independently selected hydrogen or $C_{1-6}alkyl$;

- 15 R^2 is hydrogen, halo, hydroxy, amino, nitro, $C_{1-6}alkyl$, $C_{1-6}alkyloxy$, trifluoromethyl, di($C_{1-6}alkyl$)amino, hydroxyamino or naphthalenylsulfonylpyrazinyl;

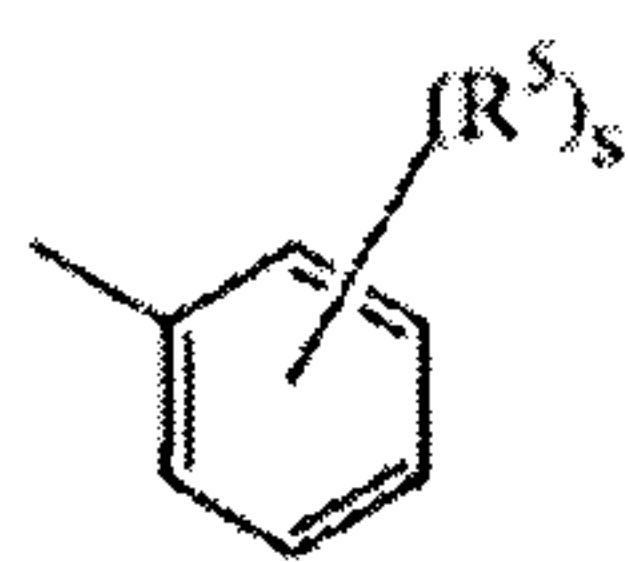
$-L-$ is a direct bond or a bivalent radical selected from $C_{1-6}alkanediyI$, amino, carbonyl or aminocarbonyl;

each R^3 represents a hydrogen atom and one hydrogen atom can be replaced by aryl;

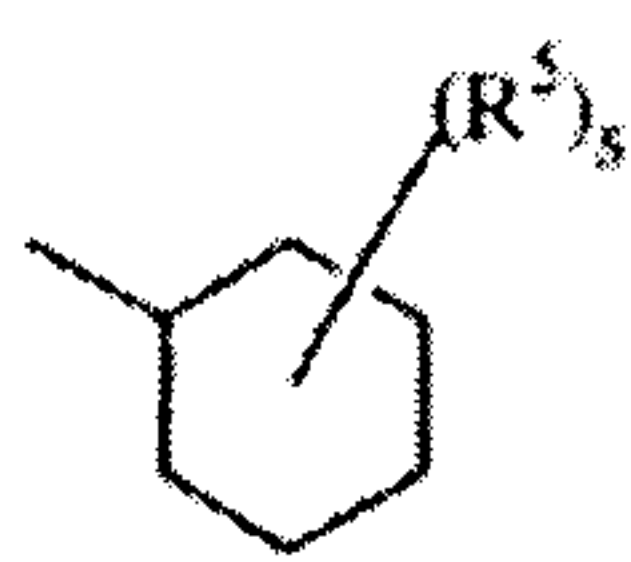
R^4 is hydrogen, hydroxy, amino, hydroxyC₁₋₆alkyl, C₁₋₆alkyl, C₁₋₆alkyloxy, arylC₁₋₆alkyl, aminocarbonyl, hydroxycarbonyl, aminoC₆alkyl, aminocarbonylC₁₋₆alkyl, hydroxycarbonylC₁₋₆alkyl, hydroxyaminocarbonyl, C₁₋₆alkyloxycarbonyl, C₁₋₆alkylaminoC₁₋₆alkyl or di(C₁₋₆alkyl)aminoC₁₋₆alkyl;



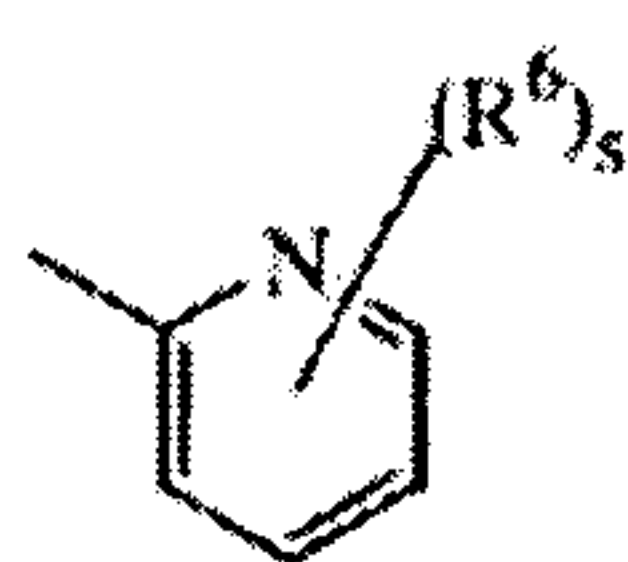
is a radical selected from



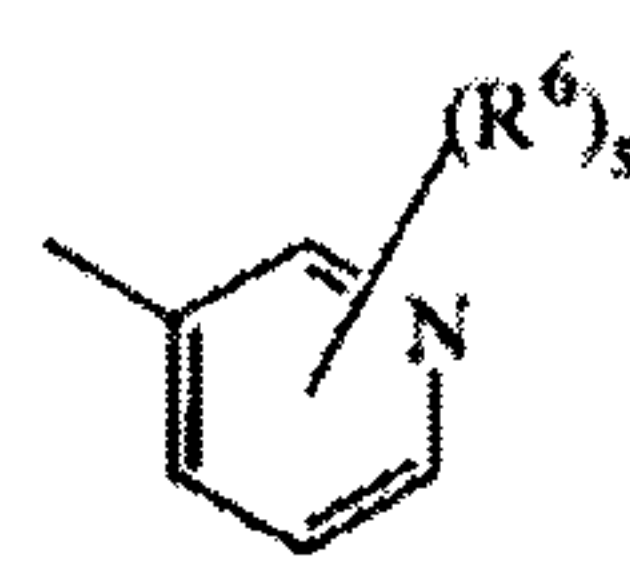
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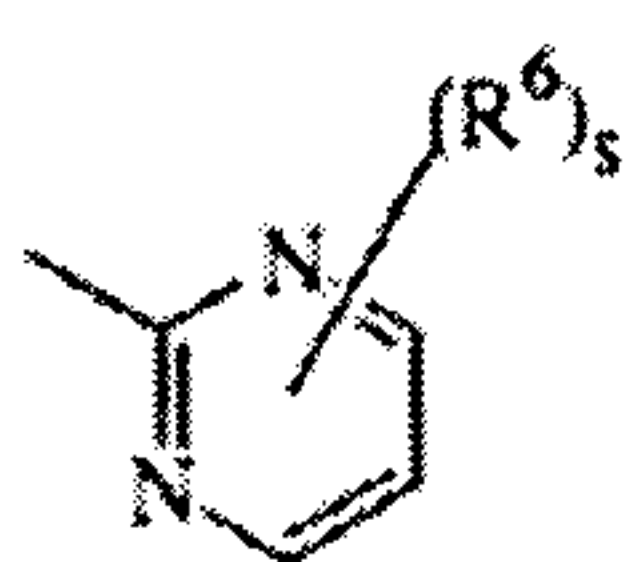
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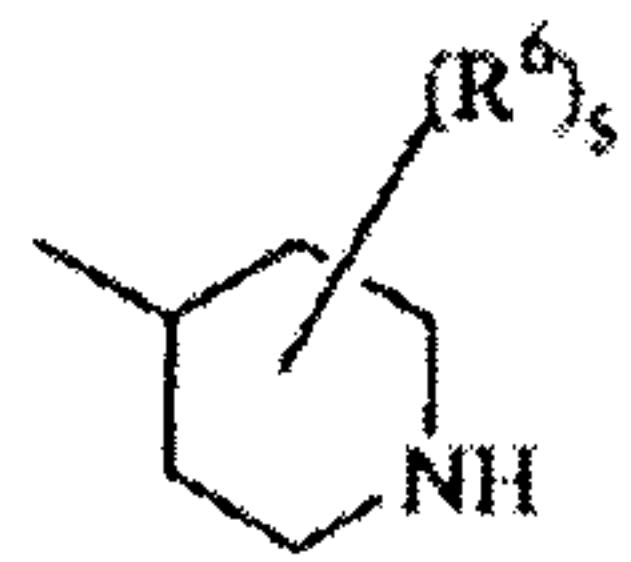
(a-3)



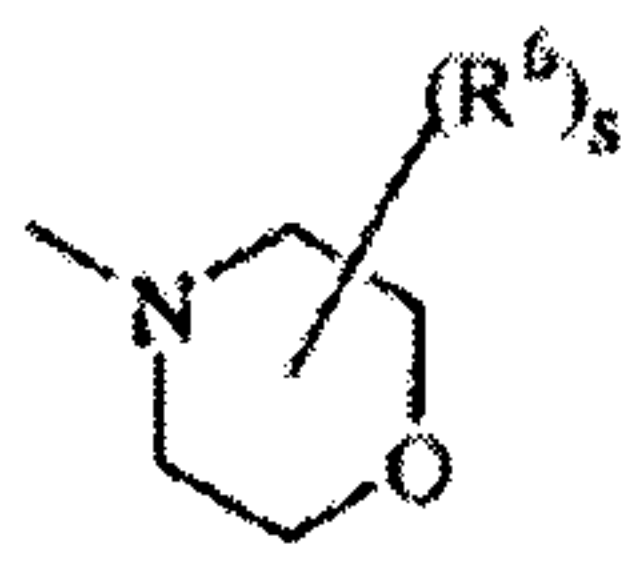
(a-4)



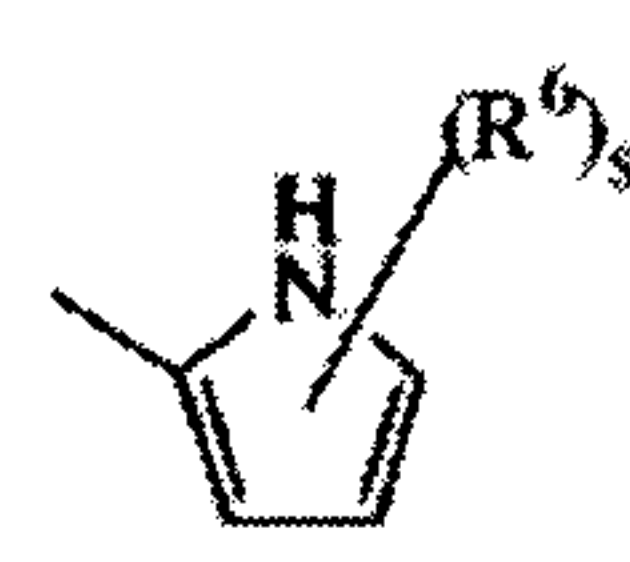
(a-5)



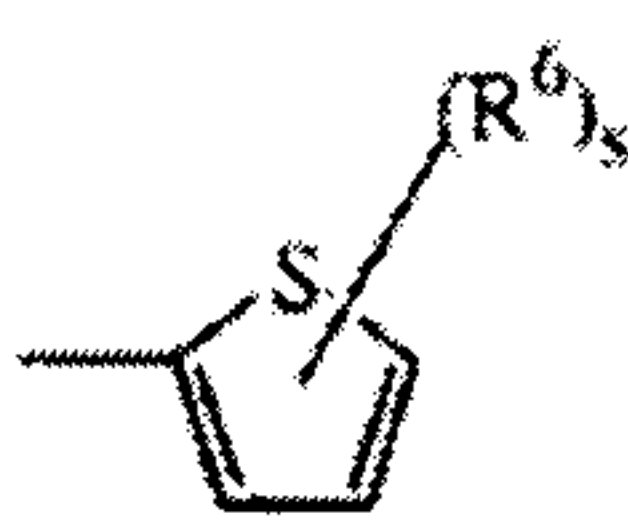
(a-6)



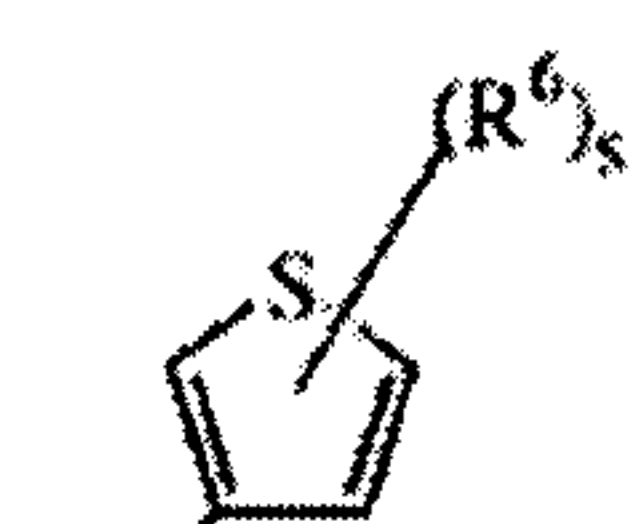
(a-7)



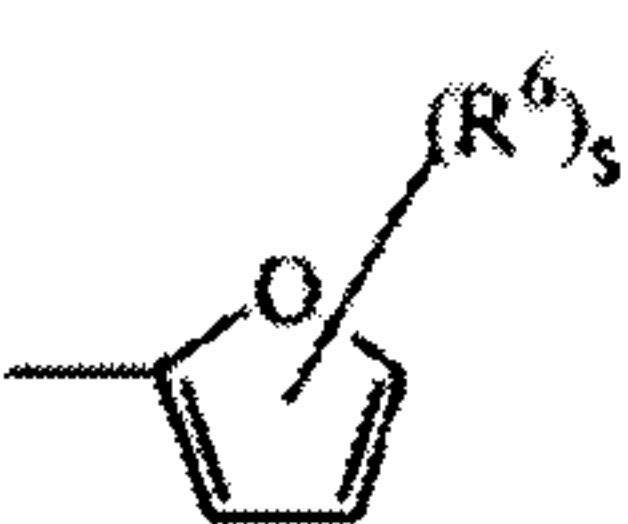
(a-8)



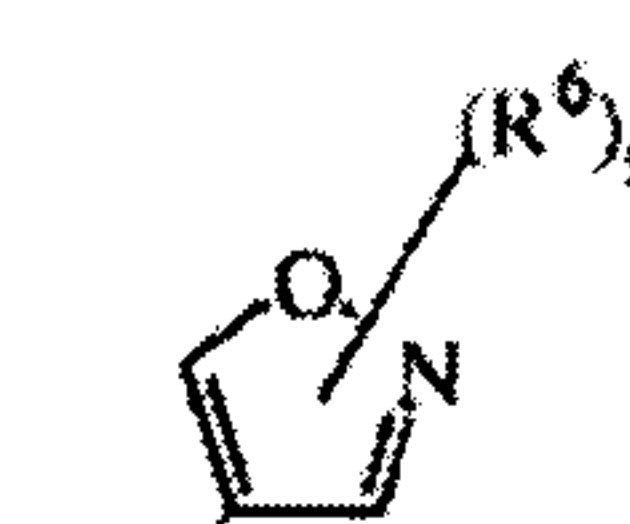
(a-9)



(a-10)



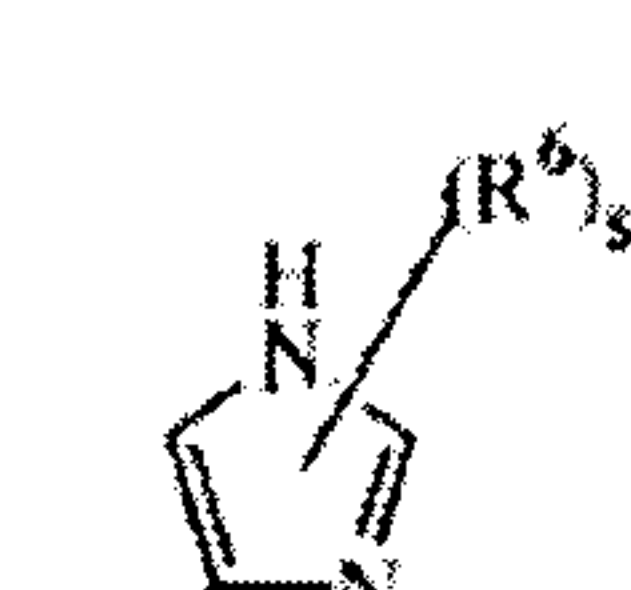
(a-11)



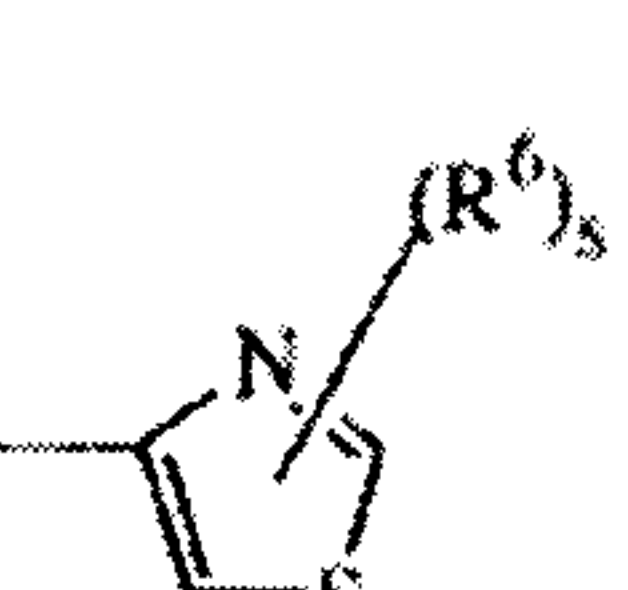
(a-12)



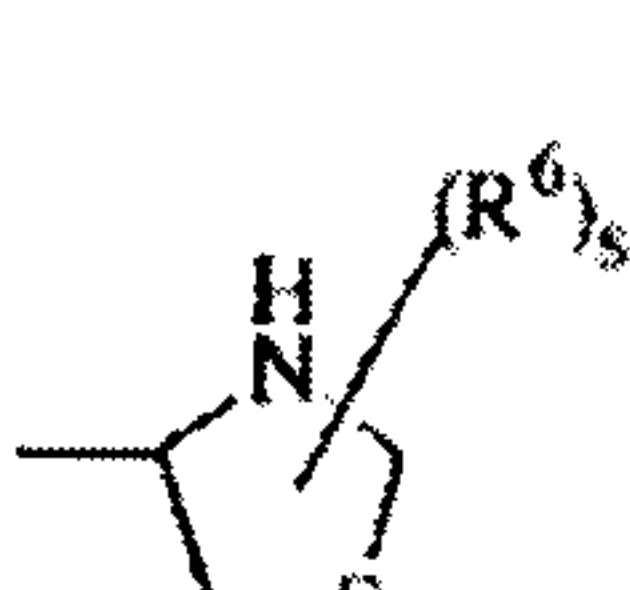
(a-13)



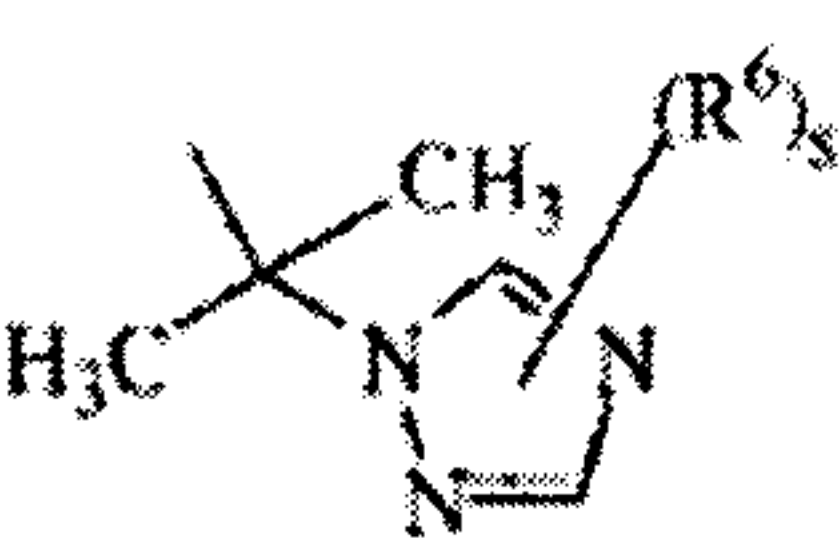
(a-14)



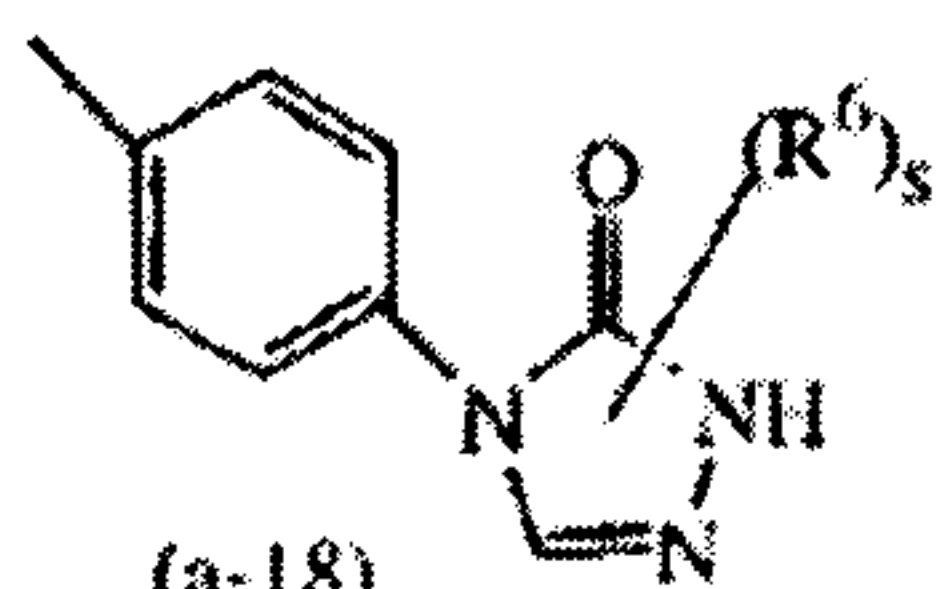
(a-15)



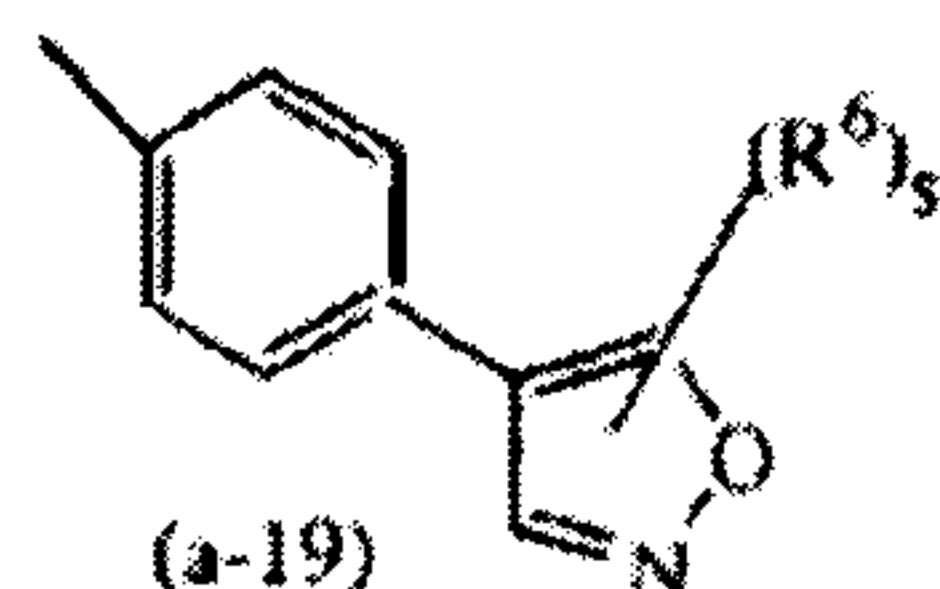
(a-16)



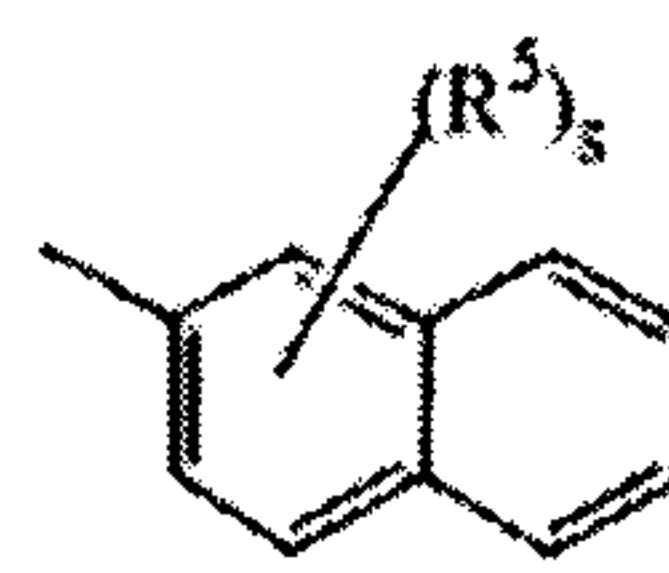
(a-17)



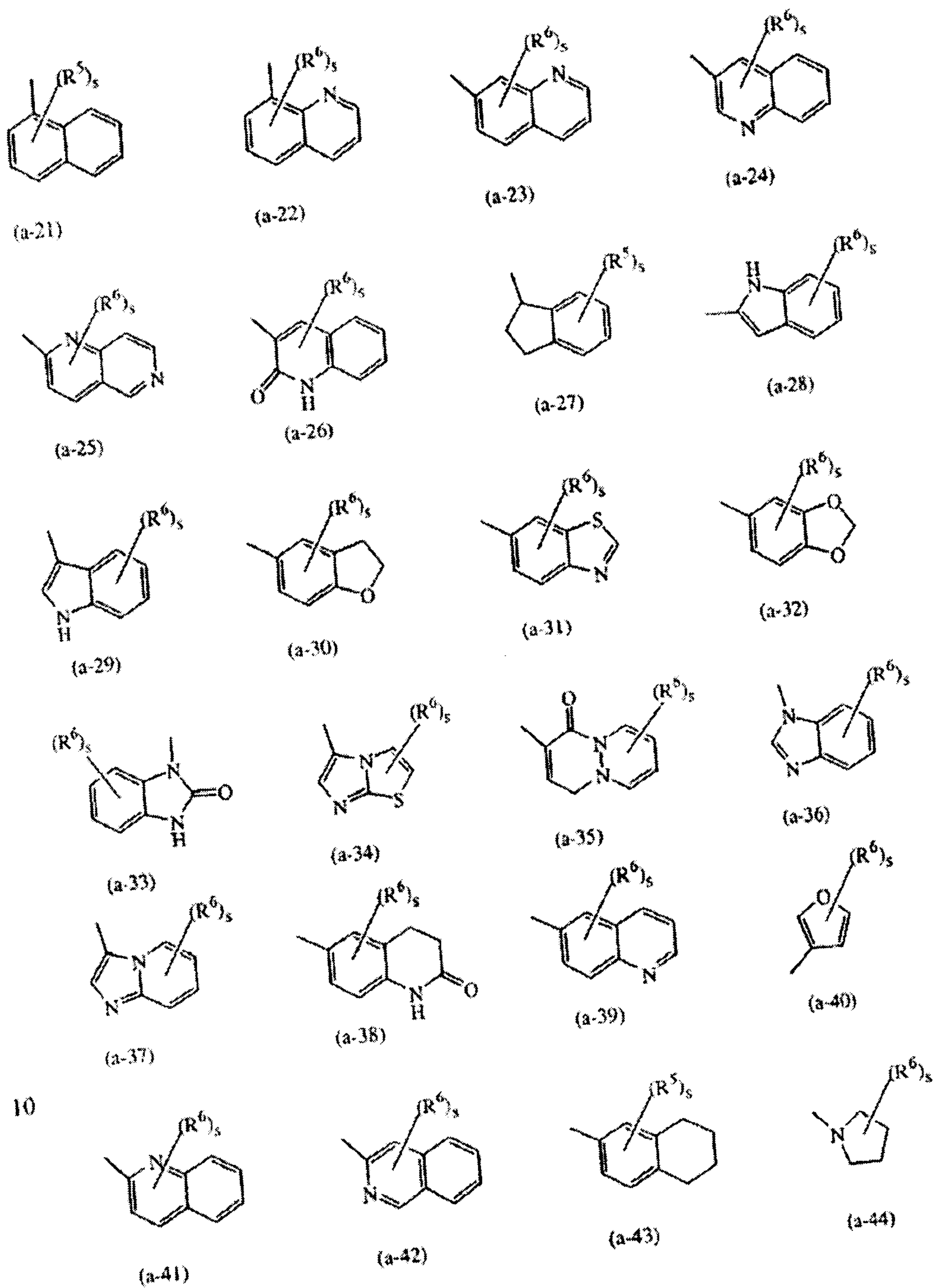
(a-18)

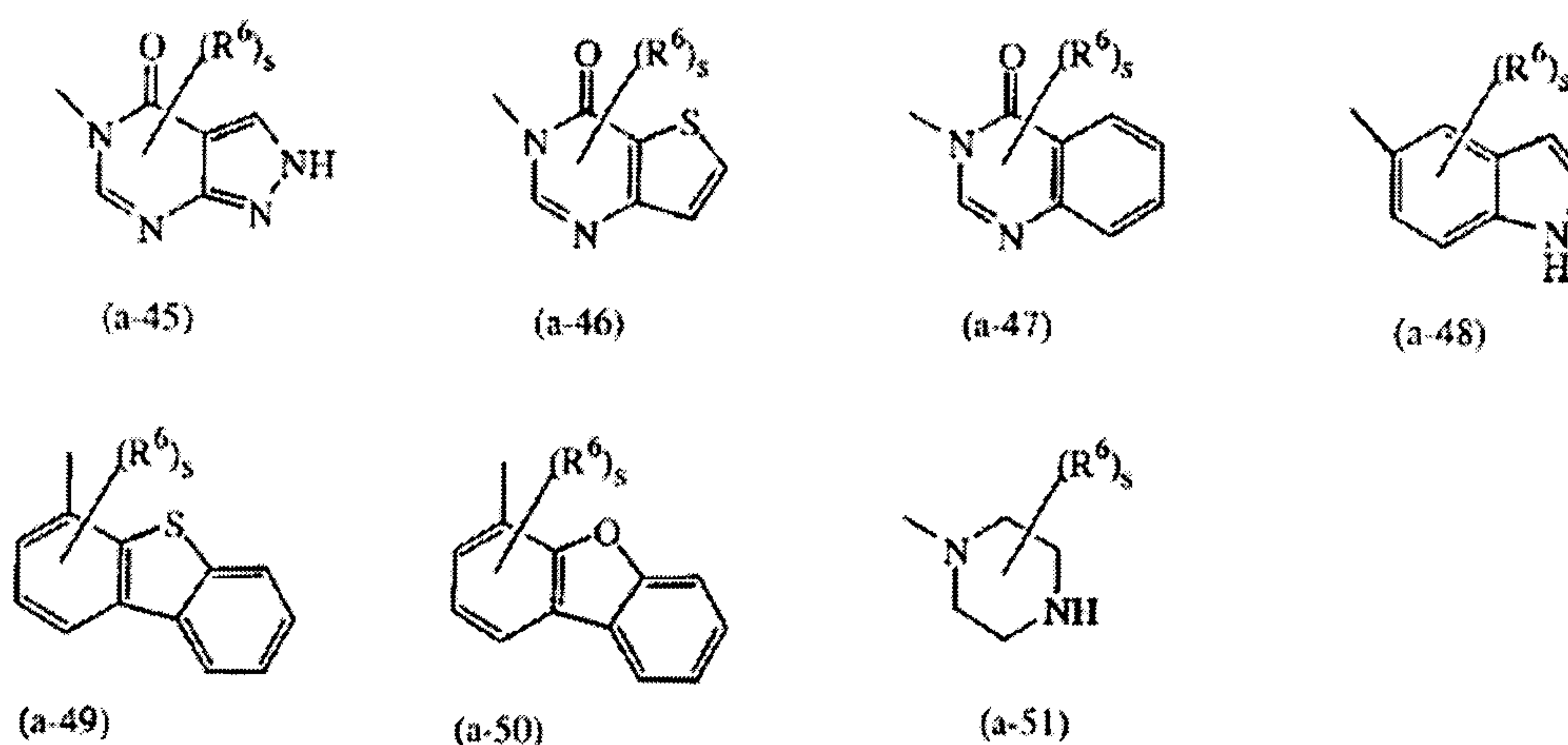


(a-19)



(a-20)





wherein each s is independently 0, 1, 2, 3, 4 or 5;

- each R^5 and R^6 are independently selected from hydrogen; halo; hydroxy; amino; nitro; trihaloC₁₋₆alkyl; trihaloC₁₋₆alkyloxy; C₁₋₆alkyl; C₁₋₆alkyl substituted with aryl and C₃₋₁₀cycloalkyl; C₁₋₆alkyloxy; C₁₋₆alkyloxyC₁₋₆alkyloxy; C₁₋₆alkylcarbonyl; C₁₋₆alkyloxycarbonyl; C₁₋₆alkylsulfonyl; cyanoC₁₋₆alkyl; hydroxyC₁₋₆alkyl; hydroxyC₁₋₆alkyloxy; hydroxyC₁₋₆alkylamino; aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminocarbonyl; di(hydroxyC₁₋₆alkyl)amino; (aryl)(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminoC₁₋₆alkylamino; di(C₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; arylsulfonyl; arylsulfonylamino; aryloxy; aryloxyC₁₋₆alkyl; arylC₂₋₆alkenediyl; di(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl; aminosulfonylamino(C₁₋₆alkyl)amino; aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; cyano; thiophenyl; thiophenyl substituted with di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, di(C₁₋₆alkyl)aminoC₁₋₆alkyl, C₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, di(C₁₋₆alkyl)aminosulfonylpiperazinylC₁₋₆alkyl, C₁₋₆alkyloxypiperidinyl, C₁₋₆alkyloxypiperidinylC₁₋₆alkyl, morpholinylC₁₋₆alkyl, hydroxyC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, or di(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkyl; furanyl; furanyl

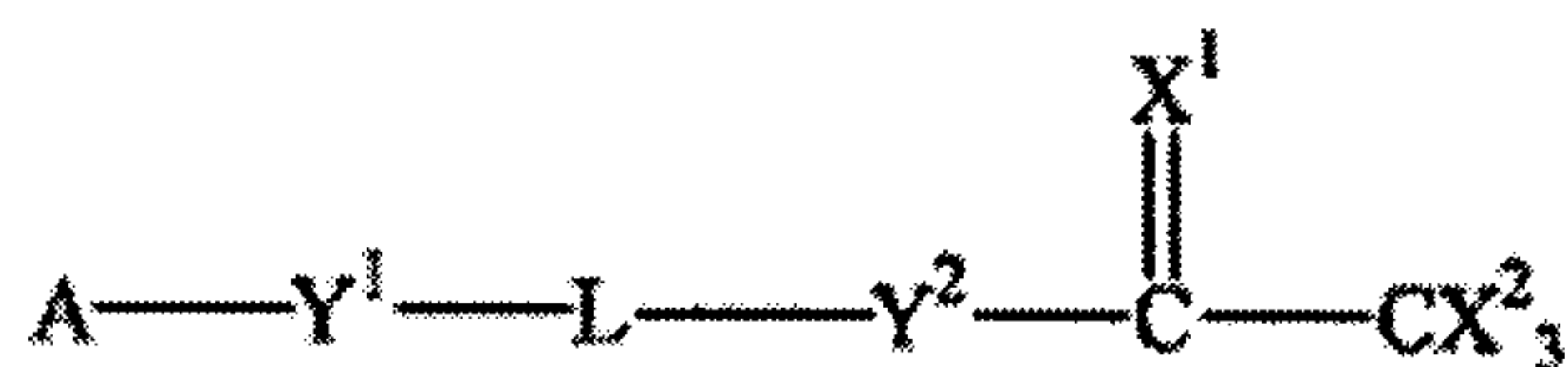
substituted with hydroxyC₁₋₆alkyl; benzofuranyl; imidazolyl; oxazolyl; oxazolyl
substituted with aryl and C₁₋₆alkyl; C₁₋₆alkyltriazolyl; tetrazolyl; pyrrolidinyl; pyrrolyl;
piperidinylC₁₋₆alkyloxy; morpholinyl; C₁₋₆alkylmorpholinyl; morpholinylC₁₋₆alkyloxy;
morpholinylC₁₋₆alkyl; morpholinylC₁₋₆alkylamino; morpholinylC₁₋₆alkylaminoC₁₋₆alkyl;
5 piperazinyl; C₁₋₆alkylpiperazinyl; C₁₋₆alkylpiperazinylC₁₋₆alkyloxy; piperazinylC₁₋₆alkyl;
naphtalenylsulfonylpiperazinyl; naphtalenylsulfonylpiperidinyl; naphtalenylsulfonyl: C₁₋₆
alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkylpiperazinylC₁₋₆alkylamino; C₁₋₆alkylpiperazinylC₁₋₆
alkylaminoC₁₋₆alkyl; C₁₋₆alkylpiperazinylsulfonyl; aminosulfonylpiperazinylC₁₋₆
alkyloxy; aminosulfonylpiperazinyl; aminosulfonylpiperazinylC₁₋₆alkyl; di(C₁₋₆alkyl)
10 aminosulfonylpiperazinyl; di(C₁₋₆alkyl)aminosulfonylpiperazinylC₁₋₆alkyl; hydroxyC₁₋₆
alkylpiperazinyl; hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkyloxypiperidinyl; C₁₋₆
alkyloxypiperidinylC₁₋₆alkyl; piperidinylaminoC₁₋₆alkylamino; piperidinylaminoC₁₋₆
alkylaminoC₁₋₆alkyl; (C₁₋₆alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylamino; (C₁₋₆
alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; hydroxyC₁₋₆
15 alkyloxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl;
(hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)amino; (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl) aminoC₁₋₆alkyl;
hydroxyC₁₋₆alkylaminoC₁₋₆alkyl; di(hydroxyC₁₋₆alkyl) aminoC₁₋₆alkyl; pyrrolidinylC₁₋₆
alkyl; pyrrolidinylC₁₋₆alkyloxy; pyrazolyl; thiopyrazolyl; pyrazolyl substituted with two
substituents selected from C₁₋₆alkyl or trihaloC₁₋₆alkyl; pyridinyl; pyridinyl substituted
20 with C₁₋₆alkyloxy, aryloxy or aryl; pyrimidinyl; tetrahydropyrimidinylpiperazinyl;
tetrahydropyrimidinylpiperazinylC₁₋₆alkyl; quinolinyl; indolyl; phenyl; phenyl substituted
with one, two or three substituents independently selected from halo, amino, nitro, C₁₋₆
alkyl, C₁₋₆alkyloxy, hydroxyC₁₋₄alkyl, trifluoromethyl, trifluoromethyloxy, hydroxyC₁₋₄
alkyloxy, C₁₋₄alkylsulfonyl, C₁₋₄alkyloxyC₁₋₄alkyloxy, C₁₋₄alkyloxycarbonyl, aminoC₁₋₄
25 alkyloxy, di(C₁₋₄alkyl)aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)amino, di(C₁₋₄
alkyl)aminocarbonyl, di(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄
alkyl, di(C₁₋₄alkyl)amino(C₁₋₄alkyl) amino, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)aminoC₁₋₄alkyl,
di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄
alkyl)aminoC₁₋₄alkyl, aminosulfonylamino(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄
30 alkyloxyC₁₋₄alkyl, di(C₁₋₄alkyl)aminosulfonylamino(C₁₋₄alkyl)amino, di(C₁₋₄
alkyl)aminosulfonylamino(C₁₋₄alkyl)aminoC₁₋₆alkyl, cyano, piperidinylC₁₋₄alkyloxy,

pyrrolidinylC₁₋₄alkyloxy, aminosulfonylpiperazinyl, aminosulfonylpiperazinylC₁₋₄alkyl, di(C₁₋₄alkyl) aminosulfonylpiperazinyl, di(C₁₋₄alkyl)aminosulfonylpiperazinylC₁₋₄alkyl, hydroxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkyloxypiperidinyl, C₁₋₄alkyloxypiperidinylC₁₋₄alkyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)amino, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(hydroxyC₁₋₄alkyl)amino, di(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkyl, furanyl, furanyl substituted with -CH=CH-CH=CH-, pyrrolidinylC₁₋₄alkyl, pyrrolidinylC₁₋₄alkyloxy, morpholinyl, morpholinylC₁₋₄alkyloxy, morpholinylC₁₋₄alkyl, morpholinylC₁₋₄alkylamino, morpholinylC₁₋₄alkylaminoC₁₋₄alkyl, piperazinyl, C₁₋₄alkylpiperazinyl, C₁₋₄alkylpiperazinylC₁₋₄alkyloxy, piperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkylamino, C₁₋₄alkylpiperazinylC₁₋₄alkylaminoC₁₋₆alkyl, tetrahydropyrimidinylpiperazinyl, tetrahydropyrimidinylpiperazinylC₁₋₄alkyl, piperidinylaminoC₁₋₄alkylamino, piperidinylaminoC₁₋₄alkylaminoC₁₋₄alkyl, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylamino, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄alkyl, pyridinylC₁₋₄alkyloxy, hydroxyC₁₋₄alkylamino, hydroxyC₁₋₄alkylaminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylamino, aminothiadiazolyl, aminosulfonylpiperazinylC₁₋₄alkyloxy, or thiophenylC₁₋₄alkylamino;



the central moiety may also be bridged (i.e. forming a bicyclic moiety) with a methylene, ethylene or propylene bridge; each R⁵ and R⁶ can be placed on the nitrogen in replacement of the hydrogen; aryl in the above is phenyl, or phenyl substituted with one or more substituents each independently selected from halo, C₁₋₆alkyl, C₁₋₆alkyloxy, trifluoromethyl, cyano or hydroxycarbonyl.

In one aspect, the inhibitor of histone deacetylase activity may be a trihalomethylcarbonyl compound, such as, for example, compounds disclosed in WO2003099760, having the general formula:



wherein A is a cyclic moiety selected from the group consisting of C₃₋₁₄cycloalkyl, 3-14 membered heterocycloalkyl, C₄₋₁₄cycloalkenyl, 3-8 membered heterocycloalkenyl, aryl, and heteroaryl; the cyclic moiety being optionally substituted with alkyl, alkenyl, alkynyl, alkoxy, hydroxyl, hydroxylalkyl, halo, haloalkyl, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, alkylcarbonyloxy, alkyloxycarbonyl, alkylcarbonyl, alkylsulfonylamino, aminosulfonyl, or alkylsulfonyl; or A is a saturated branched C₃₋₁₂ hydrocarbon chain or an unsaturated branched C₃₋₁₂ hydrocarbon chain optionally interrupted by -O-, -S-, -N(R^a)-, -C(O)-, -N(R^a)-SO₂-, -SO₂-N(R^a)-, -N(R^a)-C(O)-O-, -O-C(O)-N(R^a)-, -N(R^a)-C(O)-N(R^b)-, -O-C(O)-, -C(O)-O-, -O-SO₂-, -SO₂-O-, or -O-C(O)-O-, where each of R^a and R^b, characterized independently, is hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; each of the saturated and the unsaturated branched hydrocarbon chain being optionally substituted with alkyl, alkenyl, alkynyl, alkoxy, hydroxyl, hydroxylalkyl, halo, haloalkyl, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, alkylcarbonyloxy, alkyloxycarbonyl, alkylcarbonyl, alkylsulfonylamino, aminosulfonyl, or alkylsulfonyl;

each of Y¹ and Y², independently, is -O-, -S-, -N(R^c)-, -N(R^c)-C(O)-O-, -N(R^c)-C(O)-, -C(O)-N(R^c)-, -O-C(O)-N(R^c)-, -N(R^c)-C(O)-N(R^d)-, -O-C(O)-O-, or a bond;

each of R^c and R^d, independently, being hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; L is a straight C₃₋₁₂ hydrocarbon chain optionally containing at least one double bond, at least one triple bond, or at least one double bond and one triple bond; the hydrocarbon chain being optionally substituted with C₁₋₄alkyl, C₂₋₄alkenyl, C₂₋₄alkynyl, C₁₋₄alkoxy, hydroxyl, halo, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, nitro, cyano, C₃₋₅cycloalkyl, 3-5 membered heterocycloalkyl, monocyclic aryl, 5-6 membered heteroaryl, C₁₋₄alkylcarbonyloxy, C₁₋₄alkyloxycarbonyl, C₁₋₄alkylcarbonyl, or formyl; and further being optionally interrupted by -O-, -N(R^e)-, -N(R^e)-C(O)-O-, -O-C(O)-N(R^e)-, -N(R^e)-C(O)-N(R^f)-, or -O-C(O)-O-; each of R^e and

R^f , independently, being hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl, and X^1 is O or S; X^2 is a halogen; provided that when Y^1 and Y^2 are each a bond, L is a C_{6-12} hydrocarbon chain containing at least one double bond at C1, C2, C3 or C5 of the hydrocarbon chain from $C=X^1$, at least one triple bond, or at least one double bond and one triple bond, the hydrocarbon chain being optionally substituted with C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} alkoxy, hydroxyl, halo, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, nitro, cyano, C_{3-5} cycloalkyl, 3-5 membered heterocycloalkyl, monocyclic characterized aryl, 5-6 membered heteroaryl, C_{1-4} alkylcarbonyloxy, C_{1-4} alkyloxycarbonyl, C_{1-4} alkylcarbonyl, or formyl; and further being optionally interrupted by -O-, -N(R^e)-, -N(R^e)-C(O)-O-, -O-C(O)-N(R^e)-, -N(R^e)-C(O)-N(R^f)-, or -O-C(O)-O-; each of R^e and R^f , independently, being hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; or a salt thereof.

In one aspect, the inhibitor of histone deacetylase activity may be an α -chalcogenmethylcarbonyl compound, such as, for example, compounds disclosed in WO2003099789, having the general formula:



wherein A is a cyclic moiety selected from the group consisting of C_{3-14} cycloalkyl, 3-14 membered heterocycloalkyl, C_{4-14} cycloalkenyl, 3-8 membered heterocycloalkenyl, aryl, and heteroaryl; the cyclic moiety being optionally substituted with alkyl, alkenyl, alkynyl, alkoxy, hydroxyl, hydroxylalkyl, halo, haloalkyl, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, alkylcarbonyloxy, alkyloxycarbonyl, alkylcarbonyl, alkylsulfonylamino, aminosulfonyl, or alkylsulfonyl; or A is a saturated branched C_{3-12} hydrocarbon chain or an unsaturated branched C_{3-12} hydrocarbon chain optionally interrupted by -O-, -S-, -N(R^a)-, -C(O)-, -N(R^a)-SO₂-, -SO₂-N(R^a)-, -N(R^a)-C(O)-O-, -O-C(O)-N(R^a)-, -N(R^a)-C(O)-N(R^b)-, -O-C(O)-, -C(O)-O-, -O-SO₂-, -SO₂-O-, or -O-C(O)-O-, where each of R^a and R^b , characterized independently, is hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; each of the saturated and the

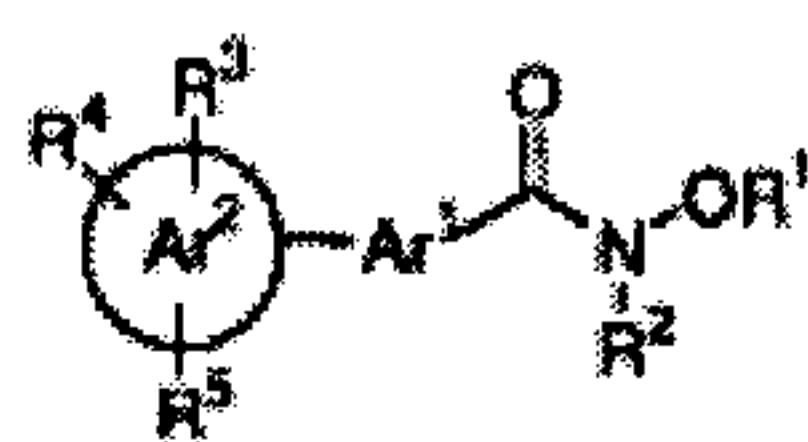
unsaturated branched hydrocarbon chain being optionally substituted with alkyl, alkenyl, alkynyl, alkoxy, hydroxyl, hydroxylalkyl, halo, haloalkyl, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, alkylcarbonyloxy, alkyloxycarbonyl, alkylcarbonyl, alkylsulfonylamino, aminosulfonyl, or alkylsulfonyl; each of Y^1 and Y^2 , independently, is

5 -CH₂-, -O-, -S-, -N(R^c)-, -N(R^c)-C(O)-O-, -N(R^c)-C(O)-, -C(O)-N(R^c)-, -O-C(O)-N(R^c)-, -N(R^c)-C(O)-N(R^d)-, -O-C(O)-O-, or a bond; each of R^c and R^d independently, being hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; L is a straight C₃₋₁₂ hydrocarbon chain optionally containing at least one double bond, at least one triple bond, or at least one double bond and one triple bond; the hydrocarbon chain

10 being optionally substituted with C₁₋₄alkyl, C₂₋₄alkenyl, C₂₋₄alkynyl, C₁₋₄alkoxy, hydroxyl, halo, amino, thio, alkylthio, arylthio, aralkylthio, acylthio, nitro, cyano, C₃₋₅cycloalkyl, 3-5 membered heterocycloalkyl, monocyclic aryl, 5-6 membered heteroaryl, C₁₋₄alkylcarbonyloxy, C₁₋₄alkyloxycarbonyl, C₁₋₄alkylcarbonyl, or formyl; and further being optionally interrupted by -O-, -N(R^e)-, -N(R^e)-C(O)-O-, -O-C(O)-N(R^e)-, -N(R^e)-C(O)-N(R^f)-, or -O-C(O)-O-; each of R^e and R^f independently, being hydrogen, alkyl,

15 alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; X¹ is O or S.; and X² is -OR, -SR¹, or -SeR¹, wherein R is hydrogen, alkyl, acyl, aryl or aralkyl; provided that when Y¹ is a bond and L is saturated, the carbon adjacent to Y¹ is not substituted with C₁₋₄alkoxy or hydroxyl; or a salt thereof.

20 In one aspect, the inhibitor of histone deacetylase activity may be bicyclic hydroxamate derivative, such as, for example, compounds disclosed in WO2003066579, having the general formula:

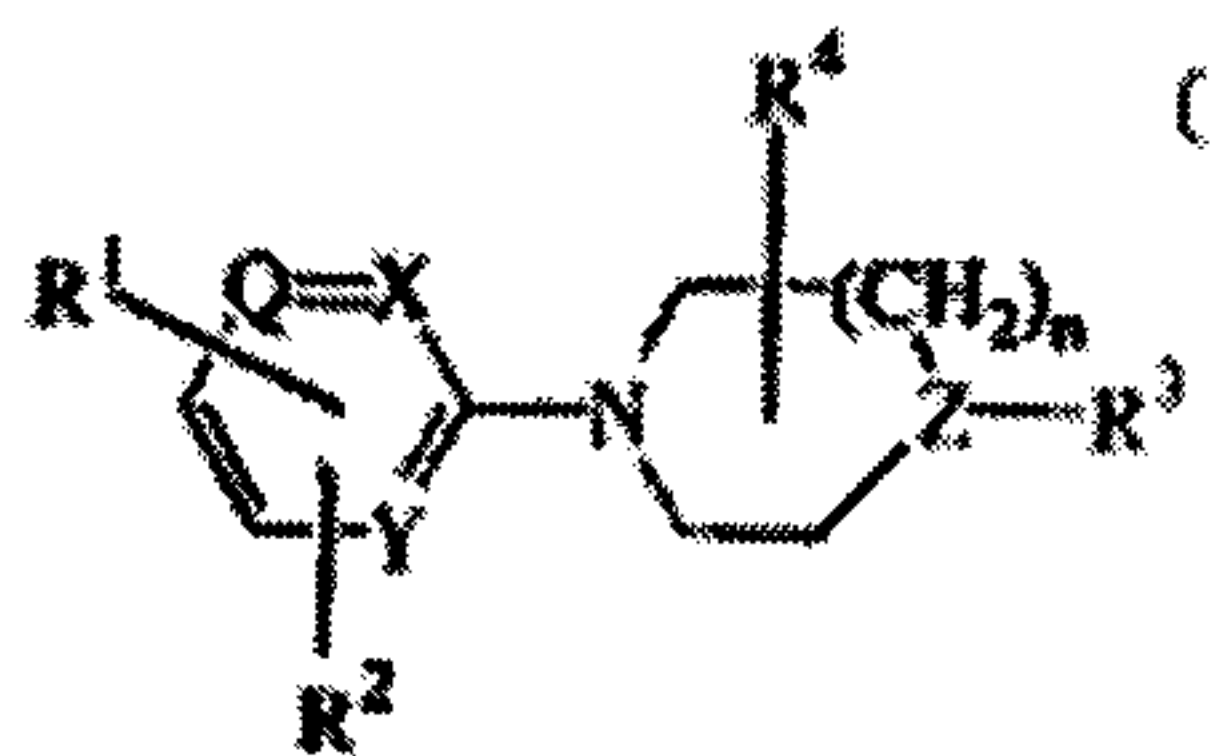


Wherein R¹ is hydrogen or alkyl; R² is hydrogen; Ar¹ is phenylene or a six membered heteroarylene ring containing one or two nitrogen ring atoms, the rest of the ring atoms being carbon; wherein said Ar¹ group is optionally substituted with one or two groups independently selected from alkyl, halo, hydroxy, alkoxy, haloalkoxy, or haloalkyl; Ar² is

25

aryl, benzimidazol-2-yl, cycloalkyl or heterocycloalkyl; R^3 is hydrogen, alkyl, halo,
 hydroxy, or alkoxy; and R^4 and R^5 are independently selected from the group consisting
 of hydrogen, alkyl, halo, haloalkyl, nitro, cyano, carboxy, carboxyalkyl, alkoxycarbonyl,
 optionally substituted phenyl, optionally substituted heteroaryl, optionally substituted
 5 heterocycloalkyl, cycloalkyl, heterocycloaminoalkyl, $-X-R^6$, or $-(C_{1-6}\text{alkylene})-Y-R^7$
 where X and Y are independently $-O-$, $-S-$, $-SO-$, $-SO_2-$, $-NR^8-$, $-CO-$, $-NR^9CO-$, $-CONR^{10}-$,
 $-NR^{11}SO_2-$, $-SO_2NR^{12}-$, $-NHC(O)O-$, $-OC(O)NH-$, $-NR^{13}CONR^{14}-$, or $-NR^{15}SO_2NR^{16}-$
 where R^6 and R^7 are independently hydrogen, alkyl, hydroxyalkyl, optionally substituted
 phenyl, optionally substituted heteroaryl, optionally substituted heterocycloalkyl,
 10 cycloalkyl, optionally substituted phenylalkyl, optionally substituted phenoxyalkyl,
 optionally substituted phenylalkenyl, optionally substituted phenylaminoalkyl, optionally
 substituted heteroaralkyl, optionally substituted heteroaryloxyalkyl, optionally substituted
 heterocycloalkylalkyl, or cycloalkylalkyl, R^8 , R^9 , R^{11} , R^{13} , and R^{15} are independently
 hydrogen, alkyl, hydroxyalkyl, alkoxyalkyl, or optionally substituted phenylalkyl; R^{10} ,
 15 R^{12} , R^{14} , and R^{16} are independently hydrogen, alkyl, optionally substituted phenylalkyl,
 alkoxy, hydroxyalkyl, haloalkyl, alkoxyalkyl, carboxyalkyl, cyanoalkyl, aminoalkyl,
 aminocarbonylalkyl, alkylaminocarbonylalkyl, dialkylaminocarbonylalkyl, or acyl or R^4
 and R^5 together form methylenedioxy; and individual isomers, mixtures of isomers; or a
 pharmaceutically acceptable salt thereof provided that: (i) at least one of R^3 , R^4 and R^5 is
 20 not hydrogen; (ii) when Ar^2 is cycloalkyl, then at least two of R^3 , R^4 and R^5 are
 hydrogen; (iii) when R^1 and R^3 are hydrogen, Ar^1 is phenylene and Ar^2 is phenyl, and one
 of R^4 and R^5 is methoxy, then the other of R^4 and R^5 is not $-OR^6$ where R^6 is S
 cyclopentyl or phenylpentyl; (iv) when Ar^1 is phenylene and Ar^2 is phenyl then at least
 one of R^3 , R^4 and R^5 is not alkyl; (v) when Ar^1 is phenylene, Ar^2 is aryl and is located at
 25 the 3-position of the phenylene ring, then Ar^2 is not substituted with an optionally
 substituted phenyl; (vi) when Ar^1 is phenylene and Ar^2 is phenyl, and R^4 or R^5 is $-$
 $CONR^{10}R^6$ or $-(C_{1-6}\text{alkylene})-CONR^{10}R^7$ then said R^4 or R^5 is not located at the 4-
 position of the phenyl ring; and (vii) when Ar^1 is phenylene and Ar^2 is phenyl and two of
 R^3 , R^4 and R^5 are hydrogen, then the remaining of R^3 , R^4 and R^5 is not nitro.

In one aspect, the inhibitor of histone deacetylase activity may be a compound of the general formula:



the *N*- oxide forms, the pharmaceutically acceptable addition salts and the stereo
 5 chemically isomeric forms thereof, wherein *n* is 0, 1, 2 or 3 and when *n* is 0 then a direct bond is intended;

each Q is nitrogen or ;

each X is nitrogen or ;

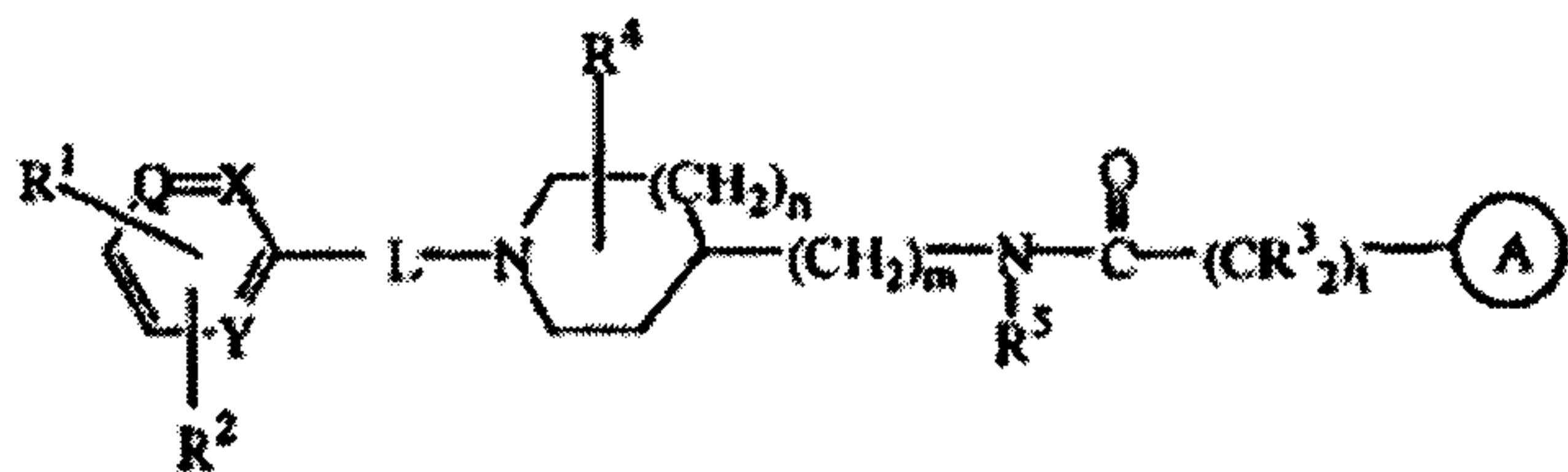
each Y is nitrogen or ;

each Z is nitrogen or ;

R^1 is $-C(O)NR^5R^6$, $-N(H)C(O)R^7$, $-C(O)-C_{1-6}alkanediyISR^7$, $-NR^8C(O)N(OH)R^7$, $-NR^8C(O)C_{1-6}alkanediyISR^7$, $-NR^8C(O)C=N(OH)R^7$ or another Zn- chelating-group wherein R^5 and R^6 are each independently selected from hydrogen, hydroxy, $C_{1-6}alkyl$,
 10 hydroxy $C_{1-6}alkyl$, amino $C_{1-6}alkyl$ or aminoaryl; R^7 is independently selected from hydrogen, $C_{1-6}alkyl$, $C_{1-6}alkylcarbonyl$, aryl $C_{1-6}alkyl$, $C_{1-6}alkylpyrazinyl$, pyridinone, pyrrolidinone or methylimidazolyl; R^8 is independently selected from hydrogen or $C_{1-6}alkyl$; R^2 is hydrogen, halo, hydroxy, amino, nitro, $C_{1-6}alkyl$, $C_{1-6}alkyloxy$, trifluoromethyl, di($C_{1-6}alkyl$)amino, hydroxyamino or naphtalenylsulfonylpyrazinyl; R^3 is
 15 hydrogen, $C_{1-6}alkyl$, aryl $C_{2-6}alkenediyI$, furanylcarbonyl, naphtalenylcarbonyl, $-C(O)phenylR^9$, $C_{1-6}alkylaminocarbonyl$, aminosulfonyl, arylaminosulfonyl, aminosulfonylamino, di($C_{1-6}alkyl$)aminosulfonylamino, arylaminosulfonylamino, aminosulfonylamino $C_{1-6}alkyl$, di($C_{1-6}alkyl$)aminosulfonylamino $C_{1-6}alkyl$, arylaminosulfonylamino $C_{1-6}alkyl$, di($C_{1-6}alkyl$)amino $C_{1-6}alkyl$, $C_{1-12}alkylsulfonyl$, di($C_{1-6}alkyl$)aminosulfonyl, trihalo $C_{1-6}alkylsulfonyl$, di(aryl) $C_{1-6}alkylcarbonyl$, thiophenyl C_{1-}
 20

₆alkylcarbonyl, pyridinylcarbonyl or arylC₁₋₆alkylcarbonyl wherein each R⁹ is independently selected from phenyl; phenyl substituted with one, two or three substituents independently selected from halo, amino, C₁₋₆alkyl, C₁₋₆alkyloxy, hydroxyC₁₋₄alkyl, hydroxyC₁₋₄alkyloxy, aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)aminoC₁₋₄alkyloxy, di(C₁₋₆alkyl)aminoC₁₋₆alkyl, di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, hydroxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkyloxypiperidinylC₁₋₄alkyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinyl, C₁₋₄alkylpiperazinylC₁₋₄alkyl, di(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkyl, pyrrolidinylC₁₋₄alkyloxy, morpholinylC₁₋₄alkyloxy, or morpholinylC₁₋₄alkyl; thiophenyl; or thiophenyl substituted with di(C₁₋₄alkyl)aminoC₁₋₄alkyloxy, di(C₁₋₆alkyl)aminoC₁₋₆alkyl, di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, pyrrolidinylC₁₋₄alkyloxy, C₁₋₄alkylpiperazinylC₁₋₄alkyl, di(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkyl or morpholinylC₁₋₄alkyloxy. R⁴ is hydrogen, hydroxy, amino, hydroxyC₁₋₆alkyl, C₁₋₆alkyl, C₁₋₆alkyloxy, arylC₁₋₆alkyl, aminocarbonyl, hydroxycarbonyl, aminoC₁₋₆alkyl, aminocarbonylC₁₋₆alkyl, hydroxycarbonylC₁₋₆alkyl, hydroxyaminocarbonyl, C₁₋₆alkyloxycarbonyl, C₁₋₆alkylaminoC₁₋₆alkyl or di(C₁₋₆alkyl)aminoC₁₋₆alkyl; when R³ and R⁴ are present on the same carbon atom, R³ and R⁴ together may form a bivalent radical of formula -C(O)-NH-CH₂-NR¹⁰-, wherein R¹⁰ is hydrogen or aryl; when R³ and R⁴ are present on adjacent carbon atoms, R³ and R⁴ together may form a bivalent radical of formula =CH-CH=CH-CH=; aryl in the above is phenyl, or phenyl substituted with one or more substituents each independently selected from halo, C₁₋₆alkyl, C₁₋₆alkyloxy, trifluoromethyl, cyano or hydroxycarbonyl. See for example, compounds disclosed in WO2003075929.

In one aspect, the inhibitor of histone deacetylase activity may be a carbonylamino derivative, such as, for example, compounds disclosed in WO2003076395, having the general formula:



the *N*-oxide forms, the pharmaceutically acceptable addition salts and the stereochemically isomeric forms thereof, wherein *n* is 0, 1, 2 or 3 and when *n* is 0 then a direct bond is intended; *m* is 0 or 1 and when *m* is 0 then a direct bond is intended; *t* is 0, 1, 2, 3 or 4 and when *t* is 0 then a direct bond is intended;

each *Q* is nitrogen or ;

each *X* is nitrogen or ;

each *Y* is nitrogen or ;

- 5 R^1 is $-C(O)NR^8R^9$, $-NHC(O)R^{10}$, $-C(O)-C_{1-6}alkanediyISR^{10}$, $-NR^{11}C(O)N(OH)R^{10}$, $-NR^{11}C(O)C_{1-6}alkanediyISR^{10}$, $-NR^{11}C(O)C=N(OH)R^{10}$ or another Zn-chelating group wherein R^8 and R^9 are each independently selected from hydrogen, hydroxy, $C_{1-6}alkyl$, hydroxy $C_{1-6}alkyl$, amino $C_{1-6}alkyl$ or aminoaryl; R^{10} is hydrogen, $C_{1-6}alkyl$, $C_{1-6}alkylcarbonyl$, aryl $C_{1-6}alkyl$, $C_{1-6}alkylpyrazinyl$, pyridinone, pyrrolidinone or
- 10 methylimidazolyl; R^{11} is hydrogen or $C_{1-6}alkyl$; R^2 is hydrogen, halo, hydroxy, amino, nitro, $C_{1-6}alkyl$, $C_{1-6}alkyloxy$, trifluoromethyl, di($C_{1-6}alkyl$)amino, hydroxyamino or naphthalenylsulfonylpyrazinyl; $-L-$ is a direct bond or a bivalent radical selected from $C_{1-6}alkanediyI$, $C_{1-6}alkanediyloxy$, amino, carbonyl or aminocarbonyl; each R^3 independently represents a hydrogen atom and one hydrogen atom can be replaced by a
- 15 substituent selected from aryl; R^4 is hydrogen, hydroxy, amino, hydroxy $C_{1-6}alkyl$, $C_{1-6}alkyl$, $C_{1-6}alkyloxy$, aryl $C_{1-6}alkyl$, aminocarbonyl, hydroxycarbonyl, amino $C_{1-6}alkyl$, aminocarbonyl $C_{1-6}alkyl$, hydroxycarbonyl $C_{1-6}alkyl$, hydroxyaminocarbonyl, $C_{1-6}alkyloxycarbonyl$, $C_{1-6}alkylaminoC_{1-6}alkyl$ or di($C_{1-6}alkyl$)amino $C_{1-6}alkyl$; R^5 is hydrogen, $C_{1-6}alkyl$, $C_{3-10}cycloalkyl$, hydroxy $C_{1-6}alkyl$, $C_{1-6}alkyloxyC_{1-6}alkyl$, di($C_{1-6}alkyl$)amino $C_{1-6}alkyl$ or aryl;
- 20



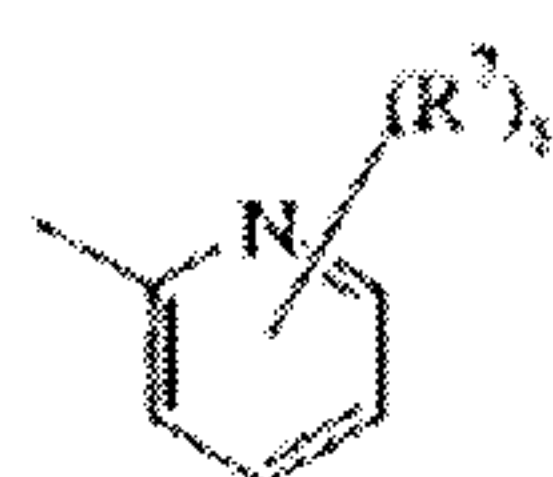
is a radical selected from



(a-1)



(a-2)



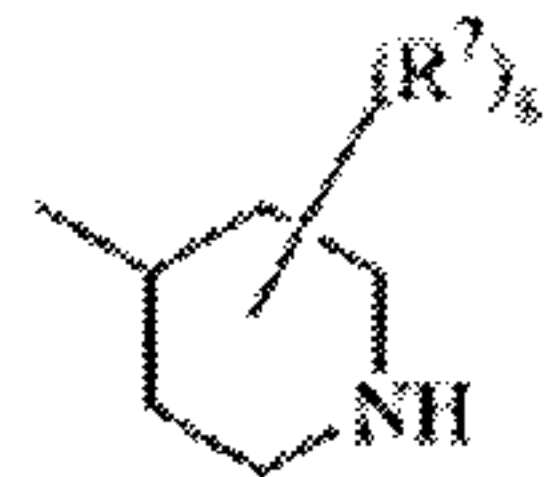
(a-3)



(a-4)



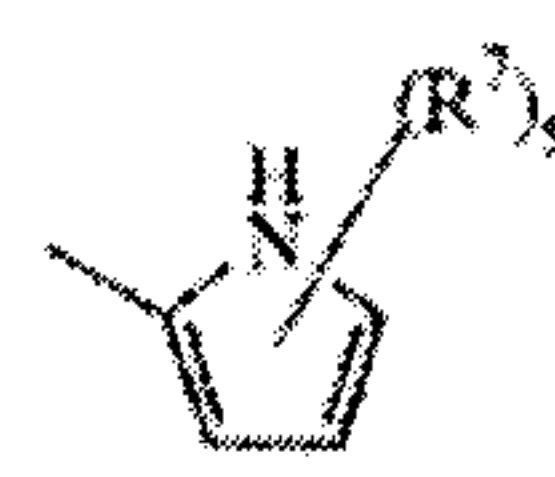
(a-5)



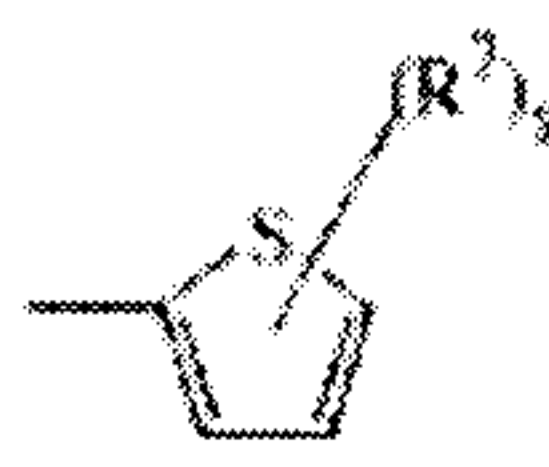
(a-6)



(a-7)



(a-8)



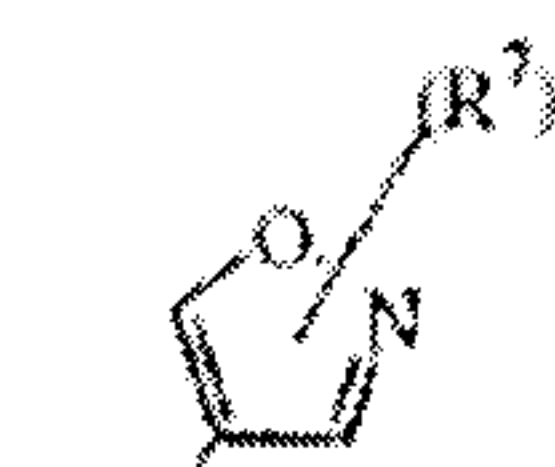
(a-9)



(a-10)



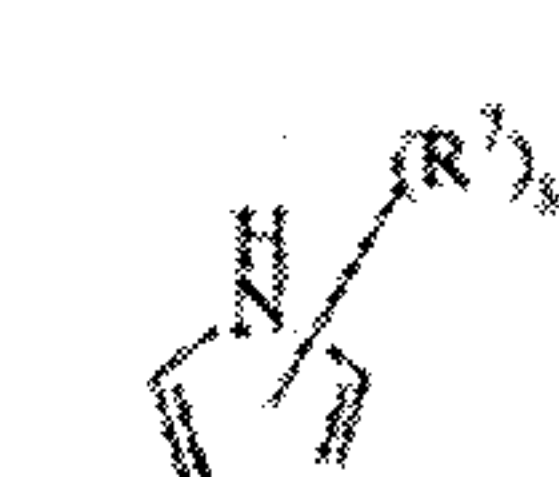
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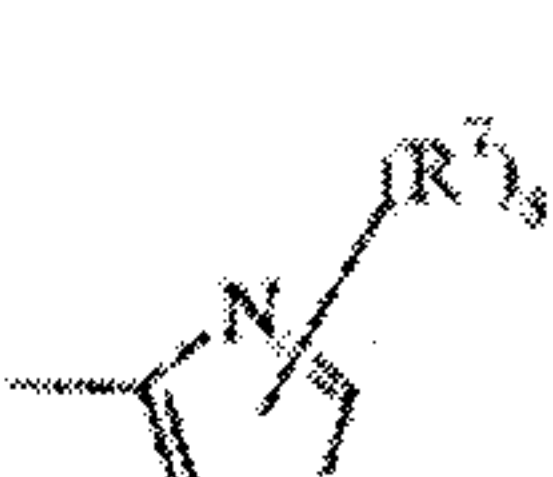
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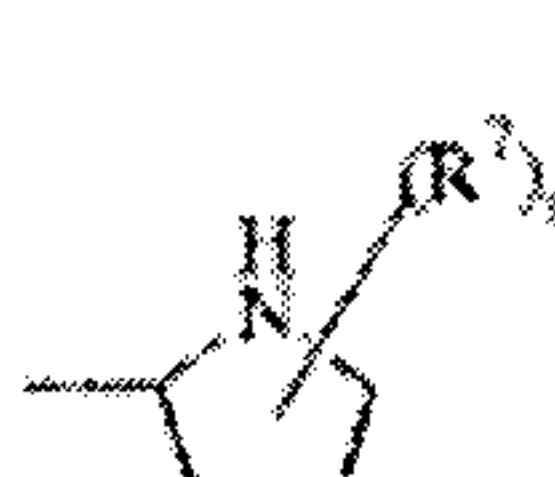
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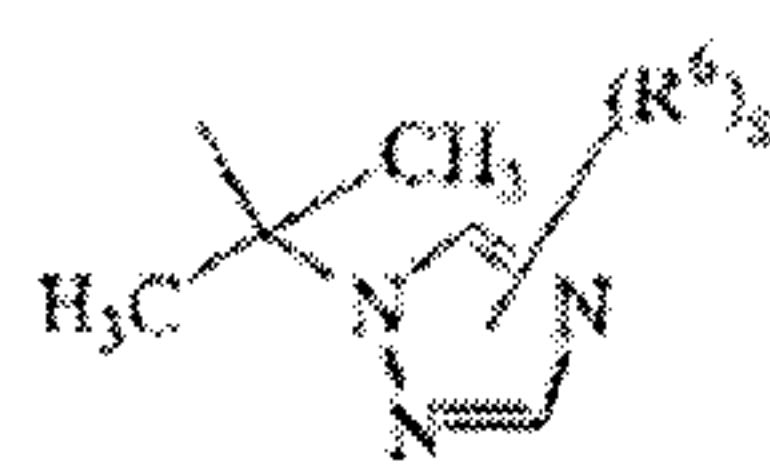
(a-14)



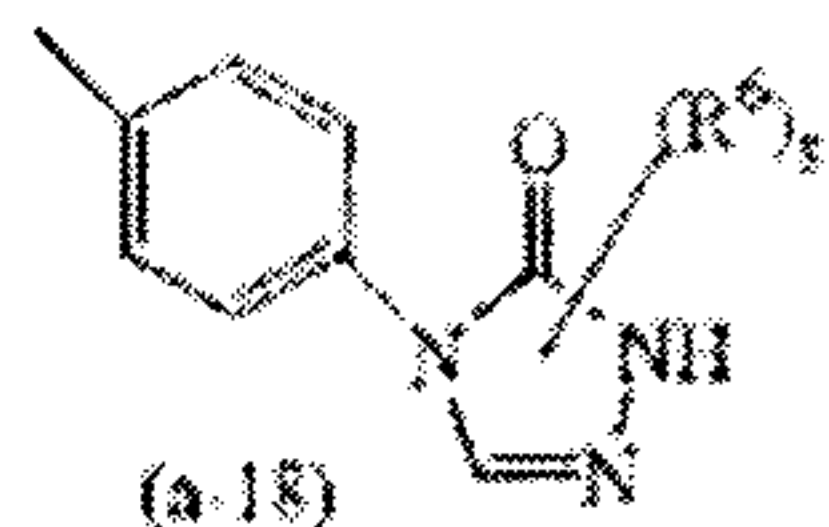
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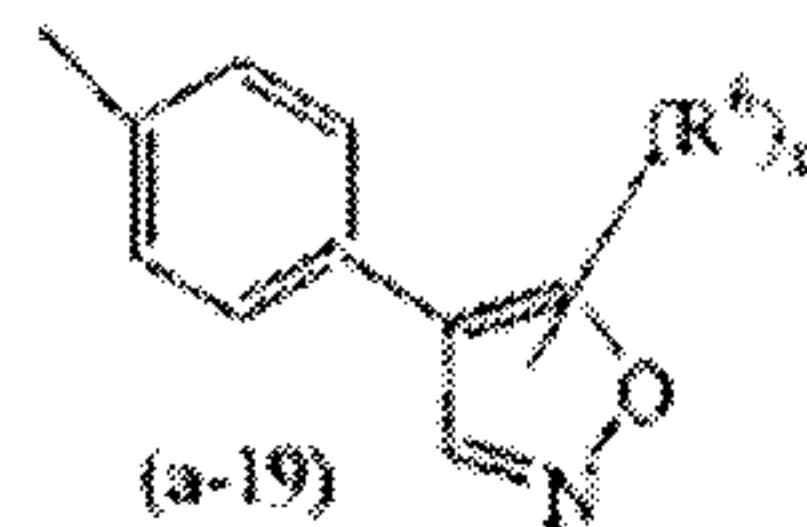
(a-16)



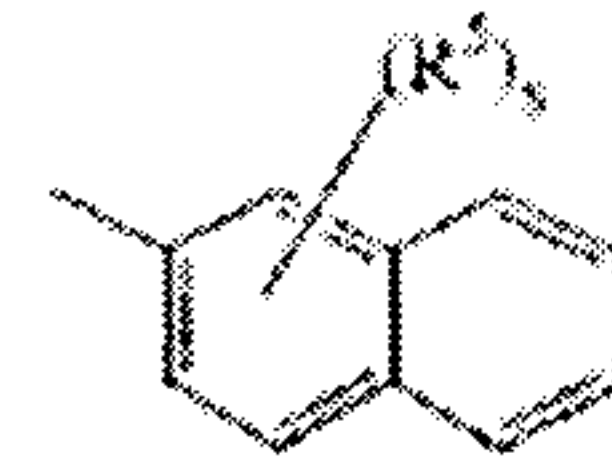
(a-17)



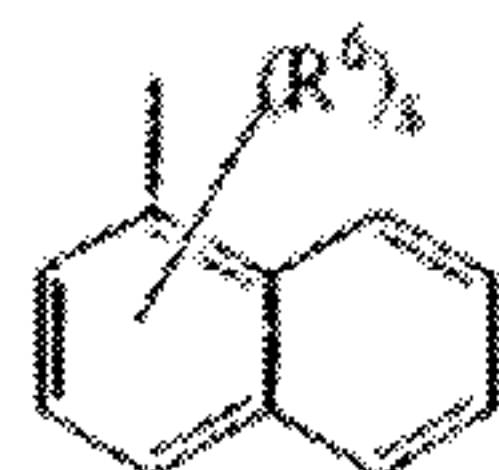
(a-18)



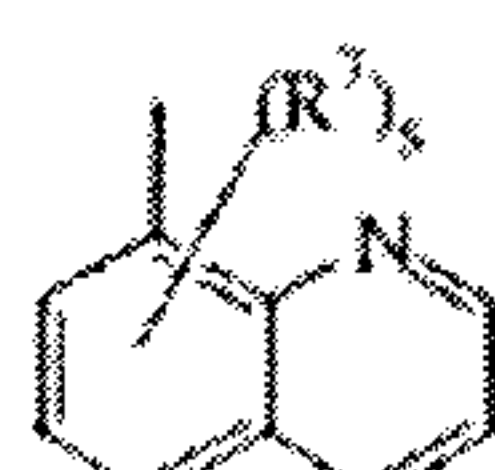
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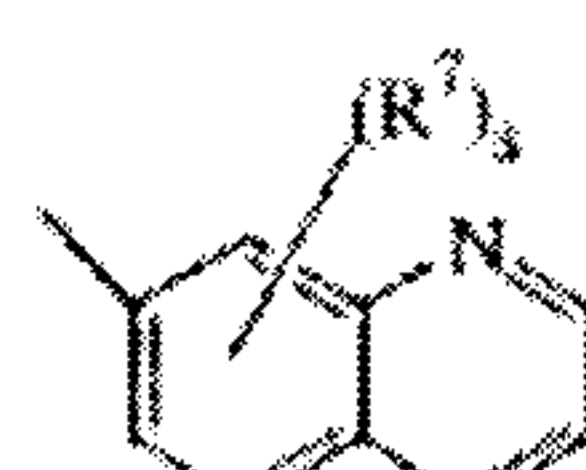
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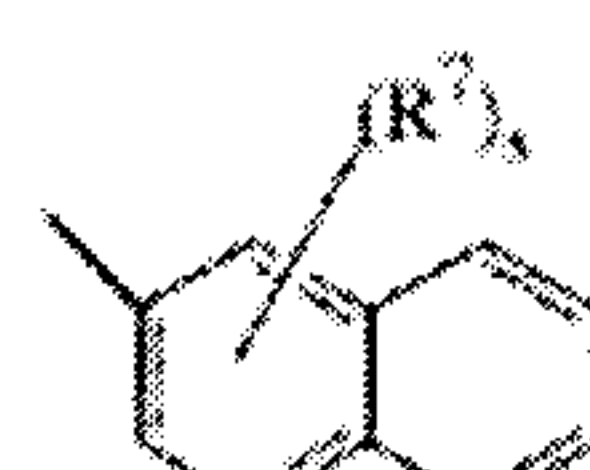
(a-21)



(a-22)



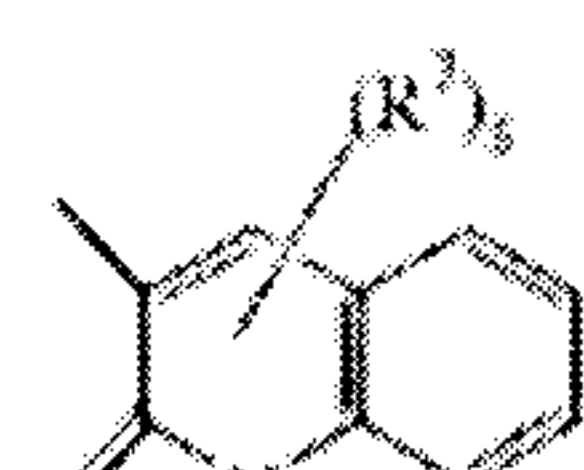
(a-23)



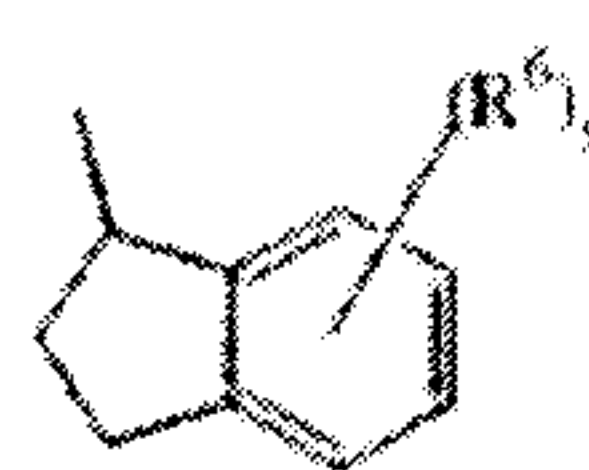
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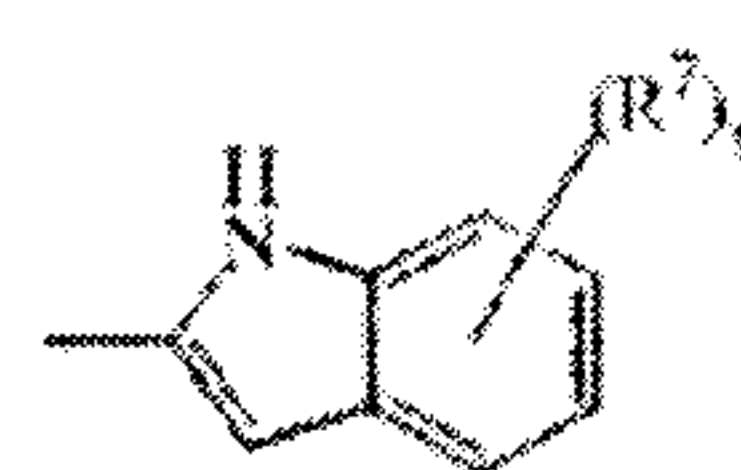
(a-25)



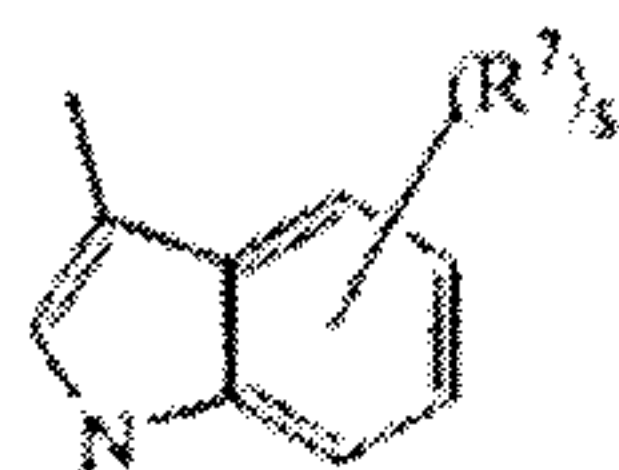
(a-26)



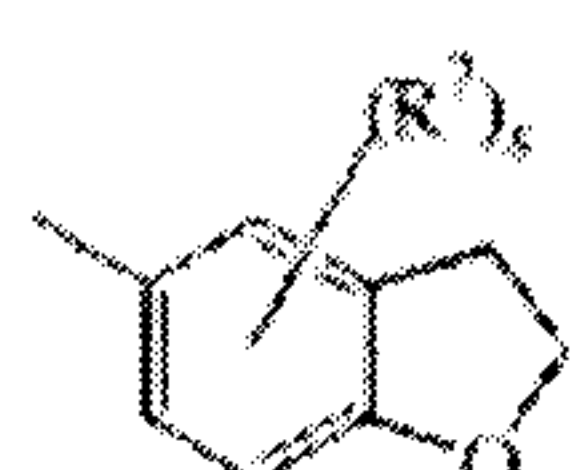
(a-27)



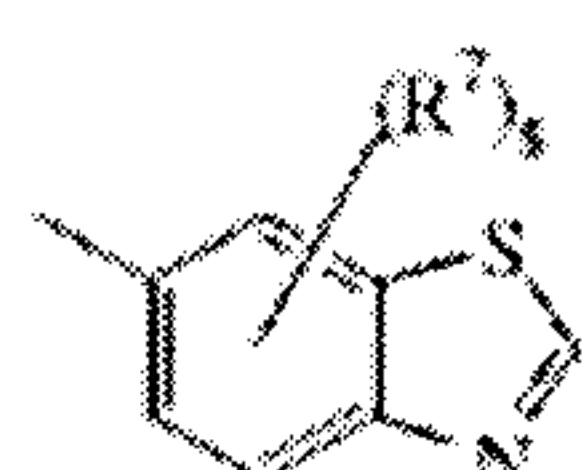
(a-28)



(a-29)



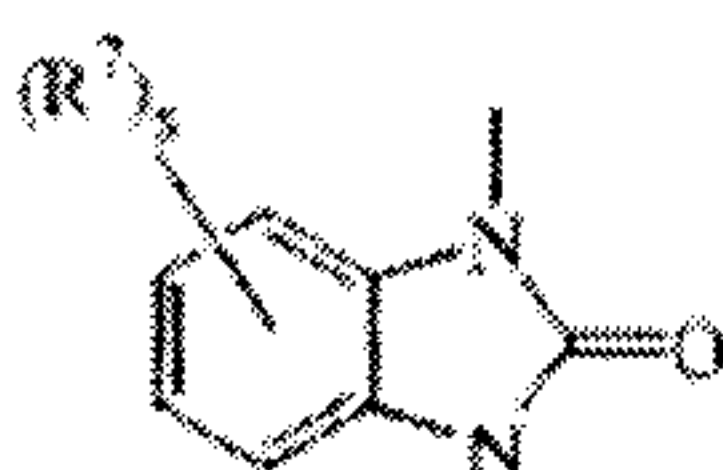
(a-30)



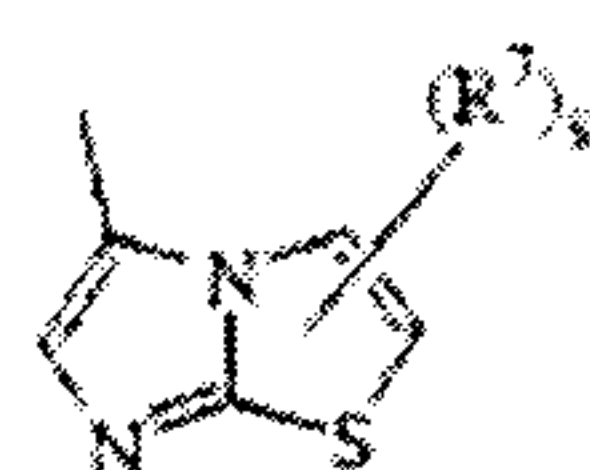
(a-31)



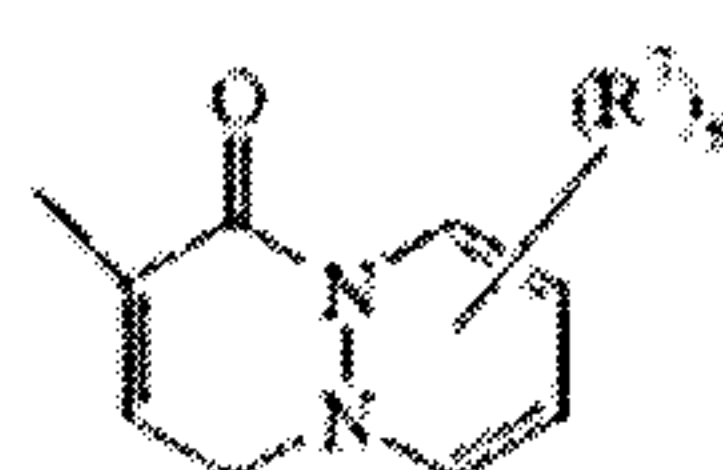
(a-32)



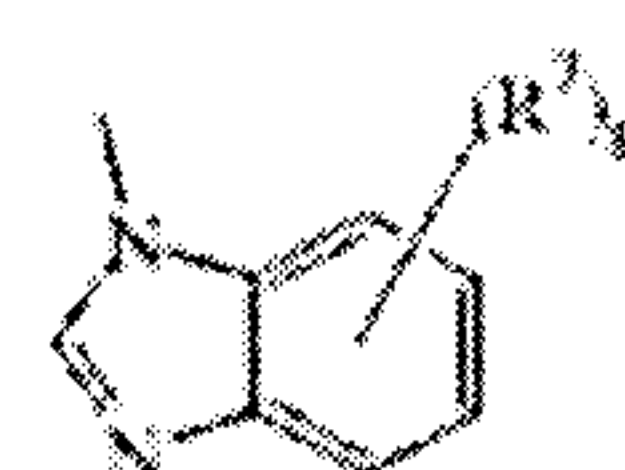
(a-33)



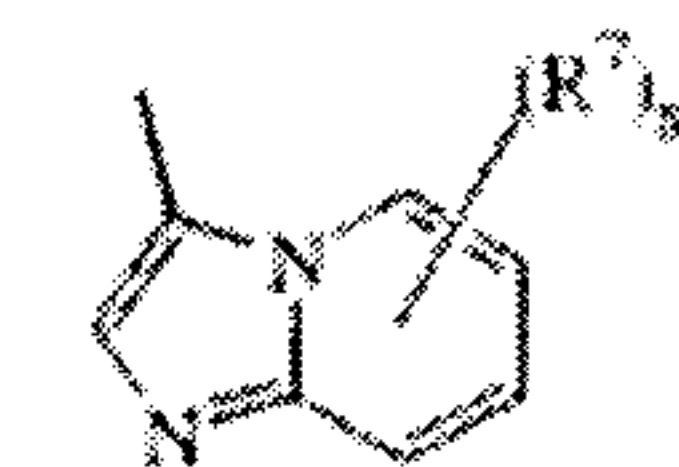
(a-34)



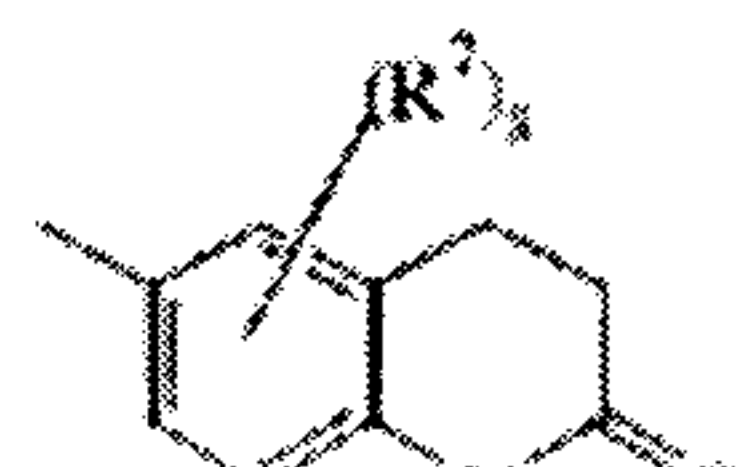
(a-35)



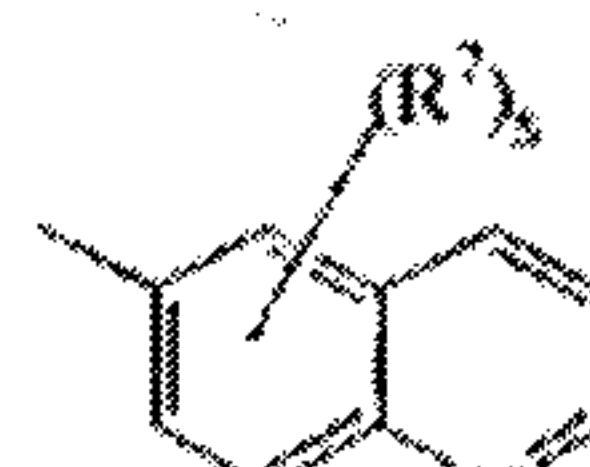
(a-36)



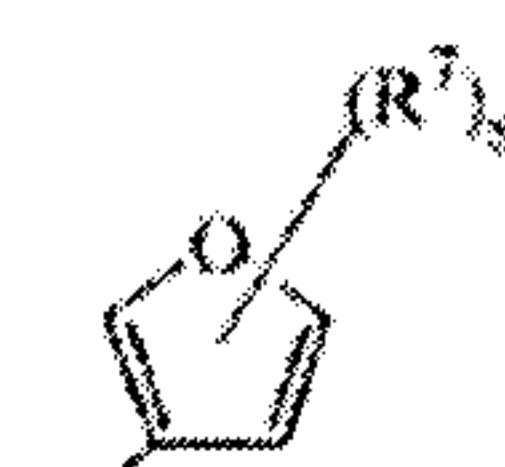
(a-37)



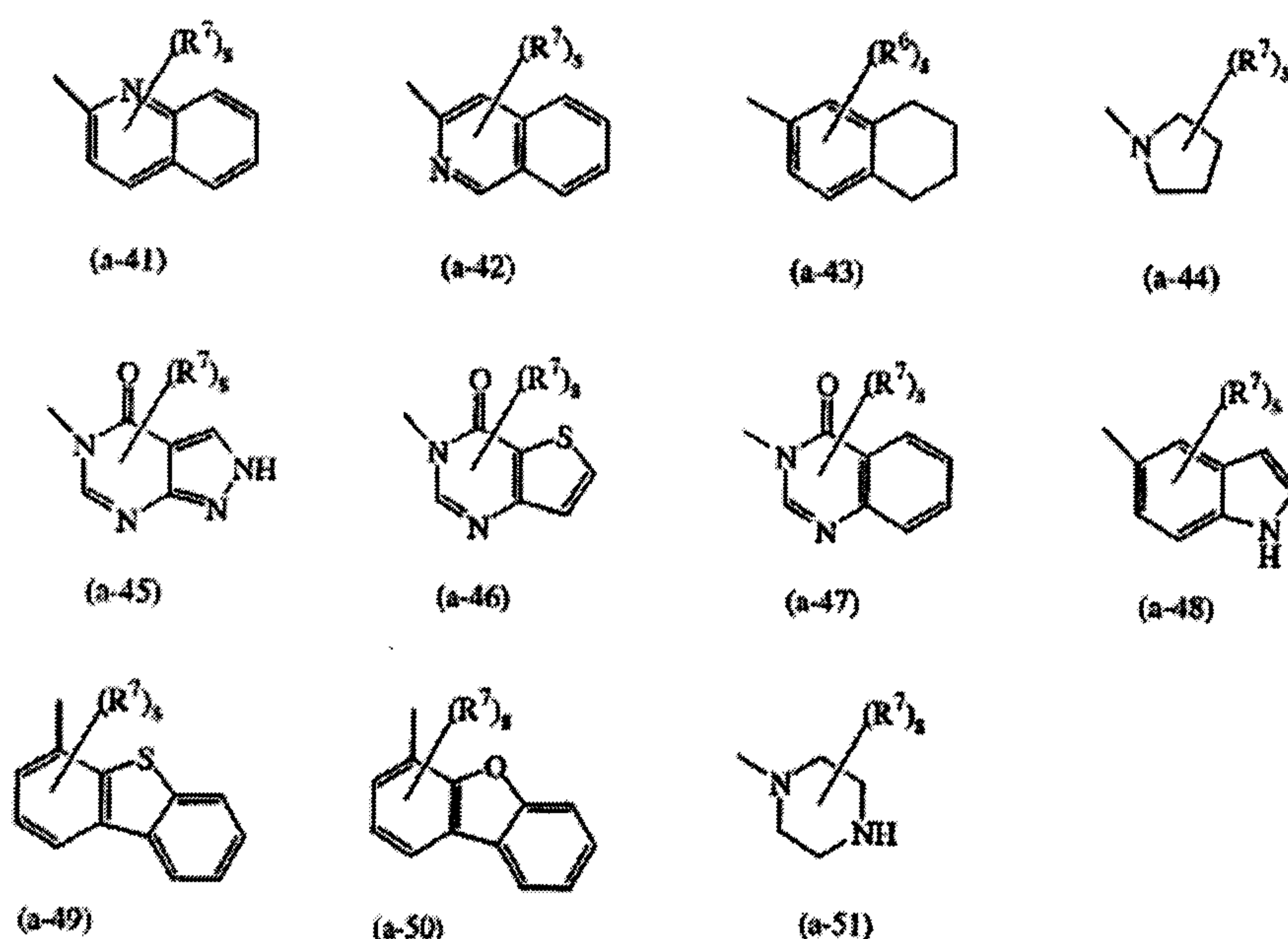
(a-38)



(a-39)



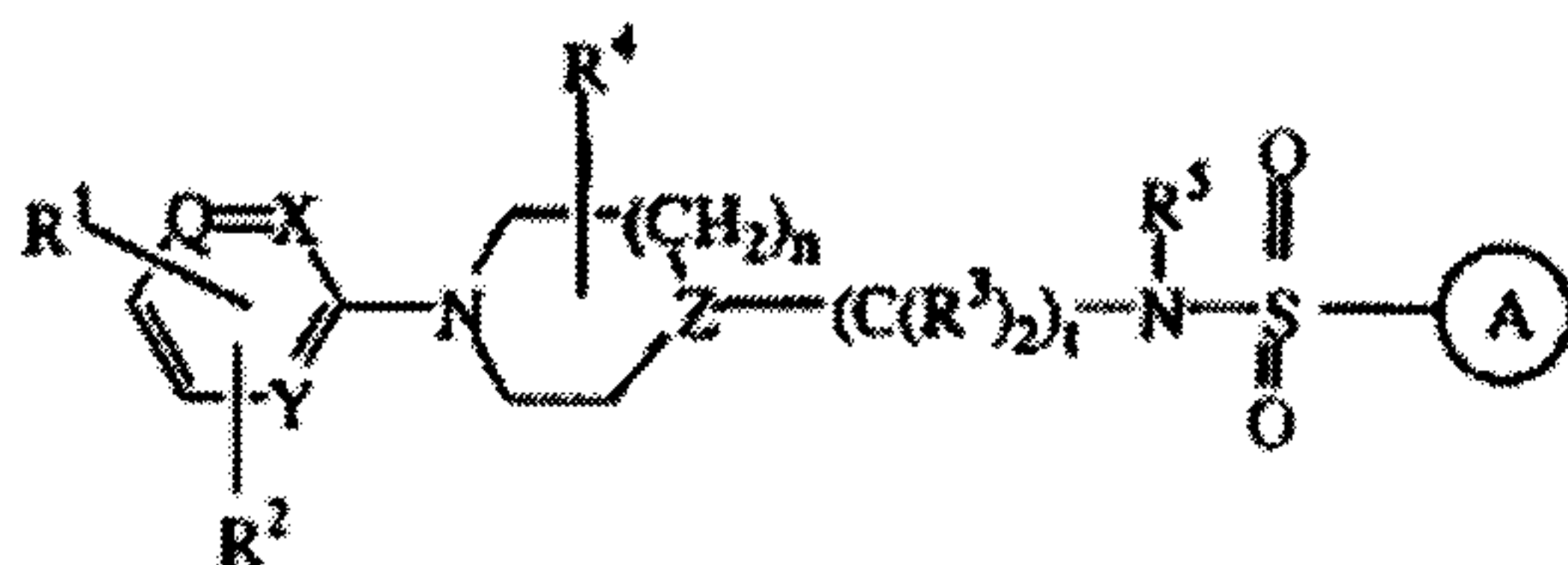
(a-40)



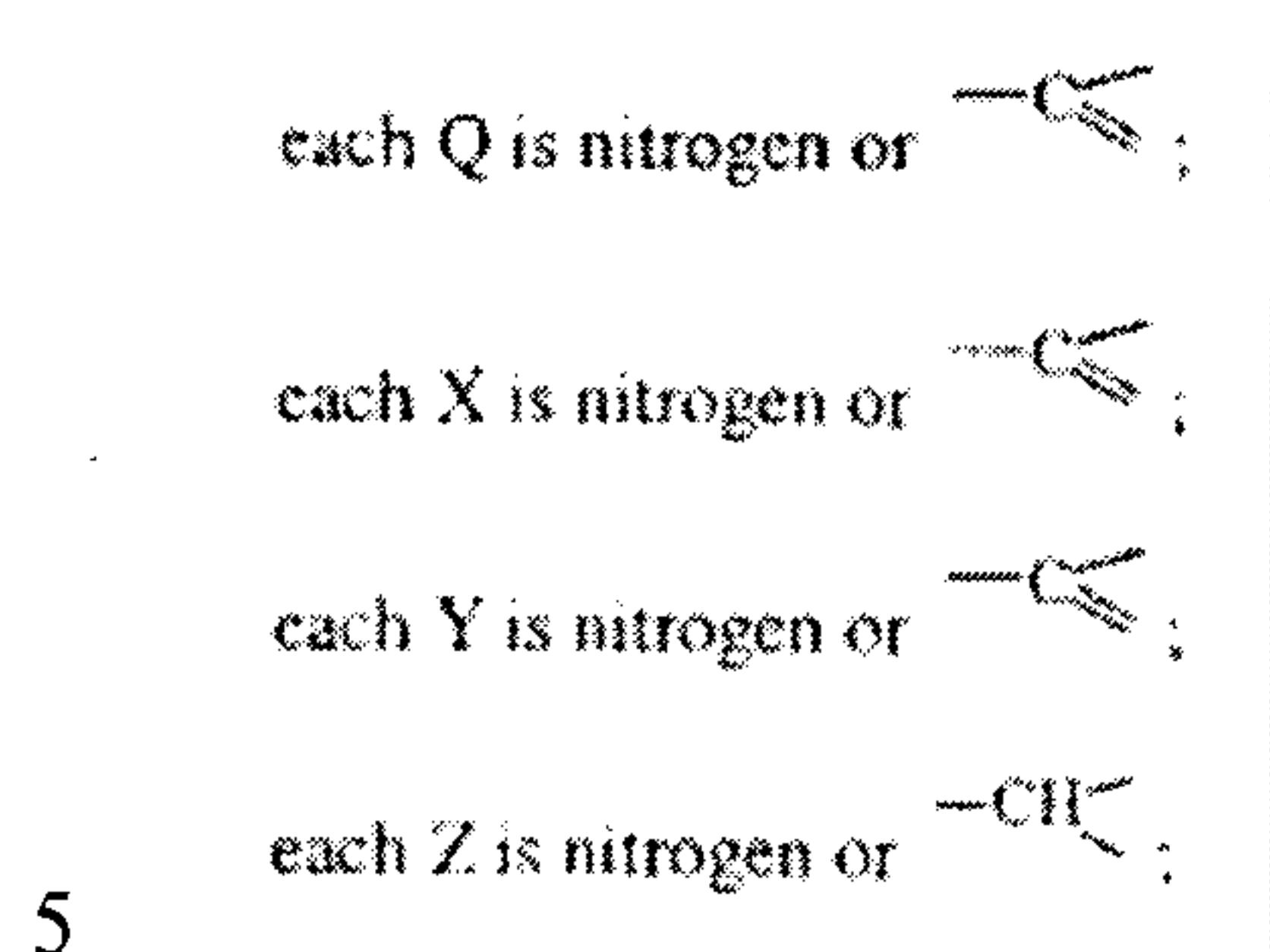
- wherein each s is independently 0, 1, 2, 3, 4 or 5; each R^6 and R^7 are independently selected from hydrogen; halo; hydroxy; amino; nitro; trihaloC₁₋₆alkyl; trihaloC₁₋₆alkyloxy; C₁₋₆alkyl; C₁₋₆alkyl substituted with aryl and C₃₋₁₀cycloalkyl; C₁₋₆alkyloxy; C₁₋₆alkyloxyC₁₋₆alkyloxy; C₁₋₆alkylcarbonyl; C₁₋₆alkyloxycarbonyl; C₁₋₆alkylsulfonyl; cyanoC₁₋₆alkyl; hydroxyC₁₋₆alkyl; hydroxyC₁₋₆alkyloxy; hydroxyC₁₋₆alkylamino; aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminocarbonyl; di(hydroxyC₁₋₆alkyl)amino; (aryl)(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminoC₁₋₆alkylamino; di(C₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; arylsulfonyl; arylsulfonylamino; aryloxy; aryloxyC₁₋₆alkyl; arylC₂₋₆alkenediyl; di(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)amino(C₁₋₆alkyl) amino; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl; aminosulfonylamino(C₁₋₆alkyl)amino; aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; cyano; thiophenyl; thiophenyl substituted with di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, di(C₁₋₆alkyl)aminoC₁₋₆alkyl, C₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, di(C₁₋₆alkyl)aminosulfonylpiperazinylC₁₋₆alkyl, C₁₋₆alkyloxypiperidinyl, C₁₋₆alkyloxypiperidinylC₁₋₆alkyl, morpholinylC₁₋₆alkyl,

hydroxyC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, or di(hydroxyC₁₋₆alkyl) aminoC₁₋₆alkyl;
 furanyl; furanyl substituted with hydroxyC₁₋₆alkyl; benzofuranyl; imidazolyl; oxazolyl;
 oxazolyl substituted with aryl and C₁₋₆alkyl; C₁₋₆alkyltriazolyl; tetrazolyl; pyrrolidinyl;
 pyrrolyl; piperidinylC₁₋₆alkyloxy; morpholinyl; C₁₋₆alkylmorpholinyl; morpholinylC₁₋₆
 5 alkyloxy; morpholinylC₁₋₆alkyl; morpholinylC₁₋₆alkylamino; morpholinylC₁₋₆
 alkylaminoC₁₋₆alkyl; piperazinyl; C₁₋₆alkylpiperazinyl; C₁₋₆alkylpiperazinylC₁₋₆alkyloxy;
 piperazinylC₁₋₆alkyl; naphtalenylsulfonylpiperazinyl; naphtalenylsulfonylpiperidinyl;
 naphtalenylsulfonyl; C₁₋₆alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkylpiperazinylC₁₋₆alkylamino;
 C₁₋₆alkylpiperazinylC₁₋₆alkylaminoC₁₋₆alkyl; C₁₋₆alkylpiperazinylsulfonyl;
 10 aminosulfonylpiperazinylC₁₋₆alkyloxy; aminosulfonylpiperazinyl;
 aminosulfonylpiperazinylC₁₋₆alkyl; di(C₁₋₆alkyl) aminosulfonylpiperazinyl; di(C₁₋₆
 alkyl)aminosulfonylpiperazinylC₁₋₆alkyl; hydroxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆
 alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkyloxypiperidinyl; C₁₋₆alkyloxypiperidinylC₁₋₆alkyl;
 piperidinylaminoC₁₋₆alkylamino; piperidinylaminoC₁₋₆alkylaminoC₁₋₆alkyl; (C₁₋₆
 15 alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylamino, (C₁₋₆
 alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; hydroxyC₁₋₆
 alkyloxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl;
 (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)amino; (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl) aminoC₁₋₆alkyl;
 hydroxyC₁₋₆alkylaminoC₁₋₆alkyl; di(hydroxyC₁₋₆alkyl) aminoC₁₋₆alkyl; pyrrolidinylC₁₋₆
 20 alkyl; pyrrolidinylC₁₋₆alkyloxy; pyrazolyl; thiopyrazolyl; pyrazolyl substituted with two
 substituents selected from C₁₋₆alkyl or trihaloC₁₋₆alkyl; pyridinyl; pyridinyl substituted
 with C₁₋₆alkyloxy, aryloxy or aryl; pyrimidinyl; tetrahydropyrimidinylpiperazinyl;
 tetrahydropyrimidinylpiperazinylC₁₋₆alkyl; quinolinyl; indole; phenyl; phenyl substituted
 with one, two or three substituents independently selected from halo, amino, nitro, C₁₋₆
 25 alkyl, C₁₋₆alkyloxy, hydroxyC₁₋₄alkyl, trifluoromethyl, trifluoromethyloxy, hydroxyC₁₋₄
 alkyloxy, C₁₋₄alkylsulfonyl, C₁₋₄alkyloxyC₁₋₄alkyloxy, C₁₋₄alkyloxycarbonyl, aminoC₁₋₄
 alkyloxy, di(C₁₋₄alkyl)aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)amino, di(C₁₋₄
 alkyl)aminocarbonyl, di(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄
 alkyl, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)aminoC₁₋₄alkyl,
 30 di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄
 alkyl)aminoC₁₋₄alkyl, aminosulfonylamino(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄

- ₄alkyl) aminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminosulfonylamino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminosulfonylamino(C₁₋₄alkyl)aminoC₁₋₆alkyl, cyano, piperidinylC₁₋₄alkyloxy, pyrrolidinylC₁₋₄alkyloxy, aminosulfonylpiperazinyl, aminosulfonylpiperazinylC₁₋₄alkyl, di(C₁₋₄alkyl)aminosulfonylpiperazinyl, di(C₁₋₄alkyl)aminosulfonylpiperazinylC₁₋₄alkyl,
- 5 hydroxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkyloxypiperidinyl, C₁₋₄alkyloxypiperidinylC₁₋₄alkyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)amino, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl) aminoC₁₋₄alkyl, di(hydroxyC₁₋₄alkyl)amino, di(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkyl, furanyl, furanyl substituted with -
- 10 CH=CH-CH=CH-, pyrrolidinylC₁₋₄alkyl, pyrrolidinylC₁₋₄alkyloxy, morpholinyl, morpholinylC₁₋₄alkyloxy, morpholinylC₁₋₄alkyl, morpholinylC₁₋₄alkylamino, morpholinylC₁₋₄alkylaminoC₁₋₄alkyl, piperazinyl, C₁₋₄alkylpiperazinyl, C₁₋₄alkylpiperazinylC₁₋₄alkyloxy, piperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkylamino, C₁₋₄alkylpiperazinylC₁₋₄alkylaminoC₁₋₆alkyl,
- 15 tetrahydropyrimidinylpiperazinyl, tetrahydropyrimidinylpiperazinylC₁₋₄alkyl, piperidinylaminoC₁₋₄alkylamino, piperidinylaminoC₁₋₄alkylaminoC₁₋₄alkyl, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylamino, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄alkyl, pyridinylC₁₋₄alkyloxy, hydroxyC₁₋₄alkylamino, hydroxyC₁₋₄alkylaminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylamino, aminothiadiazolyl, aminosulfonylpiperazinylC₁₋₄alkyloxy,
- 20 or thiophenylC₁₋₄alkylamino; each R⁶ and R⁷ can be placed on the nitrogen in replacement of the hydrogen; aryl in the above is phenyl, or phenyl substituted with one or more substituents each independently selected from halo, C₁₋₆alkyl, C₁₋₆alkyloxy, trifluoromethyl, cyano or hydroxycarbonyl.
- 25 In one aspect, the inhibitor of histone deacetylase activity may be a sulfonylamino derivative, such as, for example, compounds disclosed in WO2003076401, having the general formula:



the *N*-oxide forms, the pharmaceutically acceptable addition salts and the stereochemically isomeric forms thereof, wherein *n* is 0, 1, 2 or 3 and when *n* is 0 then a direct bond is intended; *t* is 0, 1, 2, 3 or 4 and when *t* is 0 then a direct bond is intended;

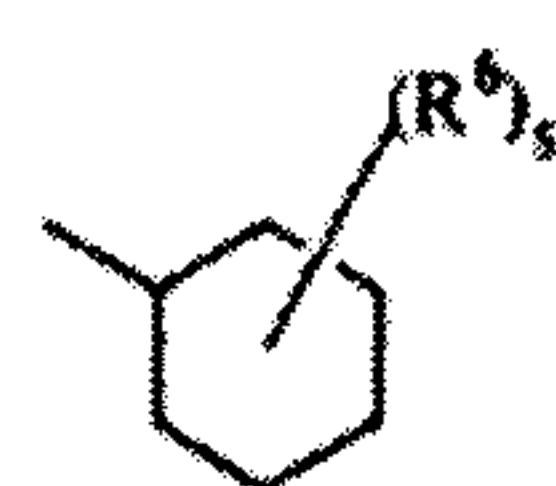


R^1 is $-C(O)NR^8R^9$, $-N(H)C(O)R^{10}$, $-C(O)-C_{1-6}\text{alkanediyl}SR^{10}$, $-NRC(O)N(OH)R^{10}$, $-NR^{11}C(O)C_{1-6}\text{alkanediyl}SR^{10}$, $-NR^{11}C(O)C=N(OH)R^{10}$ or another Zn-chelating group wherein R^8 and R^9 are each independently selected from hydrogen, hydroxy, C_{1-6} alkyl, hydroxy C_{1-6} alkyl, amino C_{1-6} alkyl or aminoaryl; R^{10} is independently selected from hydrogen, C_{1-6} alkyl, C_{1-6} alkylcarbonyl, aryl C_{1-6} alkyl, C_{1-6} alkylpyrazinyl, pyridinone, pyrrolidinone or methylimidazolyl; R^{11} is independently selected from hydrogen or C_{1-6} alkyl; R^2 is hydrogen, halo, hydroxy, amino nitro, C_{1-6} alkyl, C_{1-6} alkyloxy, trifluoromethyl, di(C_{1-6} alkyl)amino, hydroxyamino or naphthalenylsulfonylpyrazinyl; each R^3 independently represents a hydrogen atom and one hydrogen atom can be replaced by a substituent selected from aryl; R^4 is hydrogen, hydroxy, amino, hydroxy C_{1-6} alkyl, Cl_{1-6} alkyl, C_{1-6} alkyloxy, aryl C_{1-6} alkyl, aminocarbonyl, hydroxycarbonyl, amino C_{1-6} alkyl, aminocarbonyl C_{1-6} alkyl, hydroxycarbonyl C_{1-6} alkyl, hydroxyaminocarbonyl, C_{1-6} alkyloxycarbonyl, C_{1-6} alkylamino C_{1-6} alkyl or di(C_{1-6} alkyl)amino C_{1-6} alkyl; R^5 is hydrogen, C_{1-6} alkyl, C_{3-10} cycloalkyl, hydroxy C_{1-6} alkyl, C_{1-6} alkyloxy C_{1-6} alkyl, di(C_{1-6} alkyl)amino C_{1-6} alkyl or aryl;

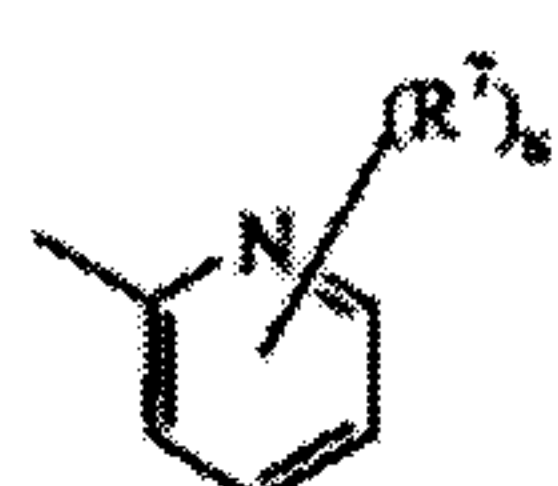
 is a radical selected from



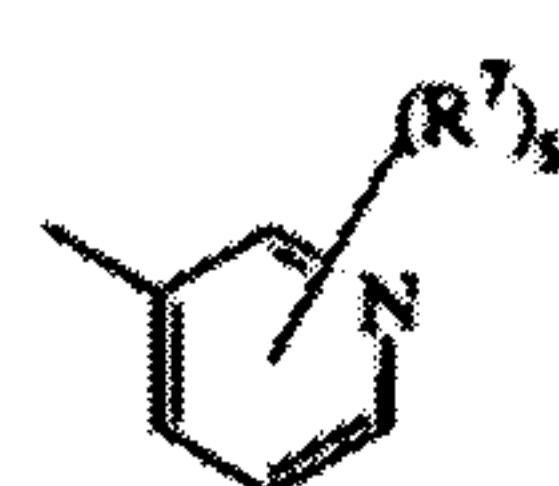
(a-1)



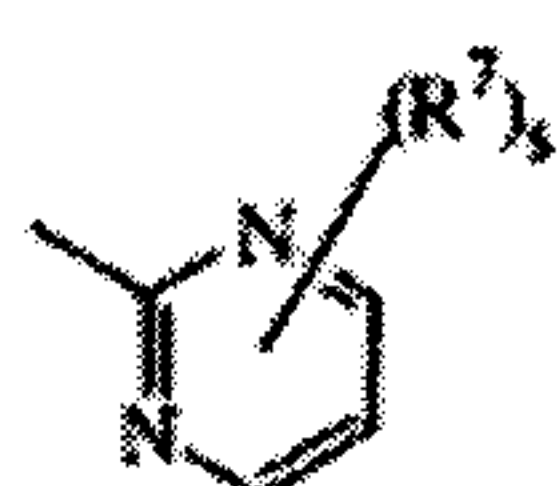
(a-2)



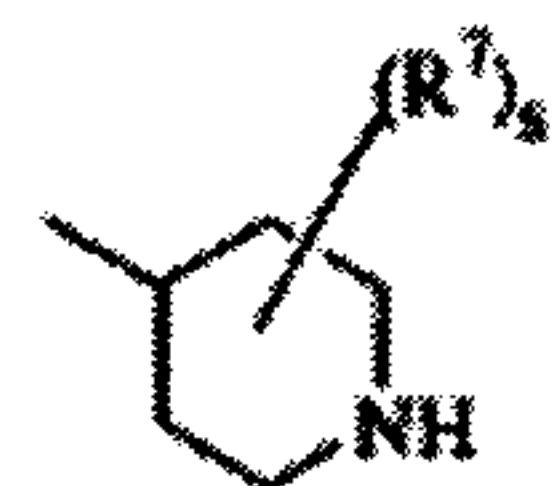
(a-3)



(a-4)



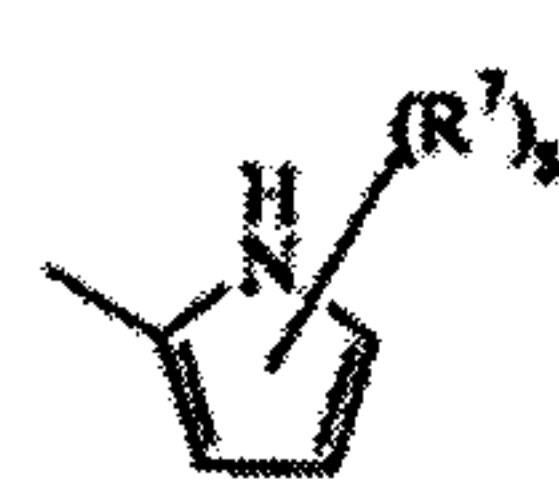
(a-5)



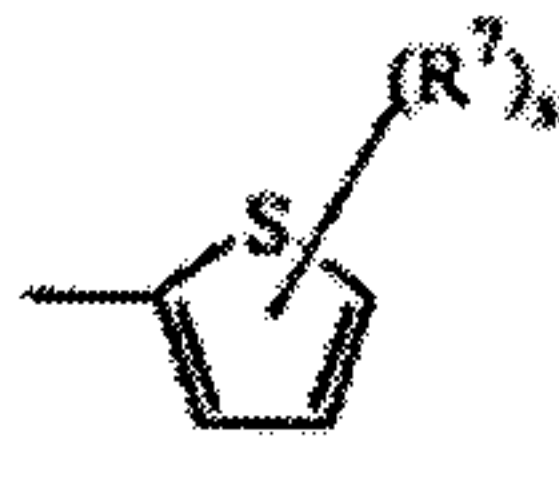
(a-6)



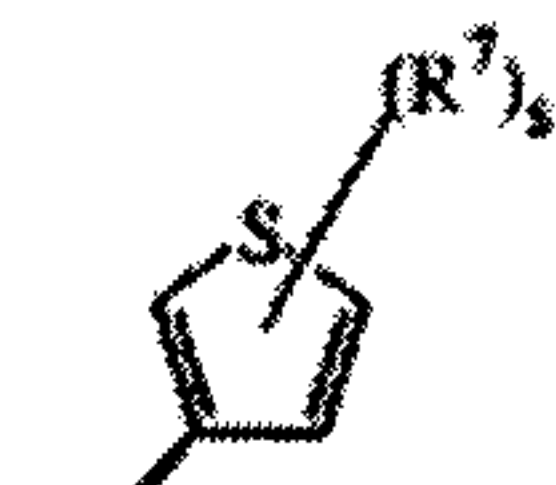
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(a-8)



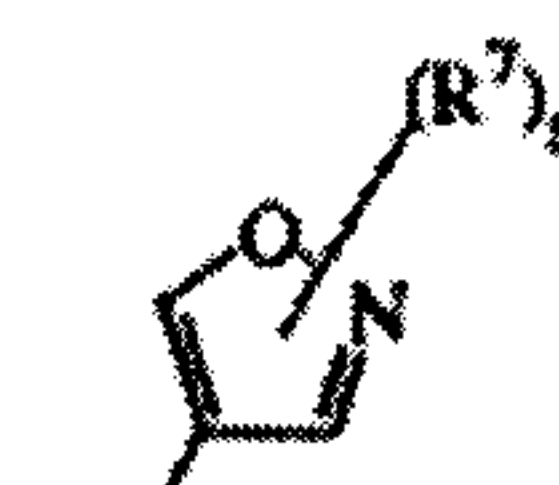
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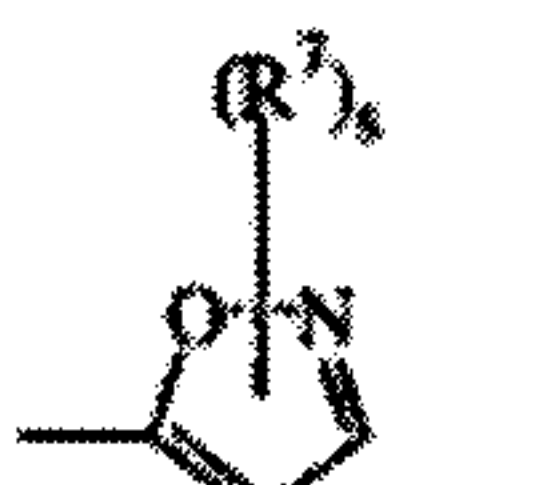
(a-10)



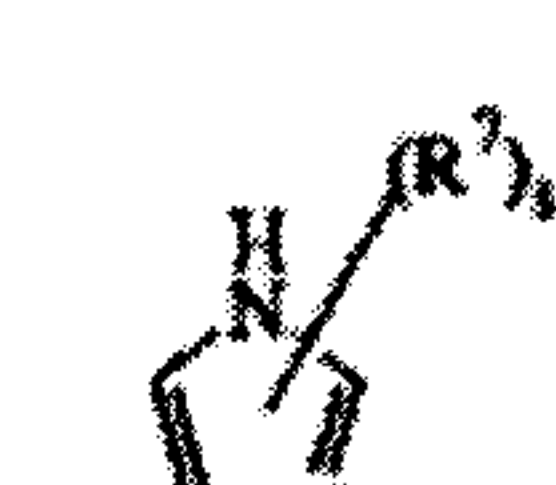
(a-11)



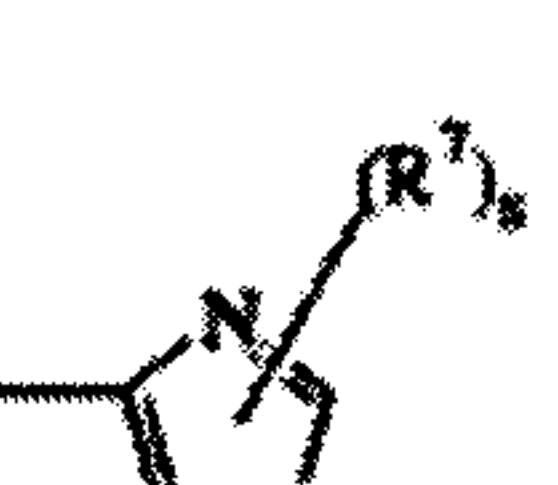
(a-12)



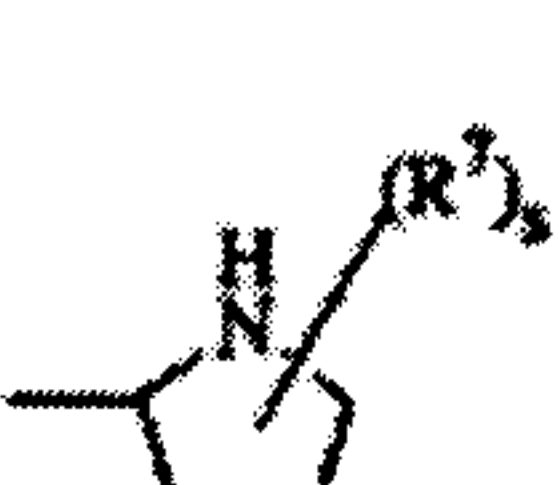
(a-13)



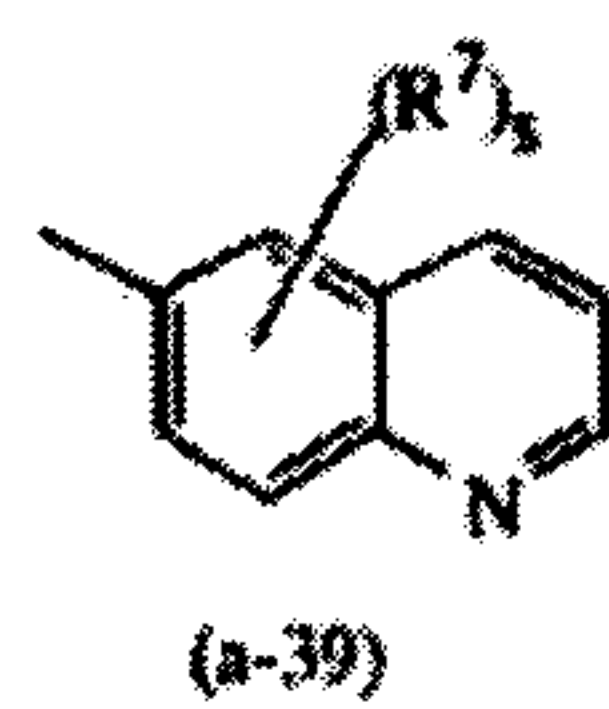
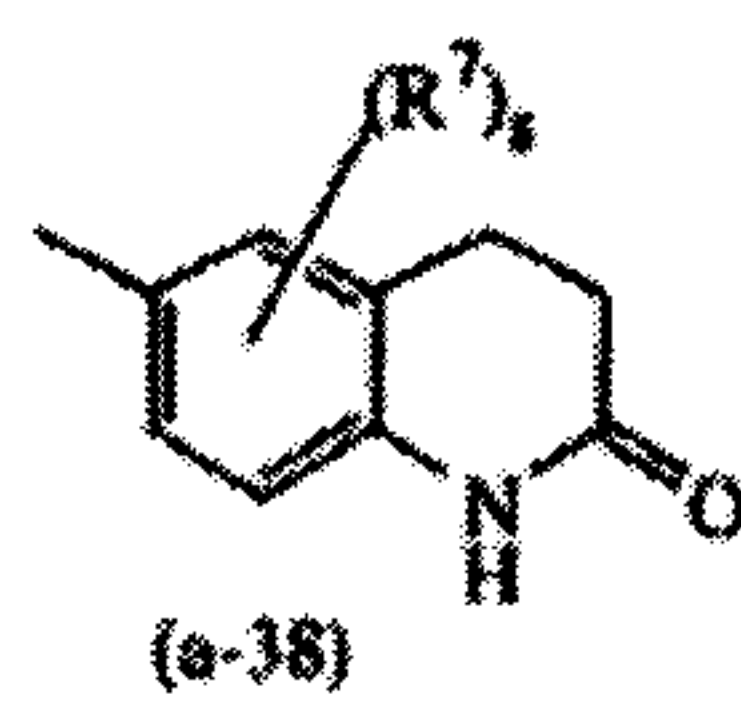
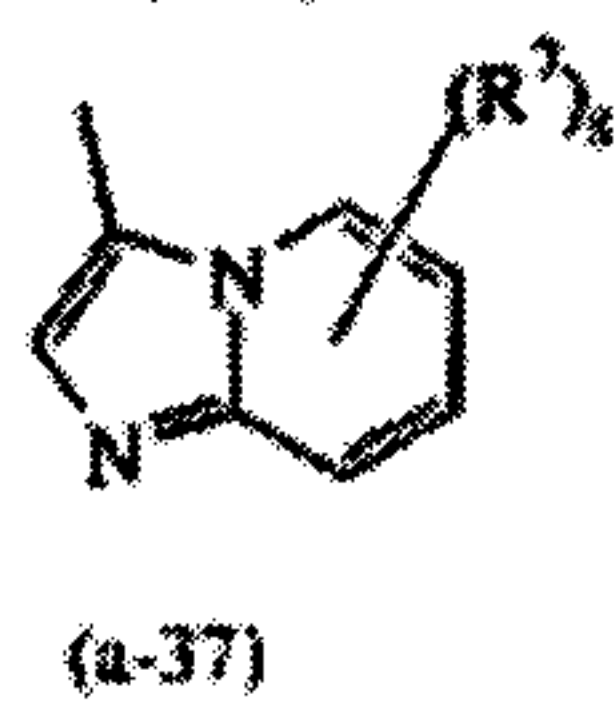
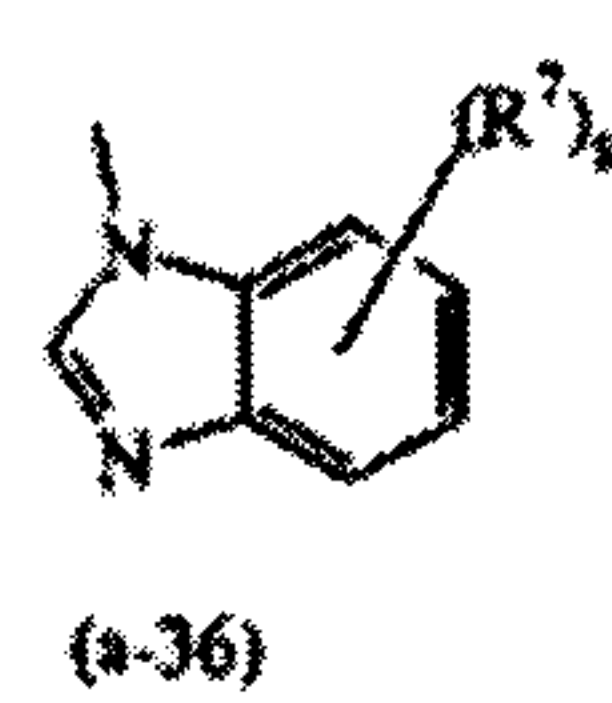
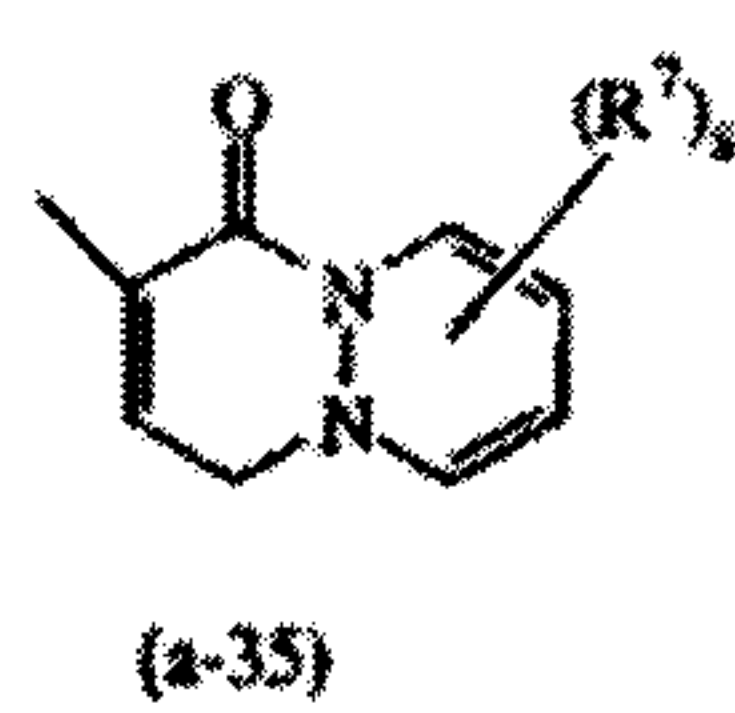
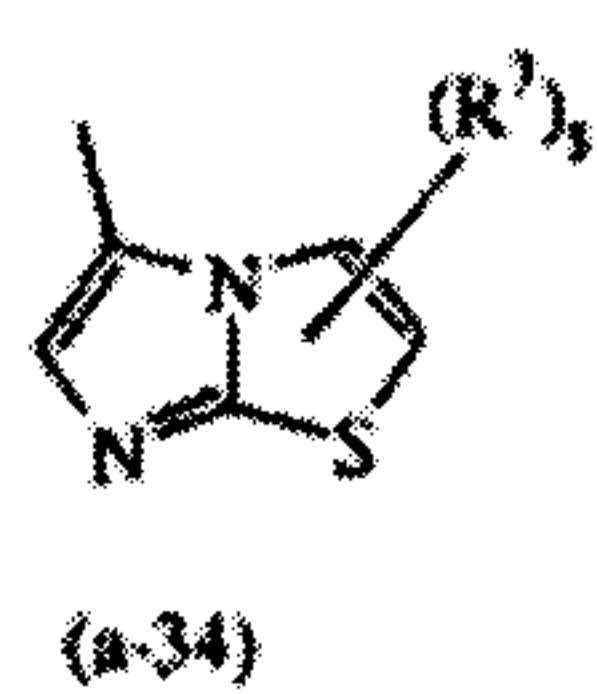
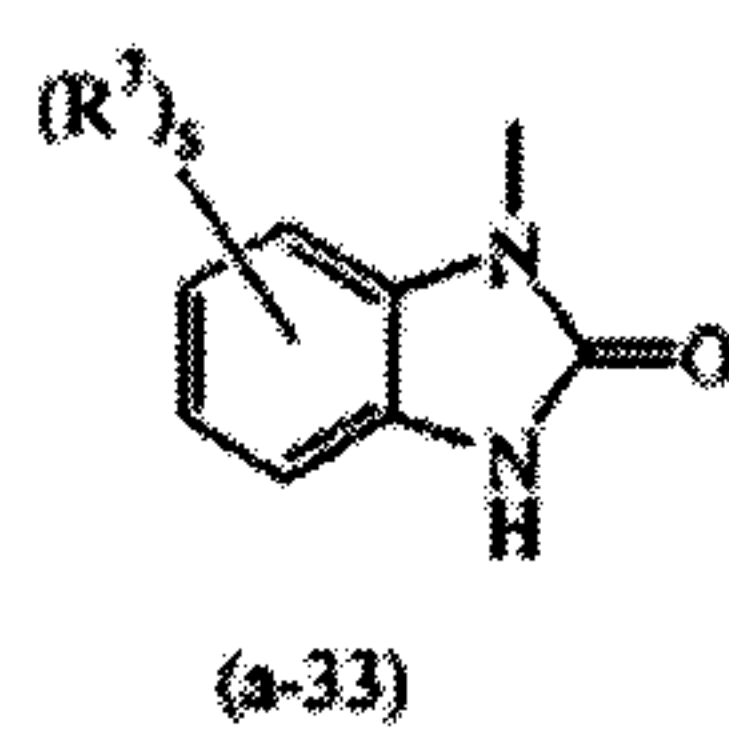
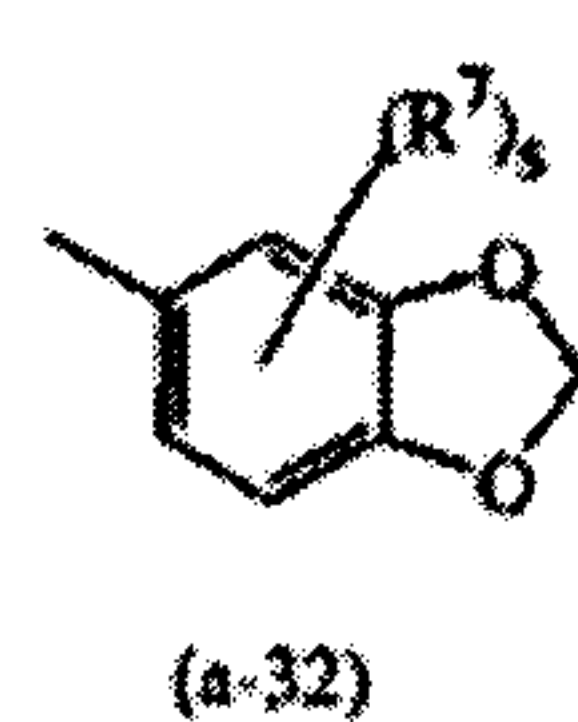
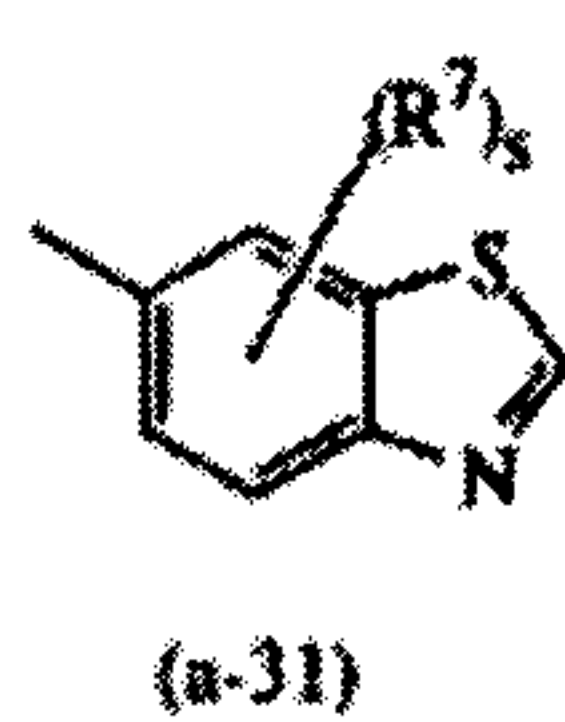
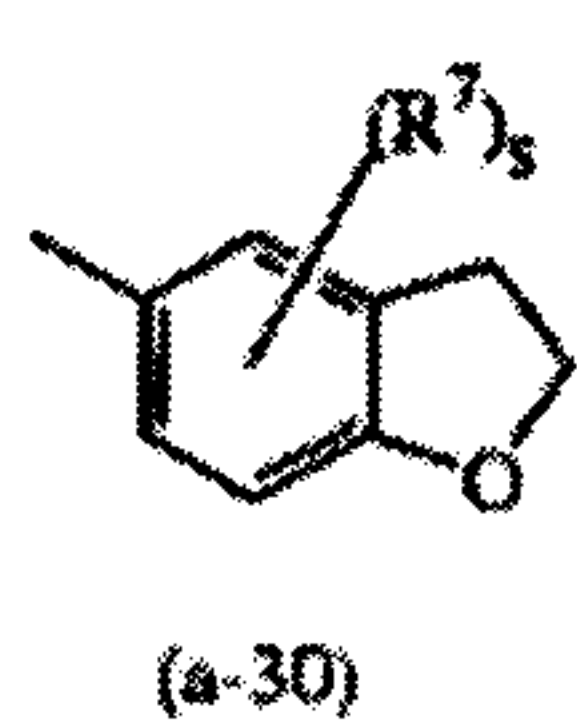
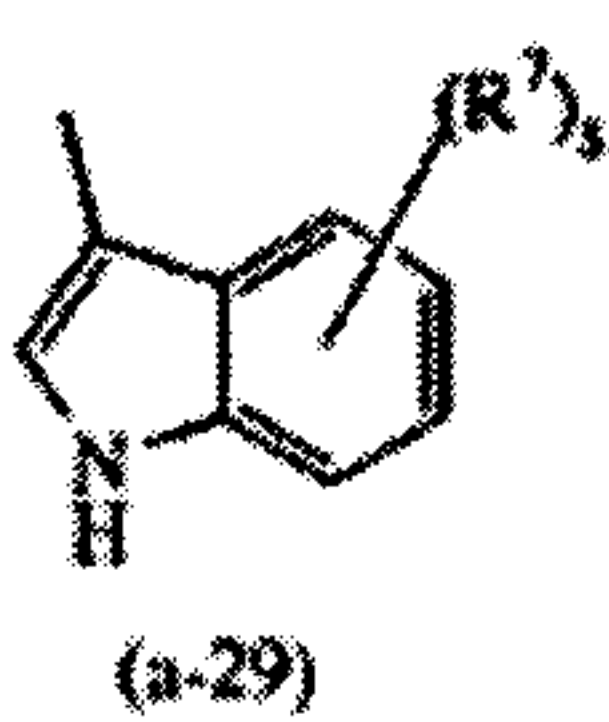
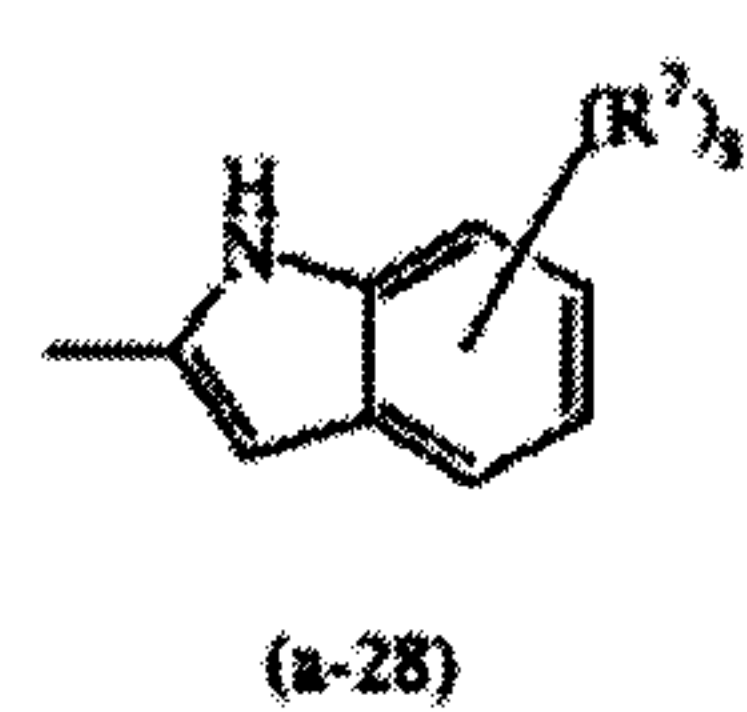
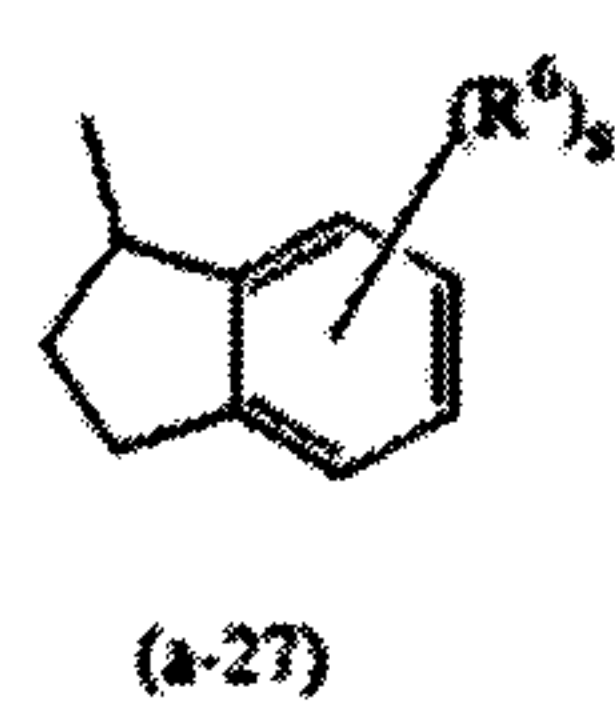
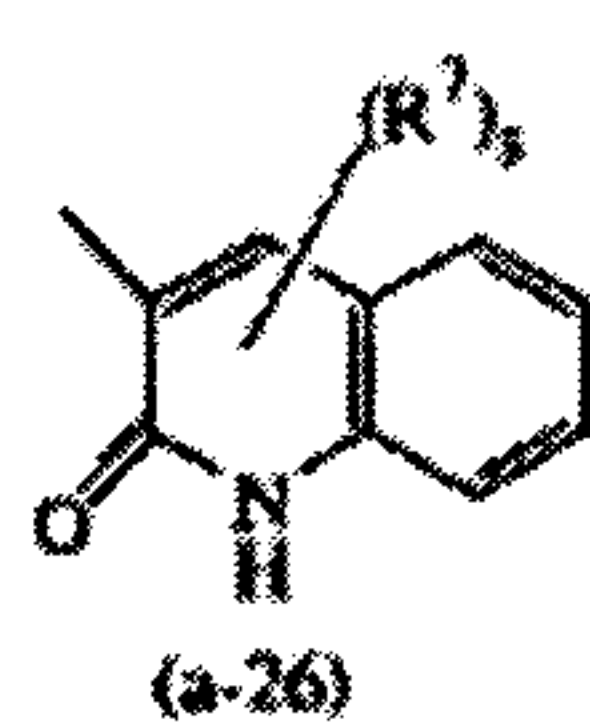
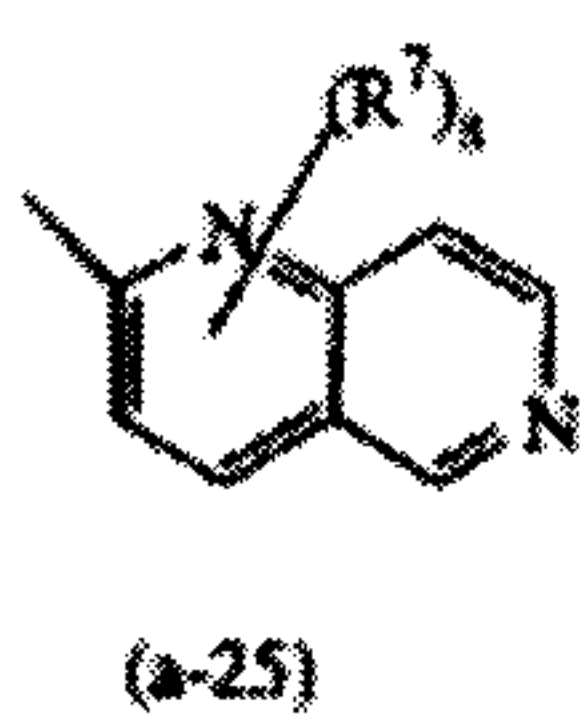
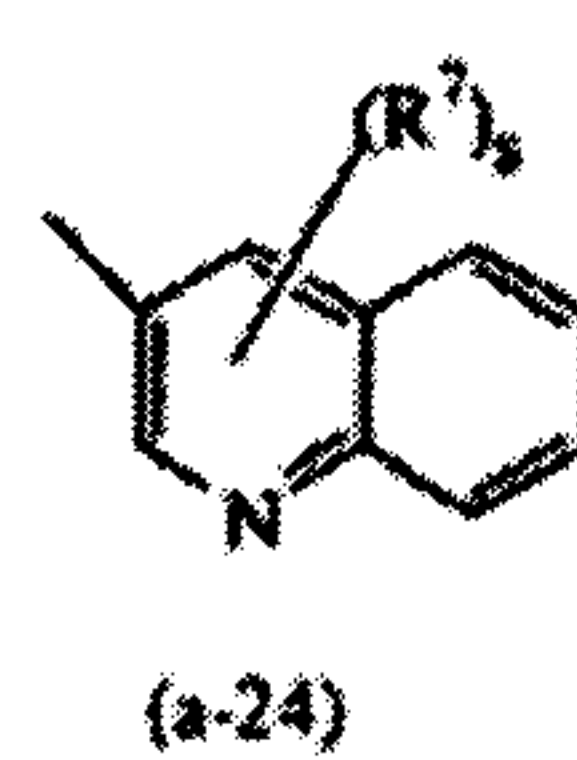
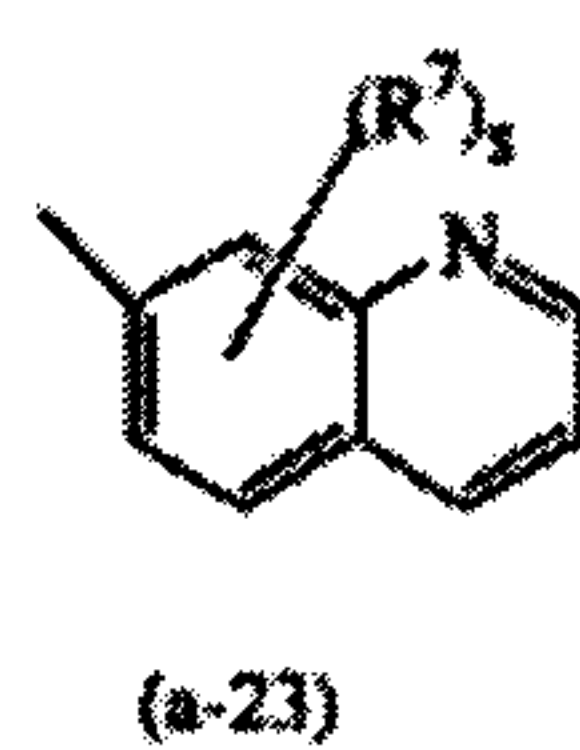
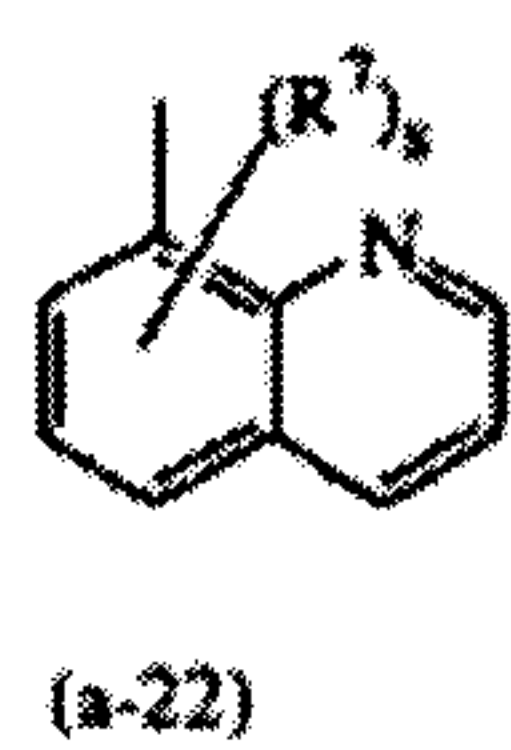
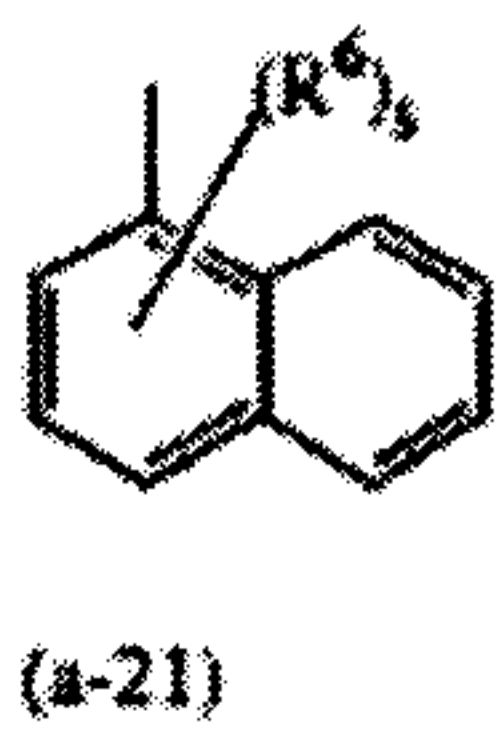
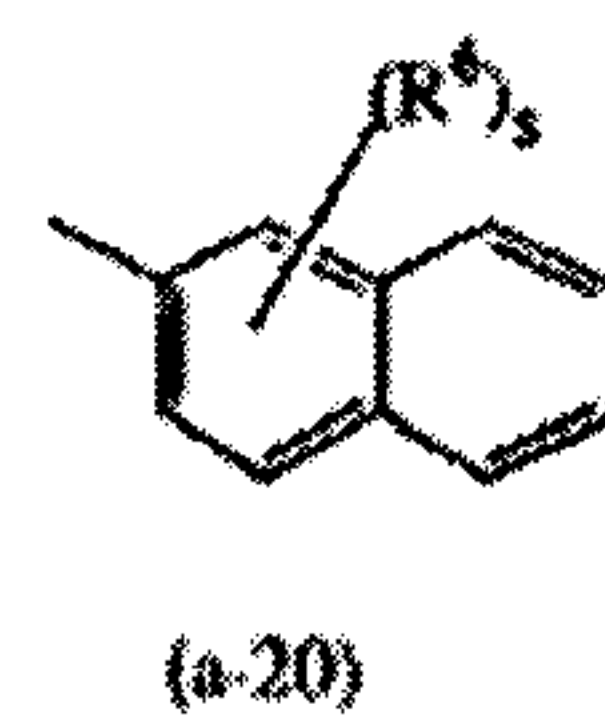
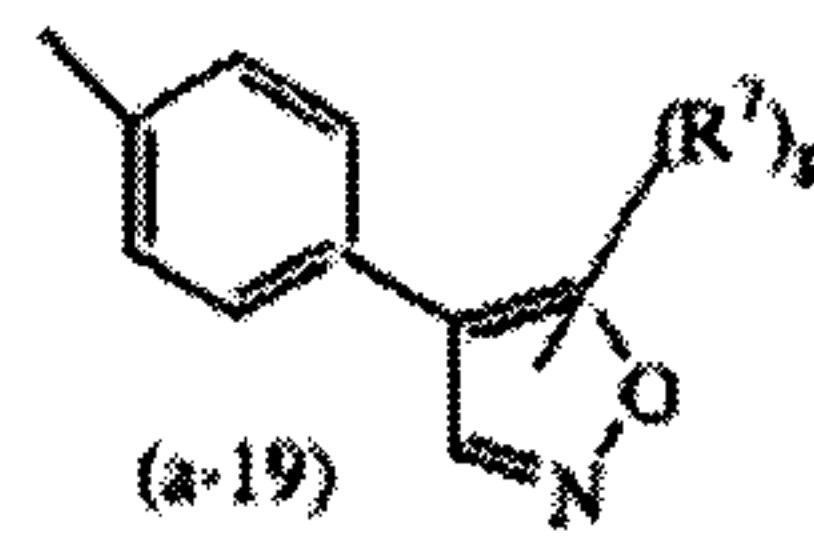
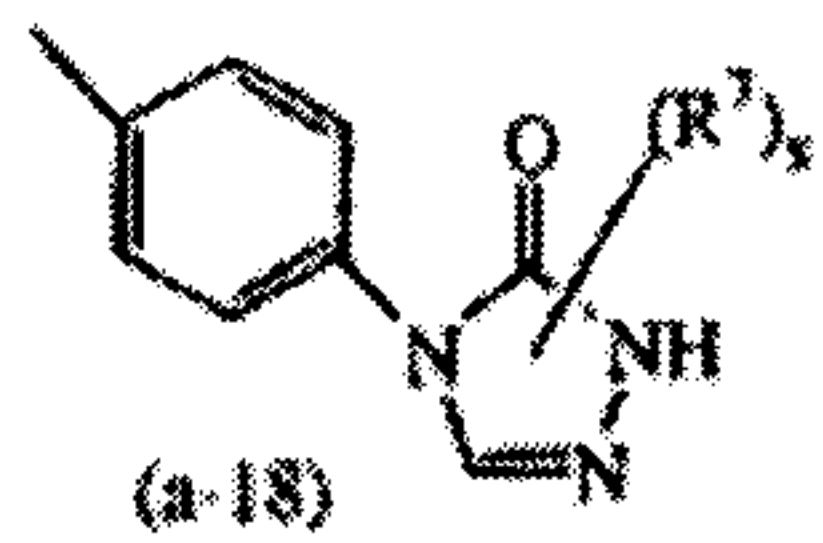
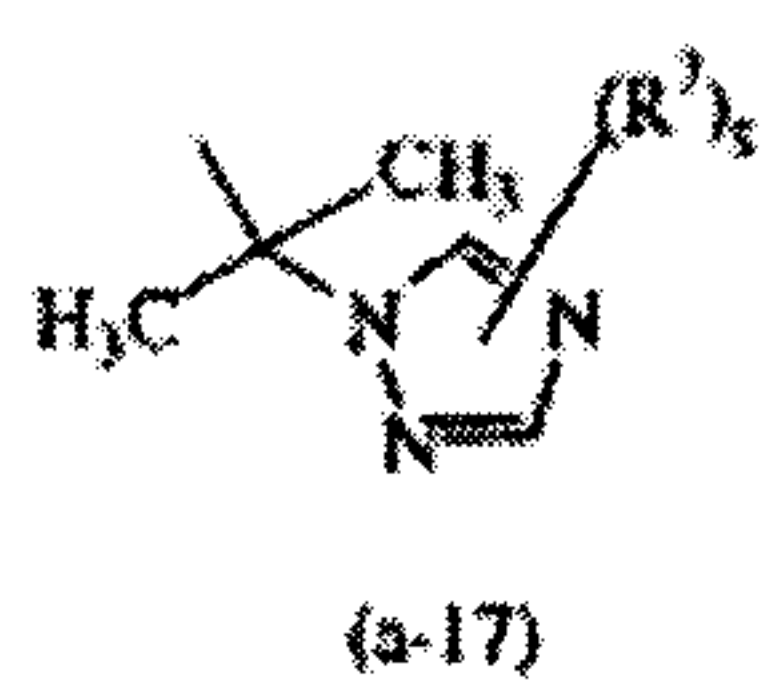
(a-14)

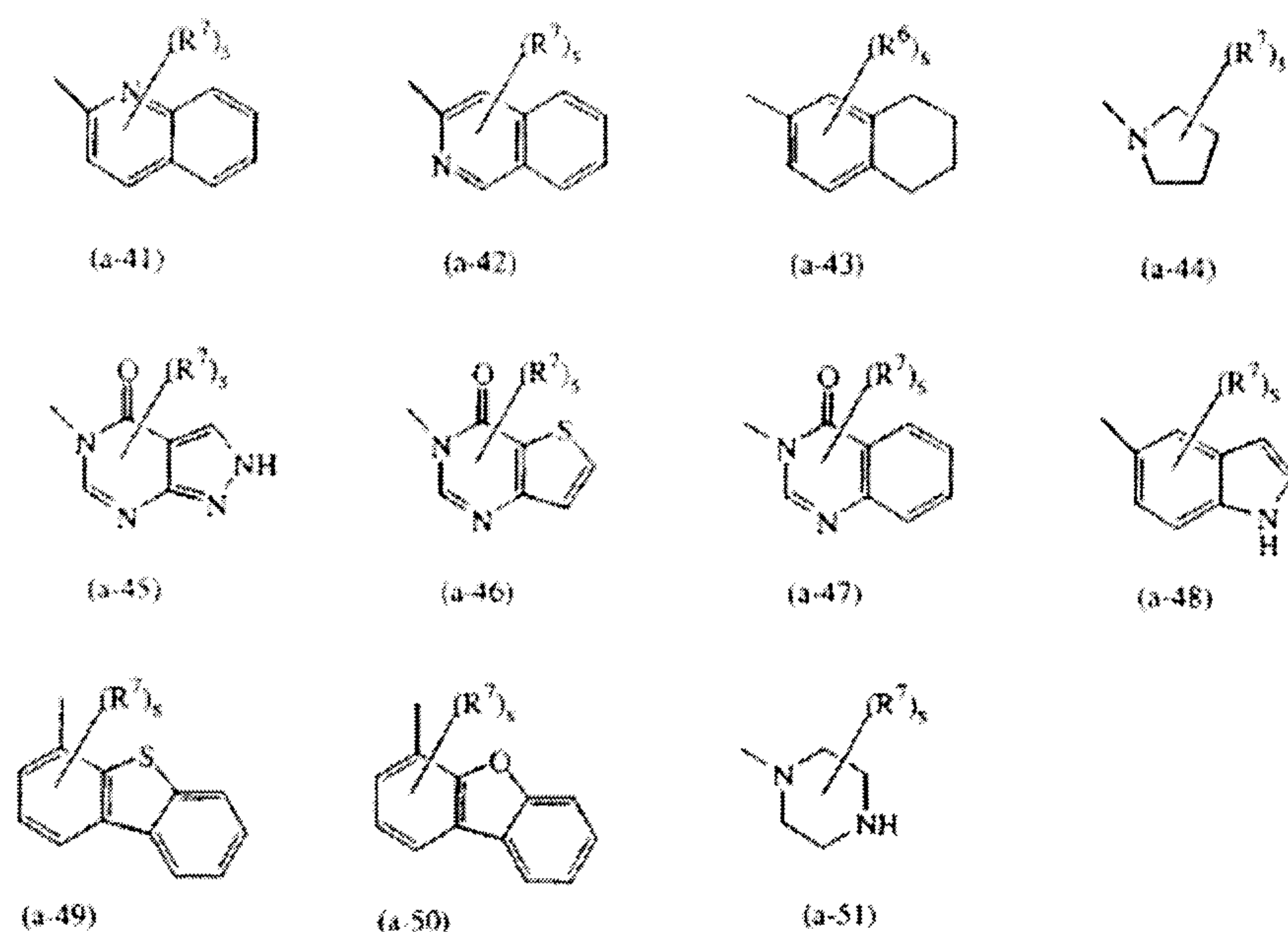


(a-15)



(a-16)

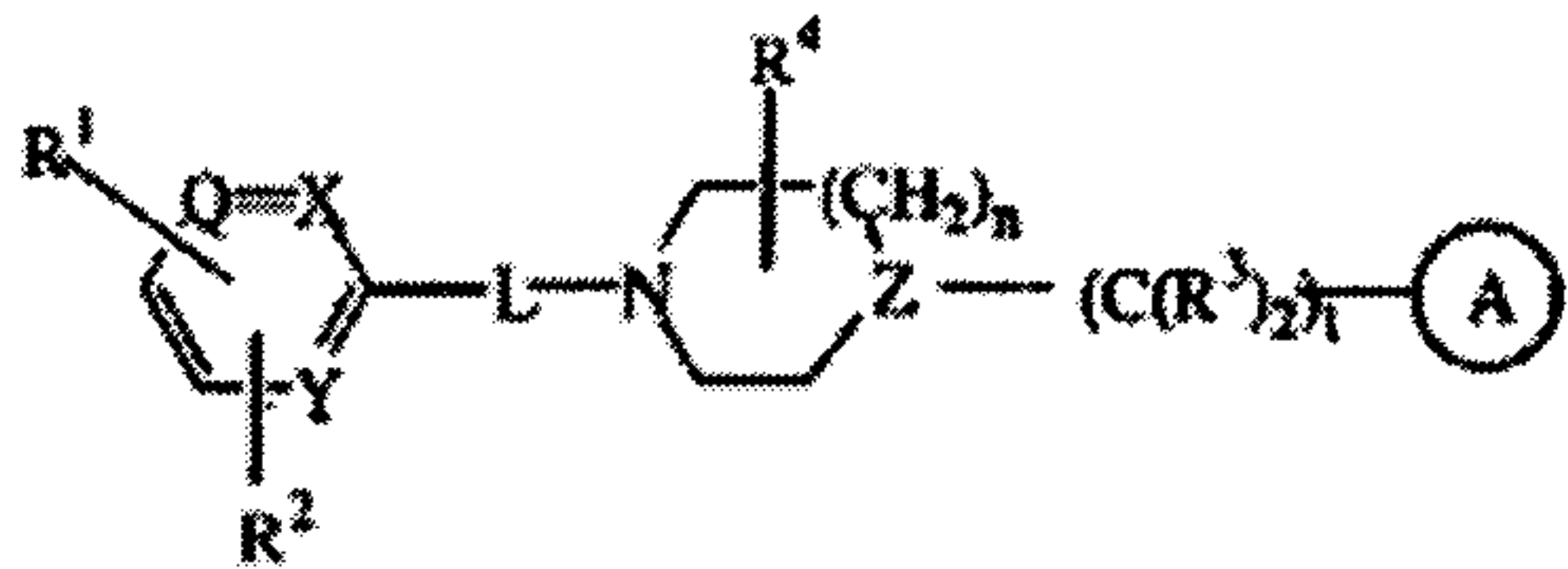




- wherein each s is independently 0, 1, 2, 3, 4 or 5; each R^6 and R^7 are independently selected from hydrogen; halo; hydroxy; amino; nitro; trihaloC₁₋₆alkyl; trihaloC₁₋₆alkyloxy; C₁₋₆alkyl; C₁₋₆alkyl substituted with aryl and C₃₋₁₀cycloalkyl; C₁₋₆alkyloxy; C₁₋₆alkyloxyC₁₋₆alkyloxy; C₁₋₆alkylcarbonyl; C₁₋₆alkyloxycarbonyl; C₁₋₆alkylsulfonyl; cyanoC₁₋₆alkyl; hydroxyC₁₋₆alkyl; hydroxyC₁₋₆alkyloxy; hydroxyC₁₋₆alkylamino; aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminocarbonyl; di(hydroxyC₁₋₆alkyl)amino; (aryl)(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminoC₁₋₆alkylamino; di(C₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; arylsulfonyl; arylsulfonylamino; aryloxy; aryloxyC₁₋₆alkyl; arylC₂₋₆alkenediyl; di(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl; aminosulfonylamino(C₁₋₆alkyl)amino; aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; cyano; thiophenyl; thiophenyl substituted with di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, di(C₁₋₆alkyl)aminoC₁₋₆alkyl, C₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, di(C₁₋₆alkyl)aminosulfonylpiperazinylC₁₋₆alkyl, C₁₋₆alkyloxypiperidinyl, C₁₋₆alkyloxypiperidinylC₁₋₆alkyl, morpholinylC₁₋₆alkyl,

hydroxyC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, or di(hydroxyC₁₋₆alkyl) aminoC₁₋₆alkyl;
 furanyl; furanyl substituted with hydroxyC₁₋₆alkyl; benzofuranyl; imidazolyl; oxazolyl;
 oxazolyl substituted with aryl and C₁₋₆alkyl; C₁₋₆alkyltriazolyl; tekazolyl; pyrrolidinyl;
 pyrrolyl; piperidinylC₁₋₆alkyloxy; morpholinyl; C₁₋₆alkylmorpholinyl; morpholinylC₁₋₆
 5 alkyloxy; morpholinylC₁₋₆alkyl; morpholinylC₁₋₆alkylamino; morpholinylC₁₋₆
 alkylaminoC₁₋₆alkyl; piperazinyl; C₁₋₆alkylpiperazinyl; C₁₋₆alkylpiperazinylC₁₋₆alkyloxy;
 piperazinylC₁₋₆alkyl; naphtalenylsulfonylpiperazinyl; naphtalenylsulfonylpiperidinyl;
 naphtalenylsulfonyl; C₁₋₆alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkylpiperazinylC₁₋₆alkylamino;
 C₁₋₆alkylpiperazinylC₁₋₆alkylaminoC₁₋₆alkyl; C₁₋₆alkylpiperazinylsulfonyl;
 10 aminosulfonylpiperazinylC₁₋₆alkyloxy; aminosulfonylpiperazinyl;
 aminosulfonylpiperazinylC₁₋₆alkyl; di(C₁₋₆alkyl) aminosulfonylpiperazinyl; di(C₁₋₆
 alkyl)aminosulfonylpiperazinylC₁₋₆alkyl; hydroxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆
 alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkyloxypiperidinyl; C₁₋₆alkyloxypiperidinylC₁₋₆alkyl;
 piperidinylaminoC₁₋₆alkylamino; piperidinylaminoC₁₋₆alkylaminoC₁₋₆alkyl; (C₁₋₆
 15 alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylamino; (C₁₋₆
 alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; hydroxyC₁₋₆
 alkyloxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl;
 (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)amino; (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)aminoC₁₋₆alkyl;
 hydroxyC₁₋₆ alkylaminoC₁₋₆alkyl; di(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkyl; pyrrolidinylC₁₋₆
 20 alkyl; pyrrolidinylC₁₋₆alkyloxy; pyrazolyl; thiopyrazolyl; pyrazolyl substituted with two
 substituents selected from C₁₋₆alkyl or trihaloC₁₋₆alkyl; pyridinyl; pyridinyl substituted
 with C₁₋₆alkyloxy, aryloxy or aryl; pyrimidinyl; tetrahydropyrimidinylpiperazinyl;
 tetrahydropyrimidinylpiperazinylC₁₋₆alkyl; quinolinyl; indole; phenyl; phenyl substituted
 with one, two or three substituents independently selected from halo, amino, nitro, C₁₋₆
 25 alkyl, C₁₋₆alkyloxy, hydroxyC₁₋₄alkyl, trifluoromethyl, trifluoromethyloxy, hydroxyC₁₋₄
 alkyloxy, C₁₋₄alkylsulfonyl, C₁₋₄alkyloxyC₁₋₄alkyloxy, C₁₋₄alkyloxycarbonyl, aminoC₁₋₄
 alkyloxy, di(C₁₋₄alkyl)aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)amino, di(C₁₋₄
 alkyl)aminocarbonyl, di(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl) aminoC₁₋₄alkylaminoC₁₋₄
 alkyl, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)aminoC₁₋₄alkyl,
 30 di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄
 alkyl)aminoC₁₋₄alkyl, aminosulfonylamino(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄

- 4alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminosulfonylamino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminosulfonylamino(C₁₋₄alkyl)aminoC₁₋₆alkyl, cyano, piperidinylC₁₋₄alkyloxy, pyrrolidinylC₁₋₄alkyloxy, aminosulfonylpiperazinyl, aminosulfonylpiperazinylC₁₋₄alkyl, di(C₁₋₄alkyl)aminosulfonylpiperazinyl, di(C₁₋₄alkyl)aminosulfonylpiperazinylC₁₋₄alkyl,
- 5 hydroxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkyloxypiperidinyl, C₁₋₄alkyloxypiperidinylC₁₋₄alkyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)amino, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(hydroxyC₁₋₄alkyl)amino, di(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkyl, furanyl, furanyl substituted with -
- 10 CH=CH-CH=CH-, pyrrolidinylC₁₋₄alkyl, pyrrolidinylC₁₋₄alkyloxy, morpholinyl, morpholinylC₁₋₄alkyloxy, morpholinylC₁₋₄alkyl, morpholinylC₁₋₄alkylamino, morpholinylC₁₋₄alkylaminoC₁₋₄alkyl, piperazinyl, C₁₋₄alkylpiperazinyl, C₁₋₄alkylpiperazinylC₁₋₄alkyloxy, piperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkylamino, C₁₋₄alkylpiperazinylC₁₋₄alkylaminoC₁₋₆alkyl,
- 15 tetrahydropyrimidinylpiperazinyl, tetrahydropyrimidinylpiperazinylC₁₋₄alkyl, piperidinylaminoC₁₋₄alkylamino, piperidinylaminoC₁₋₄alkylaminoC₁₋₄alkyl, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylamino, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄alkyl, pyridinylC₁₋₄alkyloxy, hydroxyC₁₋₄alkylamino, hydroxyC₁₋₄alkylaminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylamino, aminothiadiazolyl, aminosulfonylpiperazinylC₁₋₄alkyloxy, or thiophenylC₁₋₄alkylamino; each R⁶ and R⁷ can be placed on the nitrogen in replacement of the hydrogen; aryl in the above is phenyl, or phenyl substituted with one or more substituents each independently selected from halo, C₁₋₆alkyl, C₁₋₆alkyloxy, trifluoromethyl, cyano or hydroxycarbonyl.
- 20
- 25 In one aspect, the inhibitor of histone deacetylase activity may be a compound of the general formula:



the *N*-oxide forms, the pharmaceutically acceptable addition salts and the stereochemically isomeric forms thereof, wherein *n* is 0, 1, 2 or 3 and when *n* is 0 then a direct bond is intended; *t* is 0, 1, 2, 3 or 4 and when *t* is 0 then a direct bond is intended;

each Q is nitrogen or ;

each X is nitrogen or ;

each Y is nitrogen or ;

each Z is nitrogen or ;

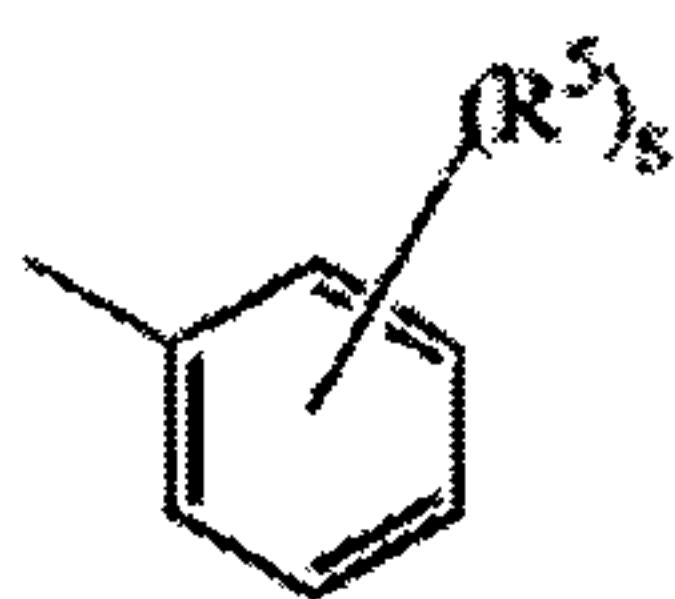
5

R^1 is $-C(O)NR^7R^8$, $-NHC(O)R^9$, $-C(O)-C_{1-6}alkanediylSR^9$, $-NR^{10}C(O)N(OH)R^9$, $-NR^{10}C(O)C_{1-6}alkanediylSR^9$, $-NR^{10}C(O)C=N(OH)R^9$ or another Zn-chelating group wherein R^7 and R^8 are each independently selected from hydrogen, hydroxy, $C_{1-6}alkyl$, hydroxy $C_{1-6}alkyl$, amino $C_{1-6}alkyl$ or aminoaryl; R^9 is independently selected from hydrogen, $C_{1-6}alkyl$, $C_{1-6}alkylcarbonyl$, aryl $C_{1-6}alkyl$, $C_{1-6}alkylpyrazinyl$, pyridinone, pyrrolidinone or methylimidazolyl; R^{10} is independently selected from hydrogen or $C_{1-6}alkyl$; R^2 is hydrogen, halo, hydroxy, amino, nitro, $C_{1-6}alkyl$, $C_{1-6}alkyloxy$, trifluoromethyl, di($C_{1-6}alkyl$)amino, hydroxyamino or naphthalenylsulfonylpyrazinyl; -L- is a direct bond or a bivalent radical selected from $C_{1-6}alkanediyl$, $C_{1-6}alkanediyl$ oxy, amino, carbonyl or aminocarbonyl; each R^3 independently represents a hydrogen atom and one hydrogen atom can be replaced by a substituent selected from aryl; R^4 is hydrogen, hydroxy, amino, hydroxy $C_{1-6}alkyl$, $C_{1-6}alkyl$, $C_{1-6}alkyloxy$, aryl $C_{1-6}alkyl$, aminocarbonyl, hydroxycarbonyl, amino $C_{1-6}alkyl$, aminocarbonyl $C_{1-6}alkyl$, hydroxycarbonyl $C_{1-6}alkyl$, hydroxyaminocarbonyl, $C_{1-6}alkyloxycarbonyl$, $C_{1-6}alkylaminoC_{1-6}alkyl$ or di($C_{1-6}alkyl$)amino $C_{1-6}alkyl$;

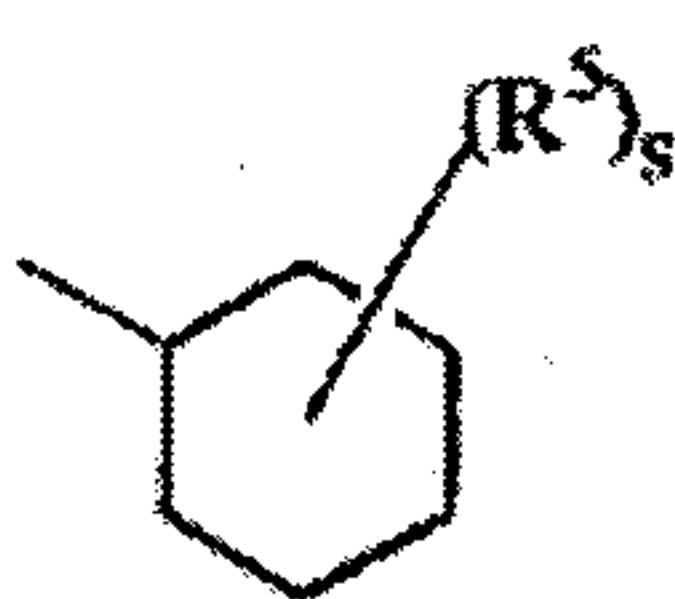
20



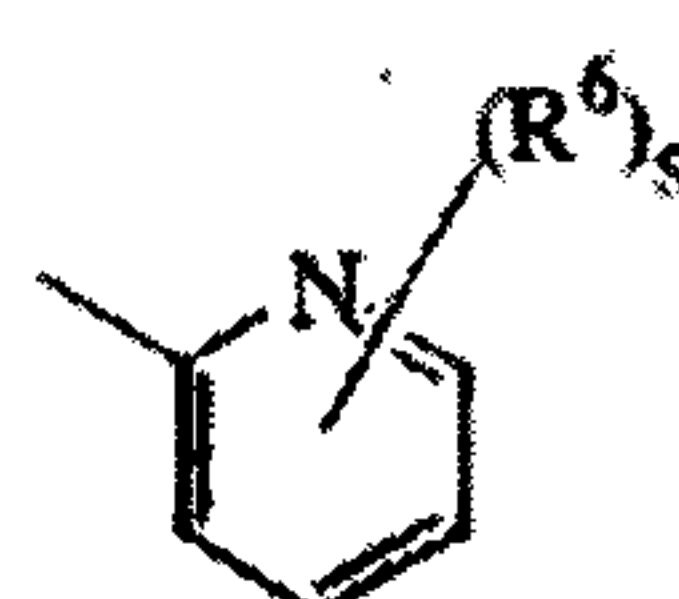
is a radical selected from



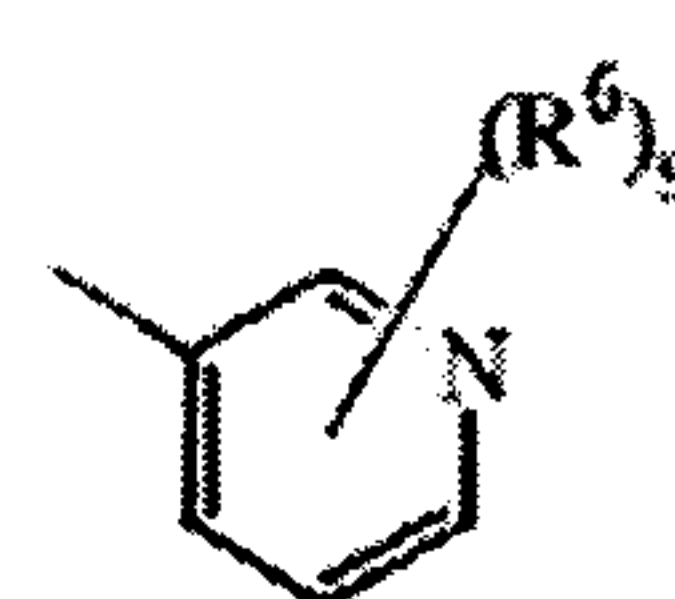
(a-1)



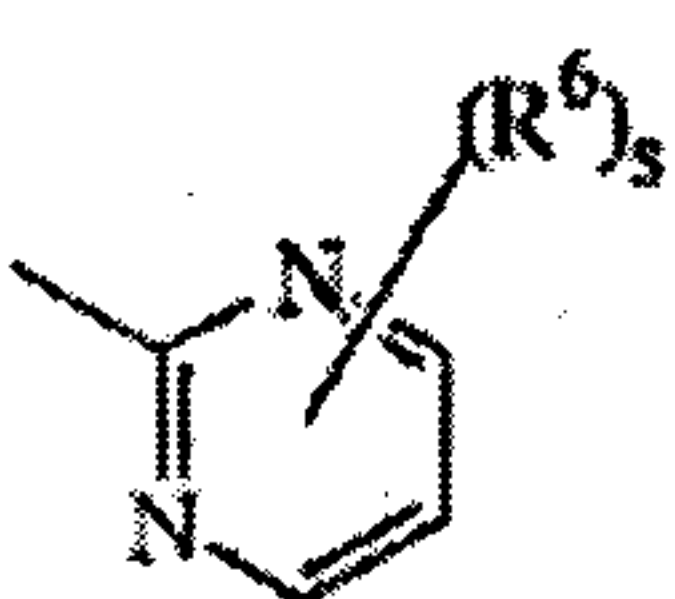
(a-2)



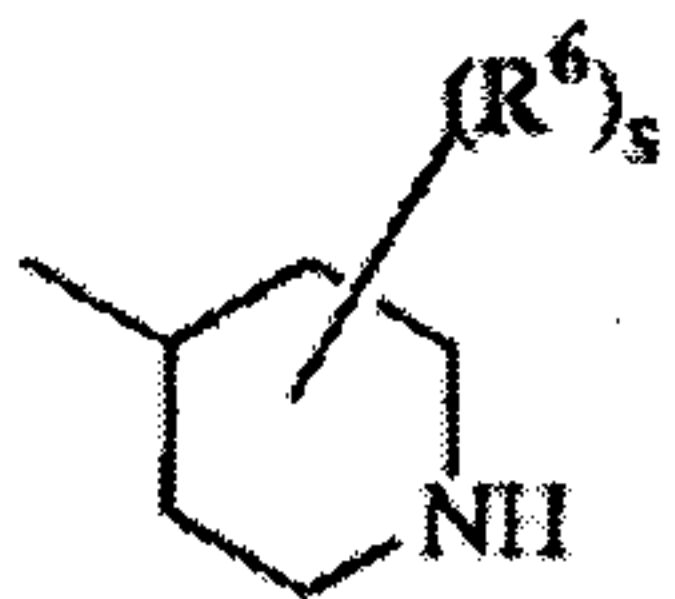
(a-3)



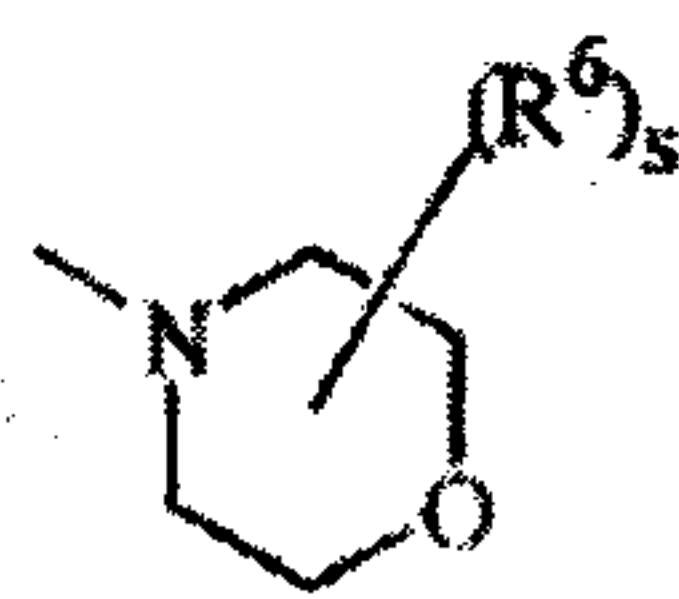
(a-4)



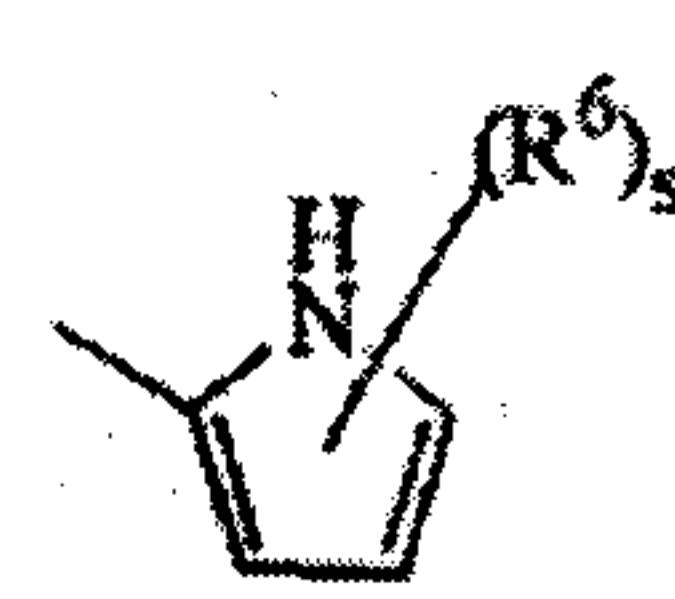
(a-5)



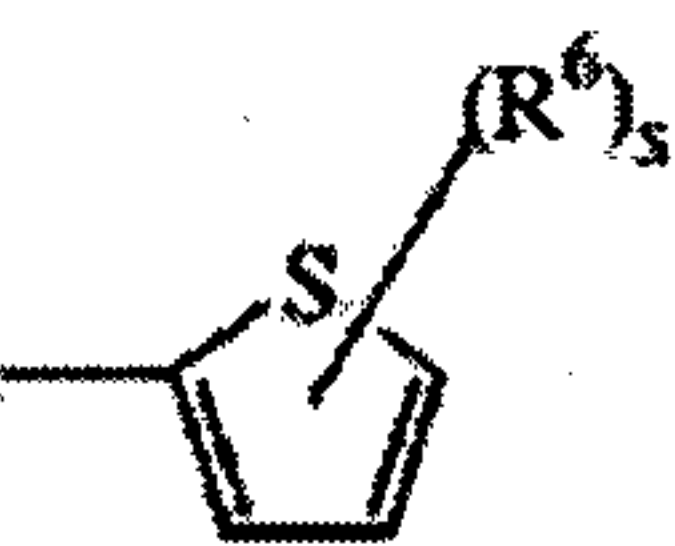
(a-6)



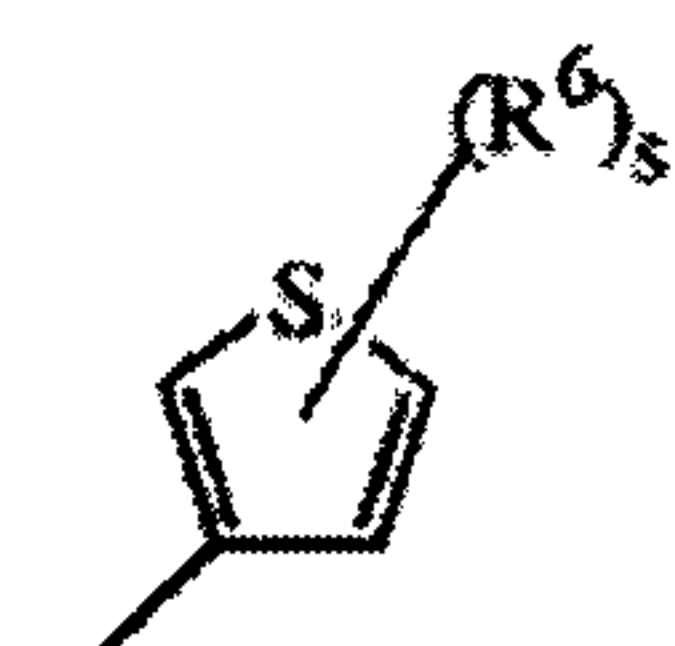
(a-7)



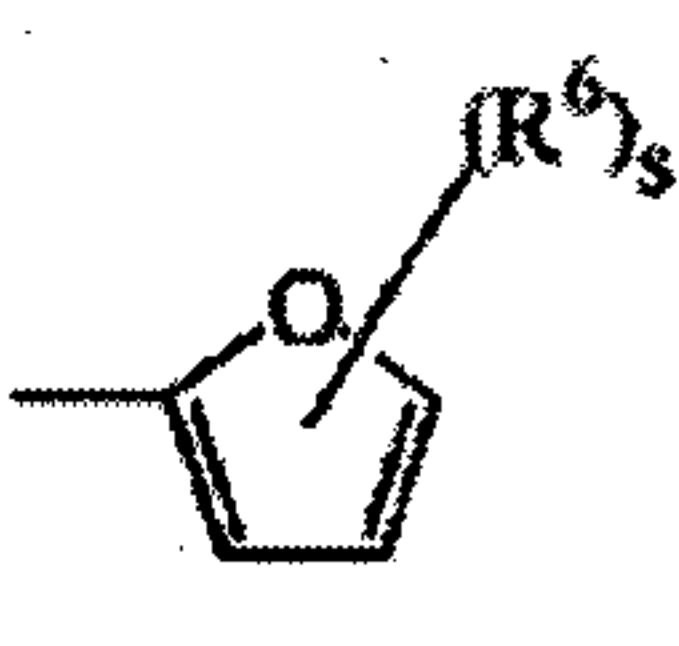
(a-8)



(a-9)



(a-10)



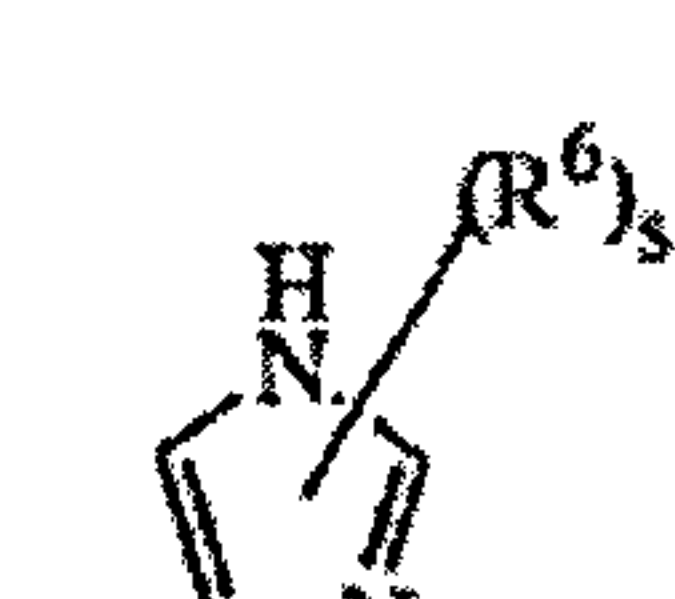
(a-11)



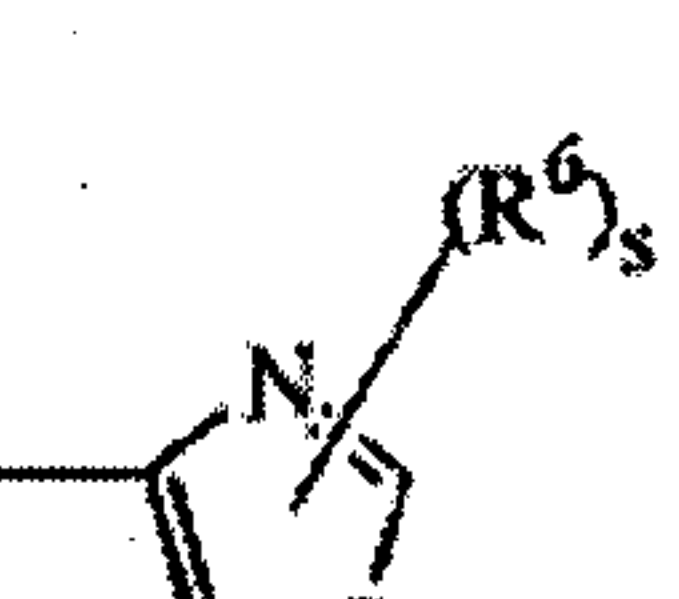
(a-12)



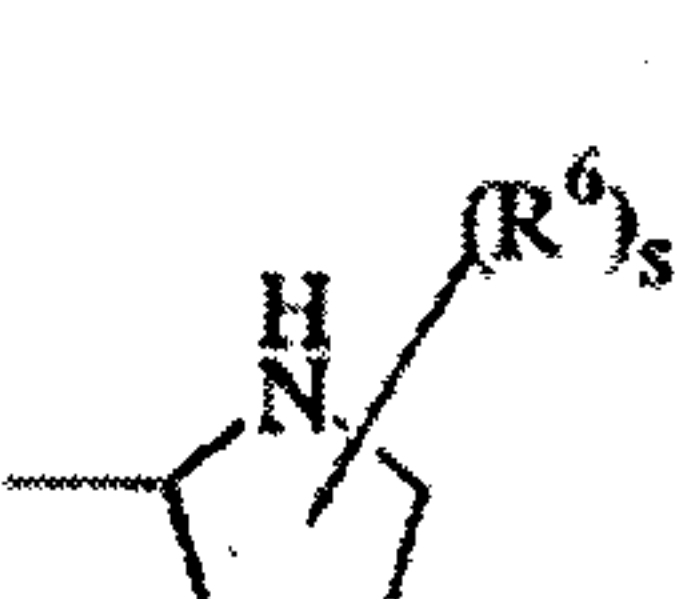
(a-13)



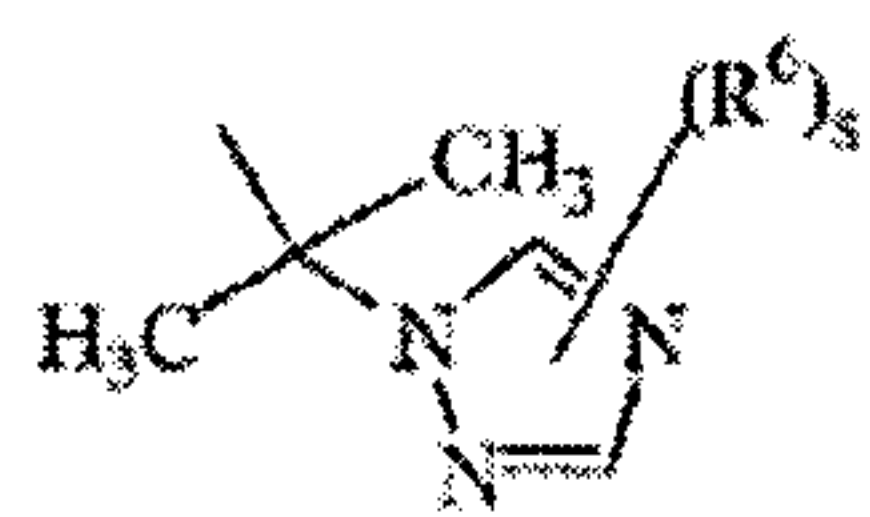
(a-14)



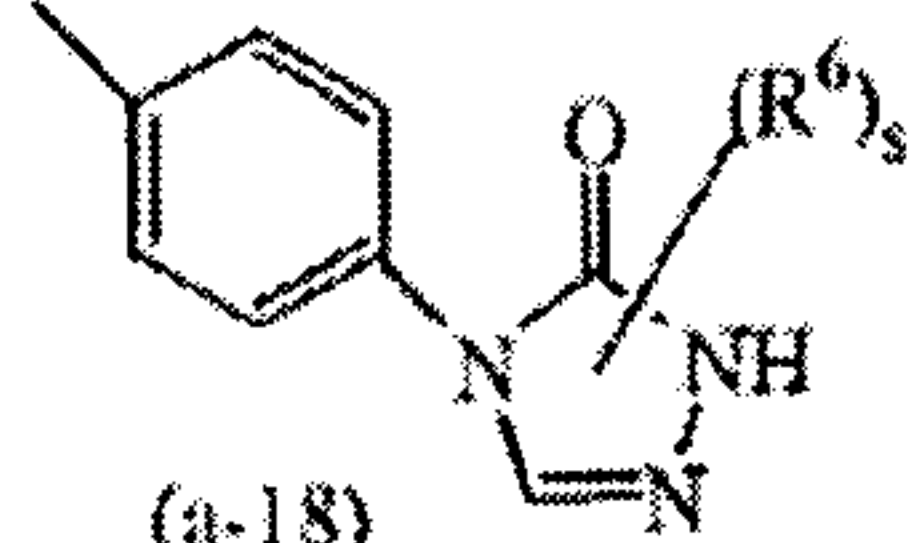
(a-15)



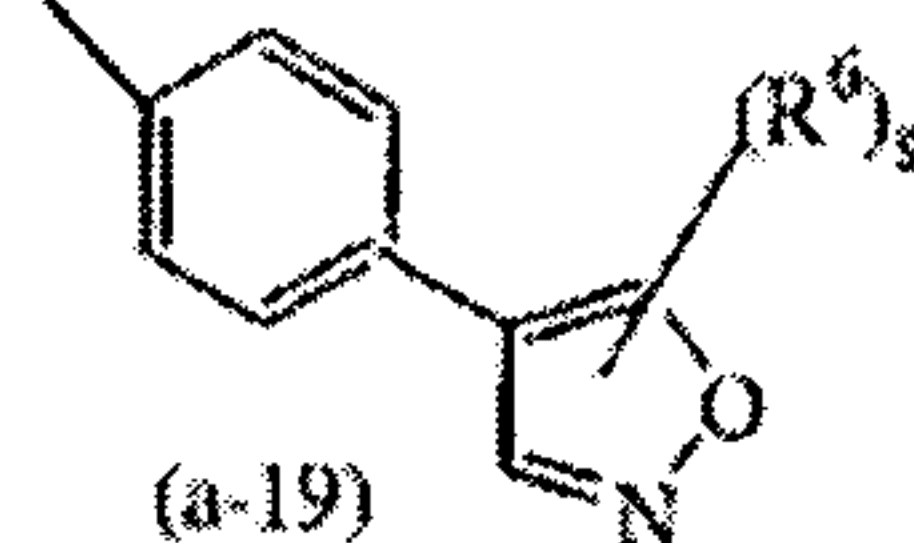
(a-16)



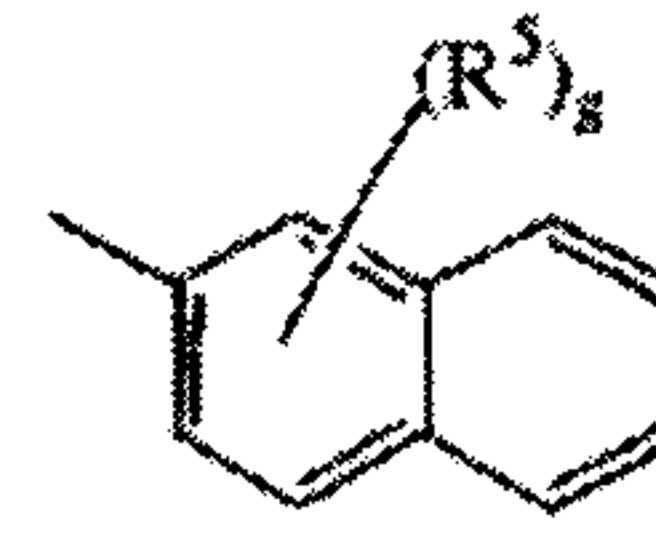
(a-17)



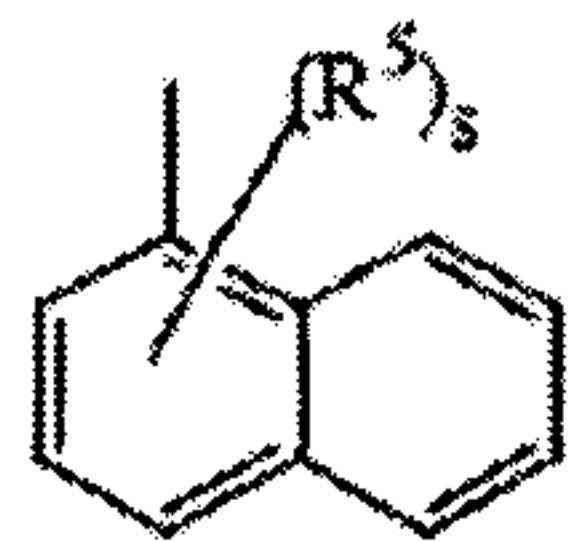
(a-18)



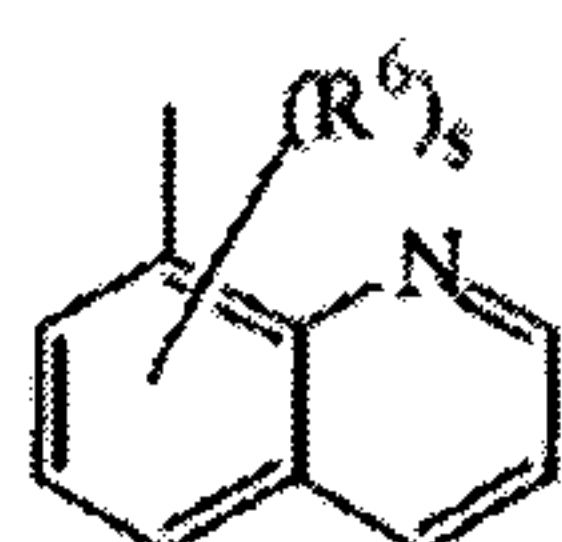
(a-19)



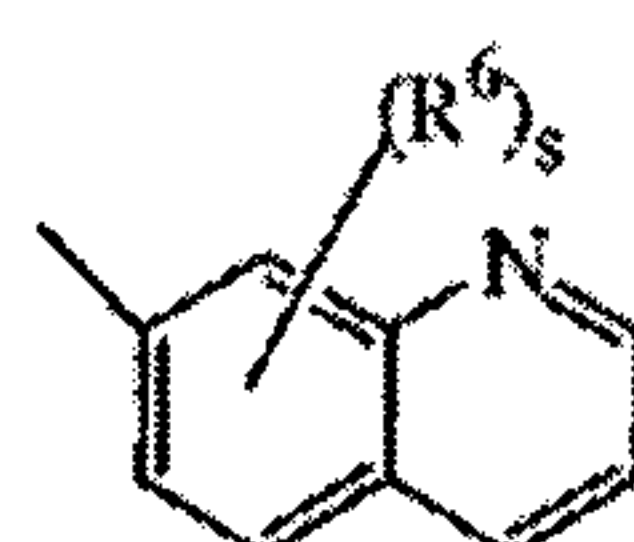
(a-20)



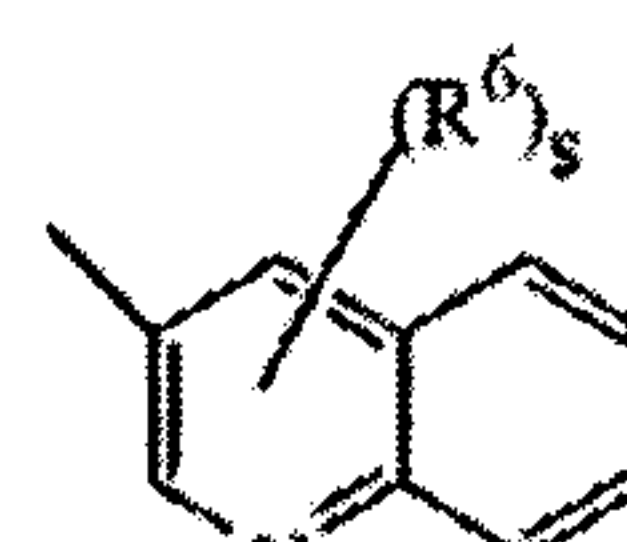
(a-21)



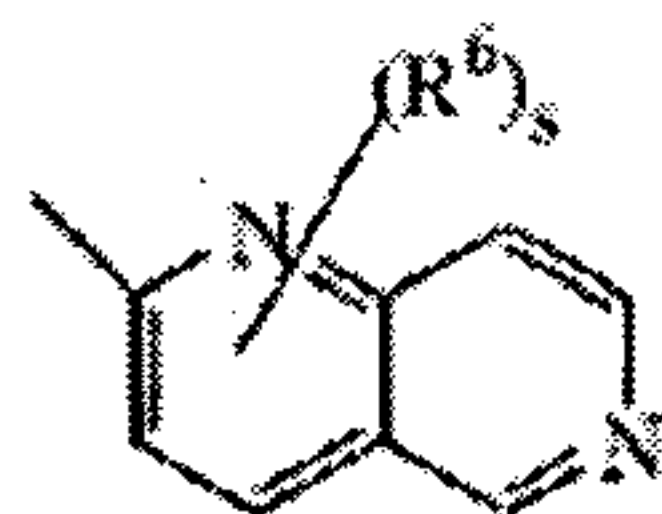
(a-22)



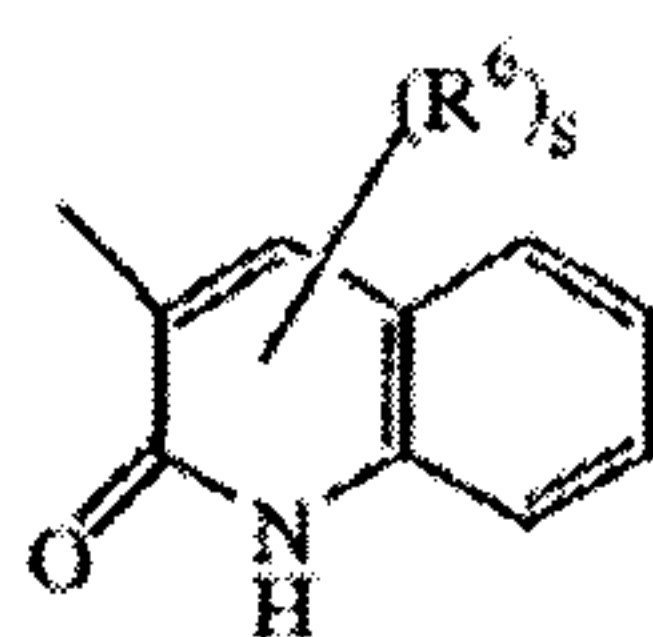
(a-23)



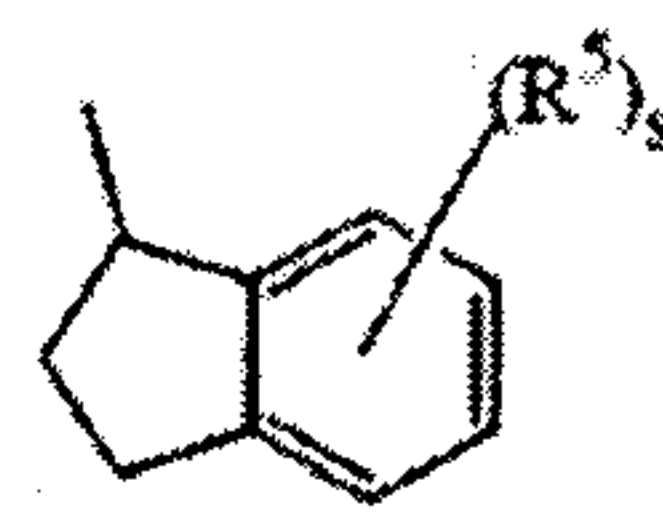
(a-24)



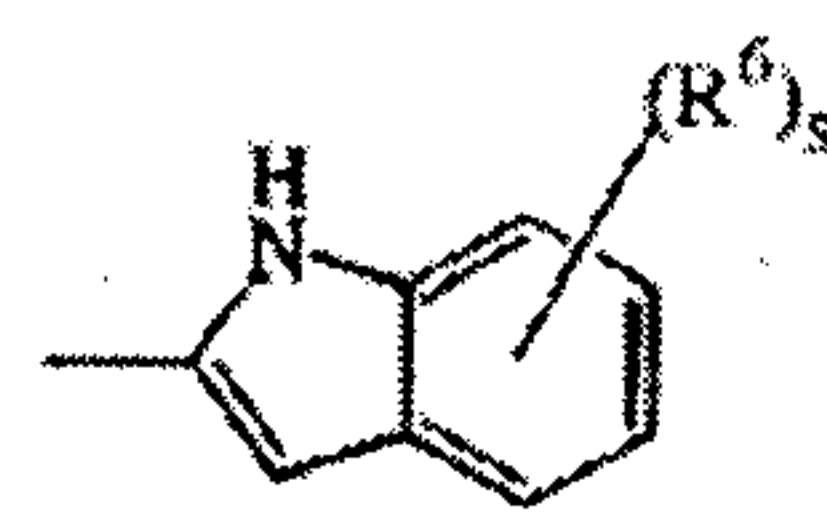
(a-25)



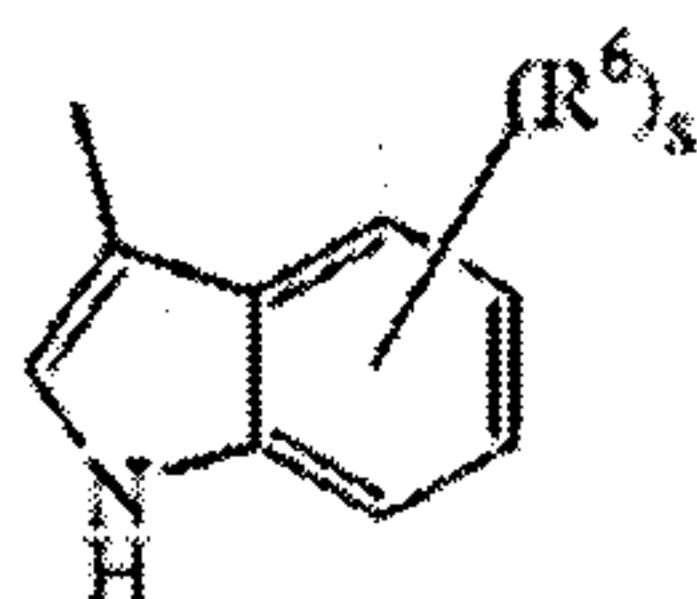
(a-26)



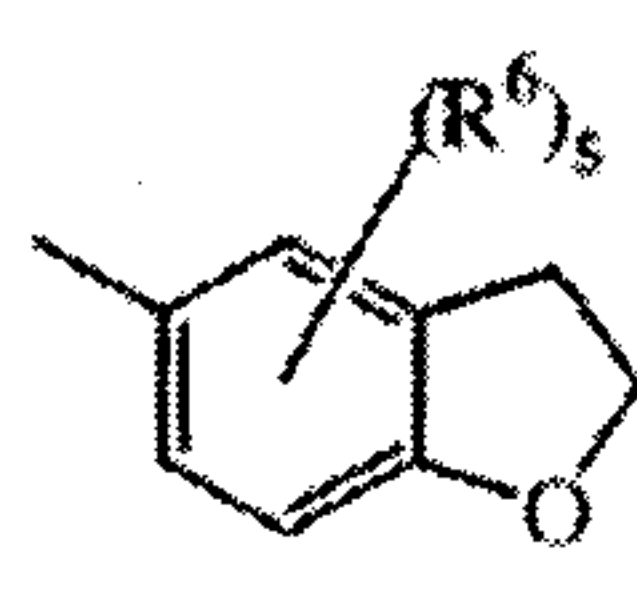
(a-27)



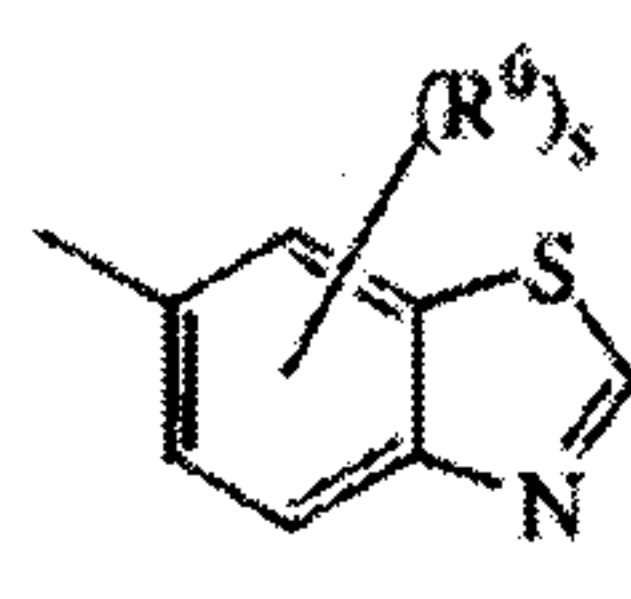
(a-28)



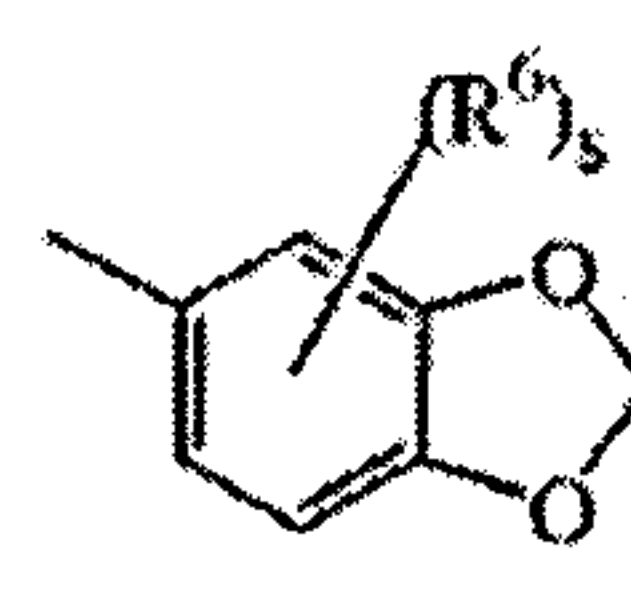
(a-29)



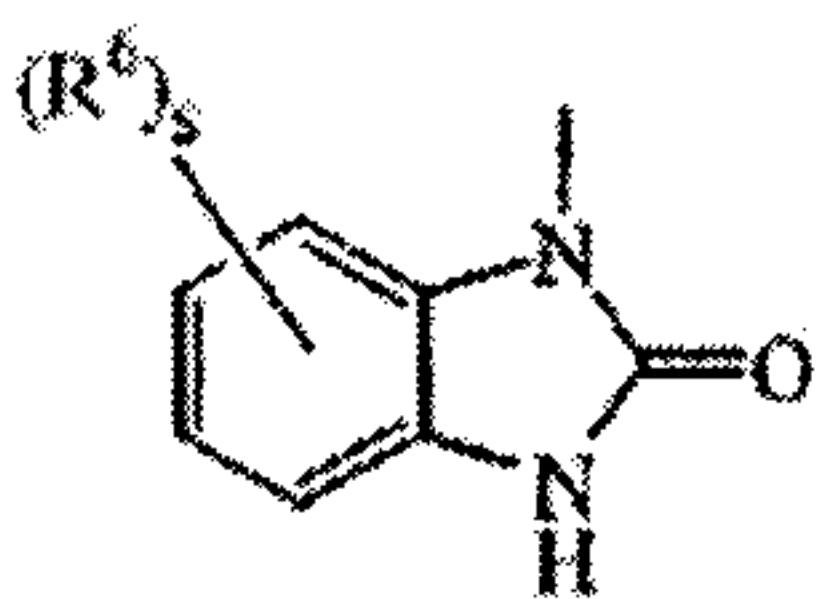
(a-30)



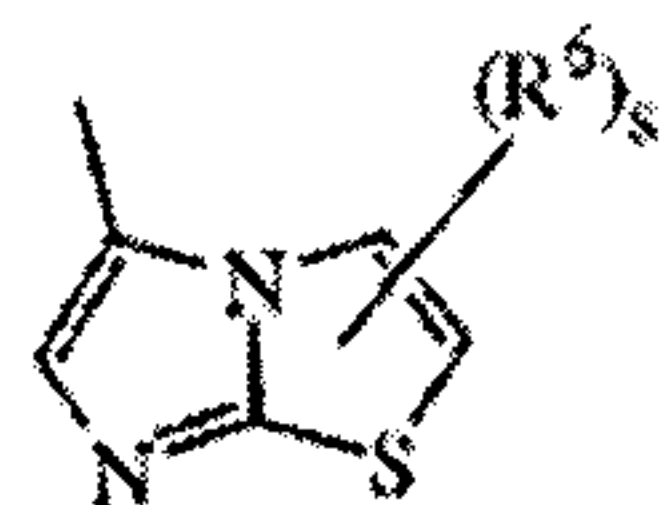
(a-31)



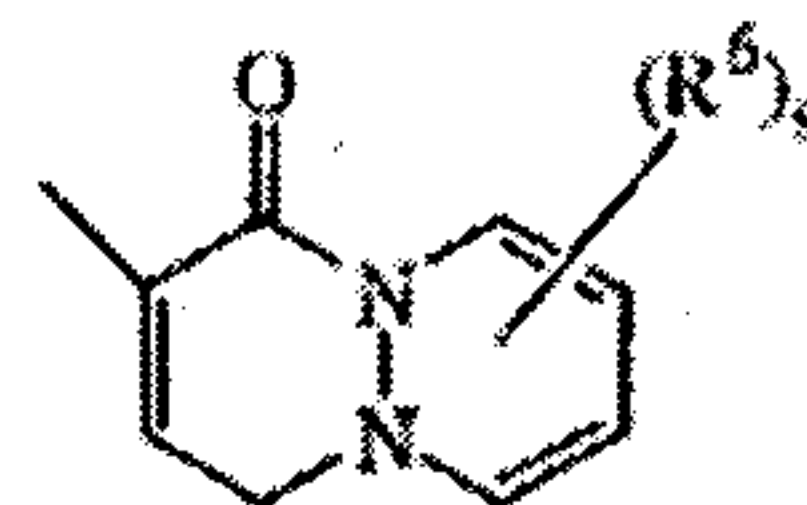
(a-32)



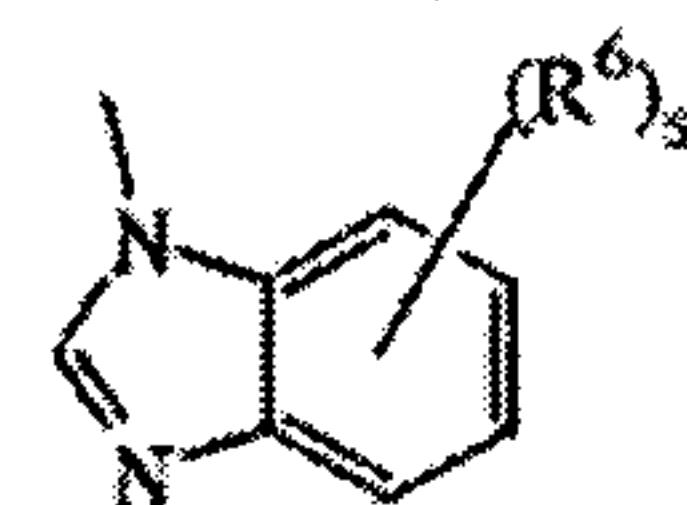
(a-33)



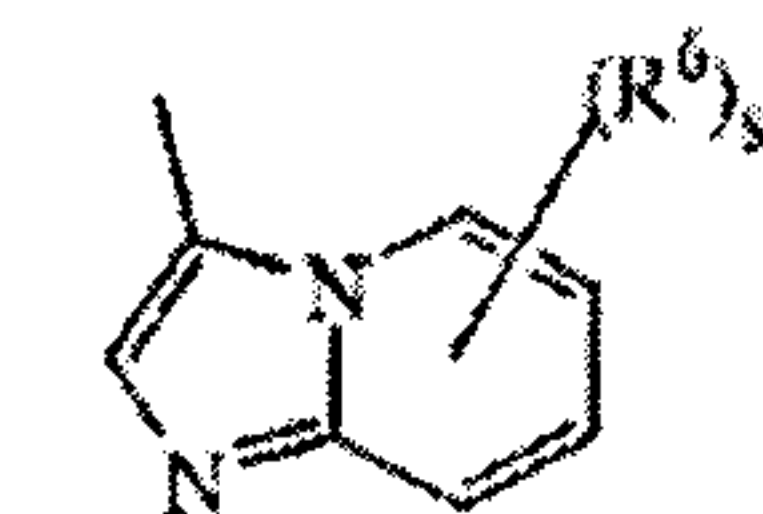
(a-34)



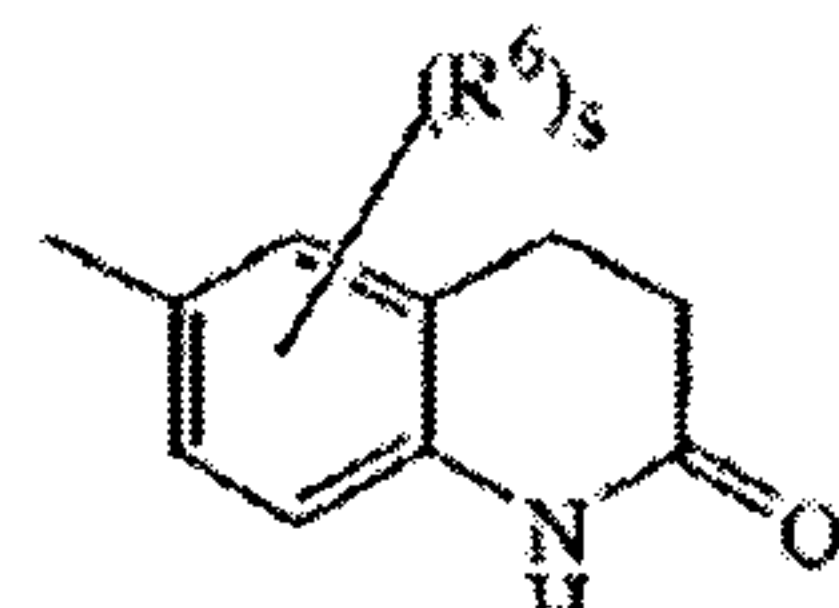
(a-35)



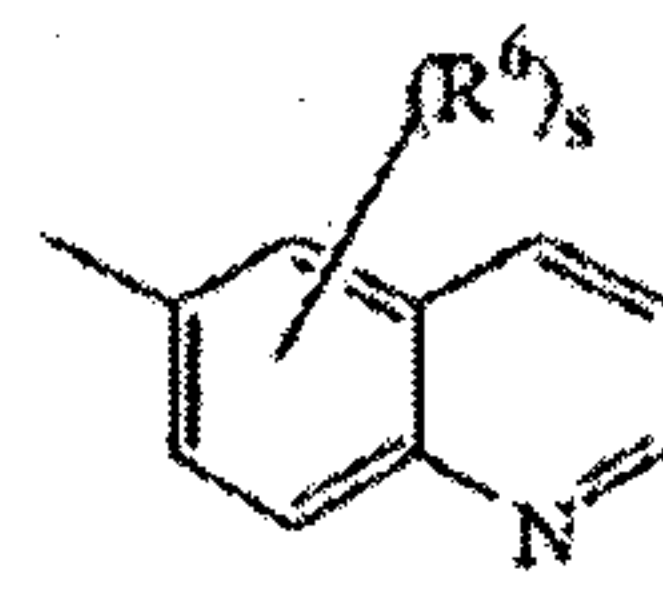
(a-36)



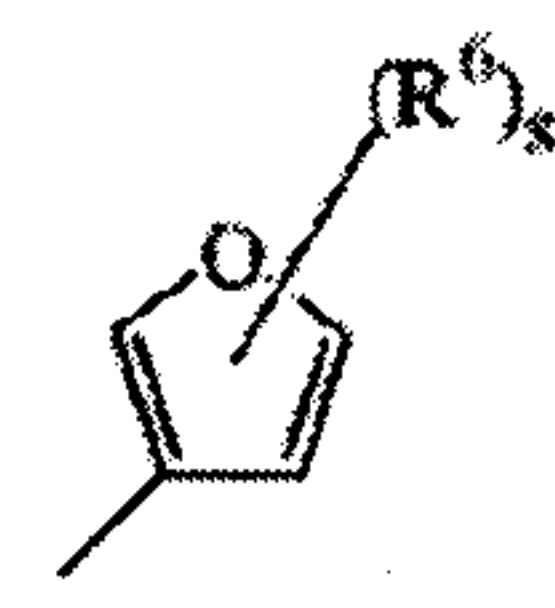
(a-37)



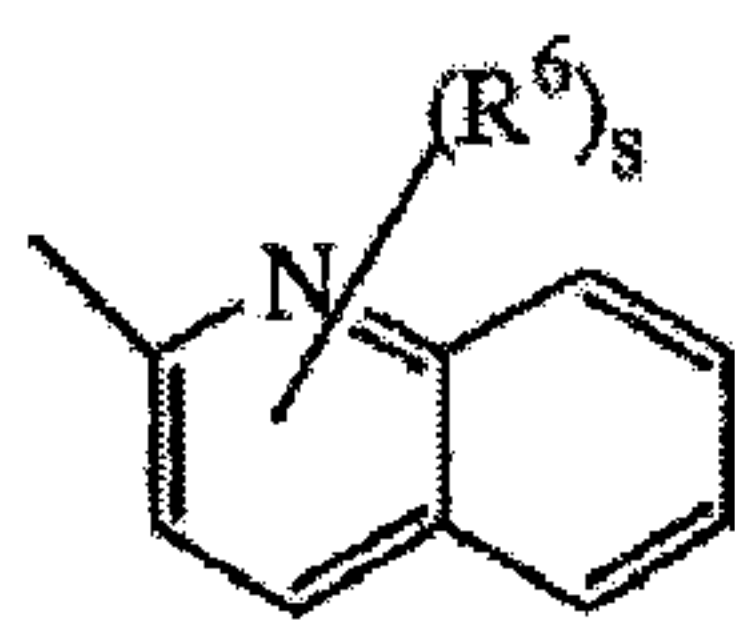
(a-38)



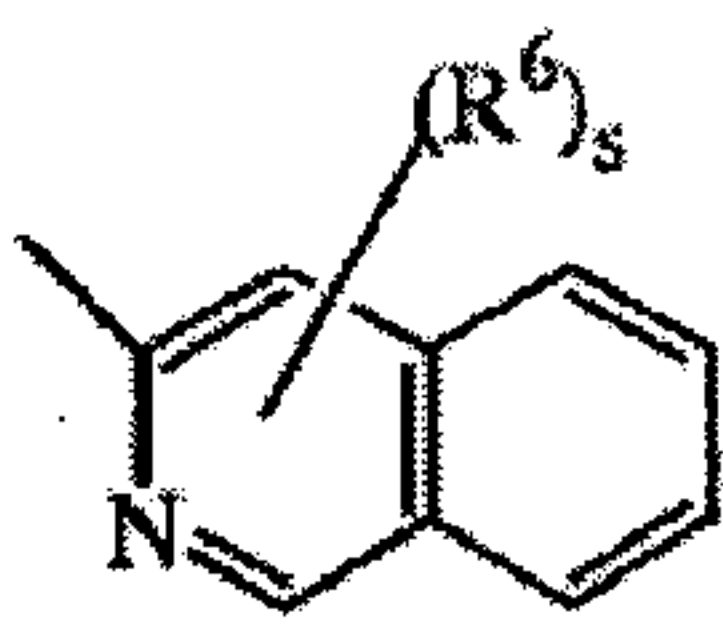
(a-39)



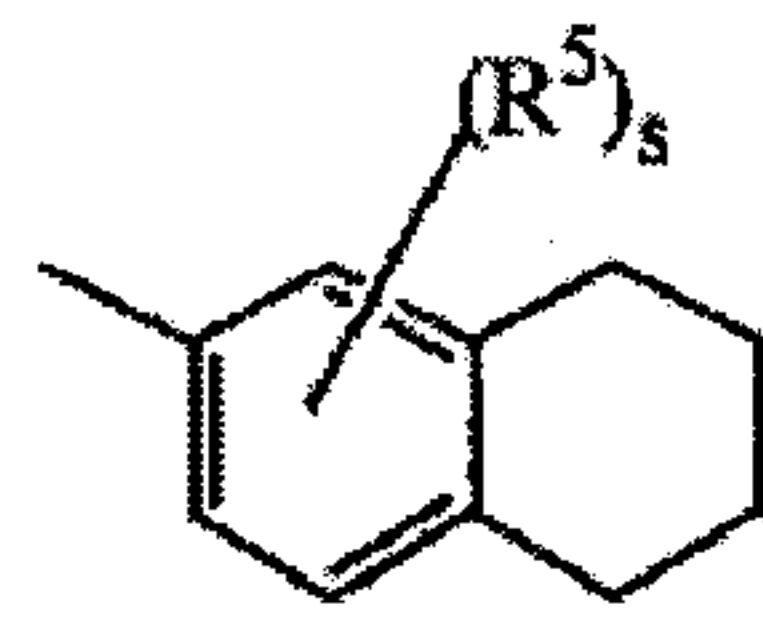
(a-40)



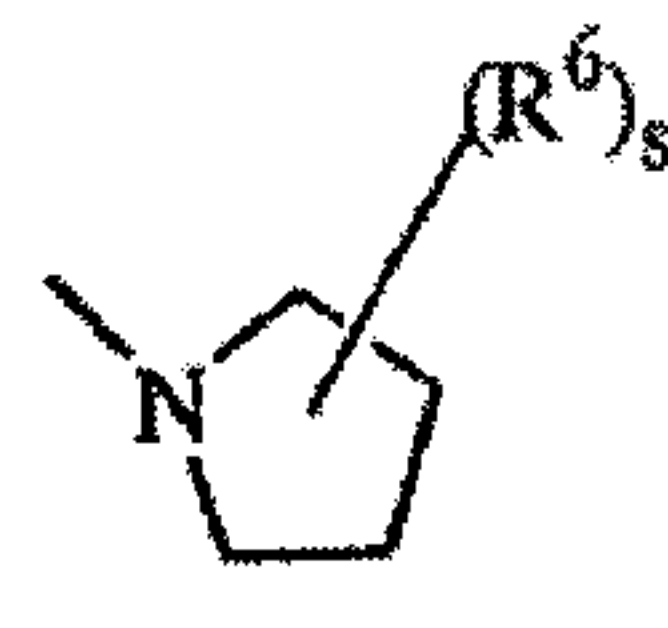
(a-41)



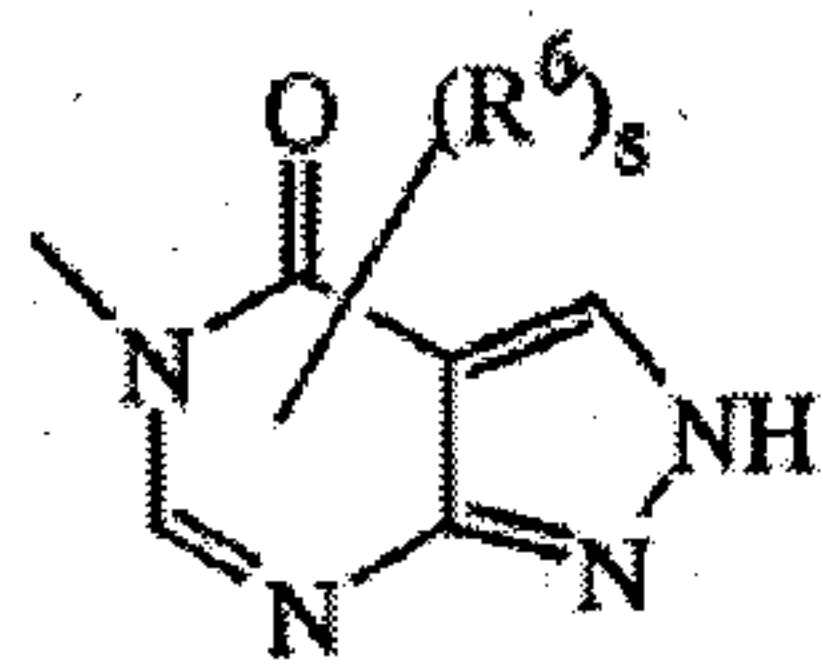
(a-42)



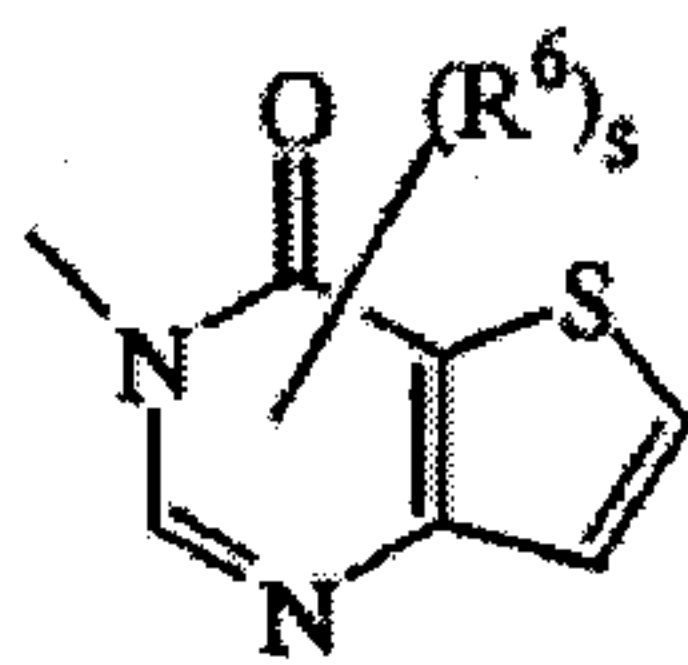
(a-43)



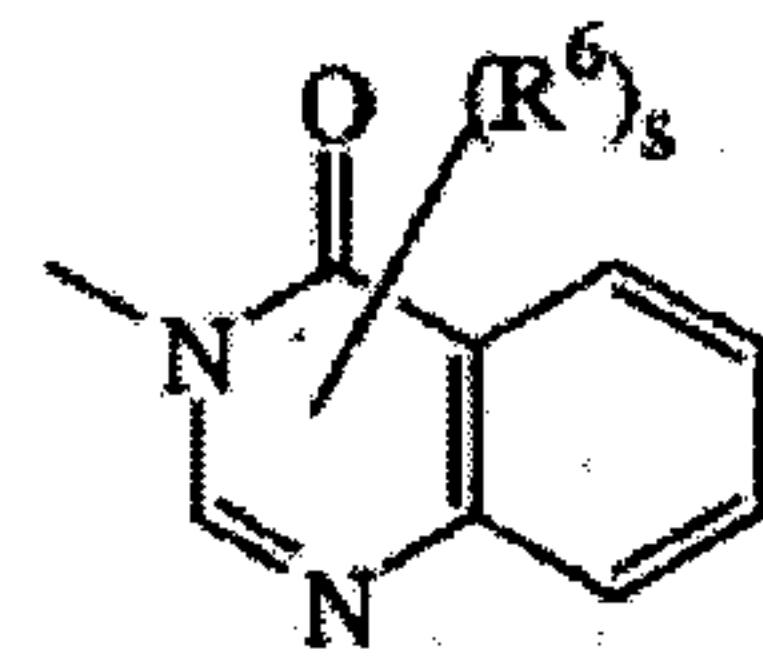
(a-44)



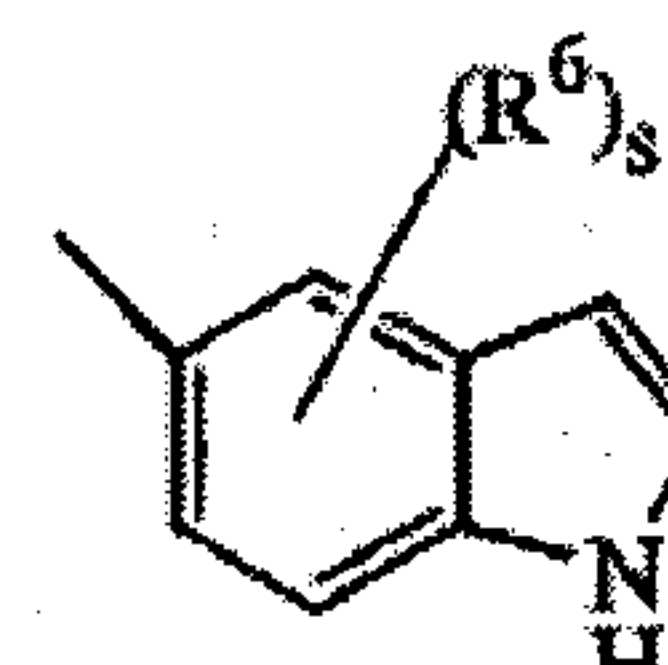
(a-45)



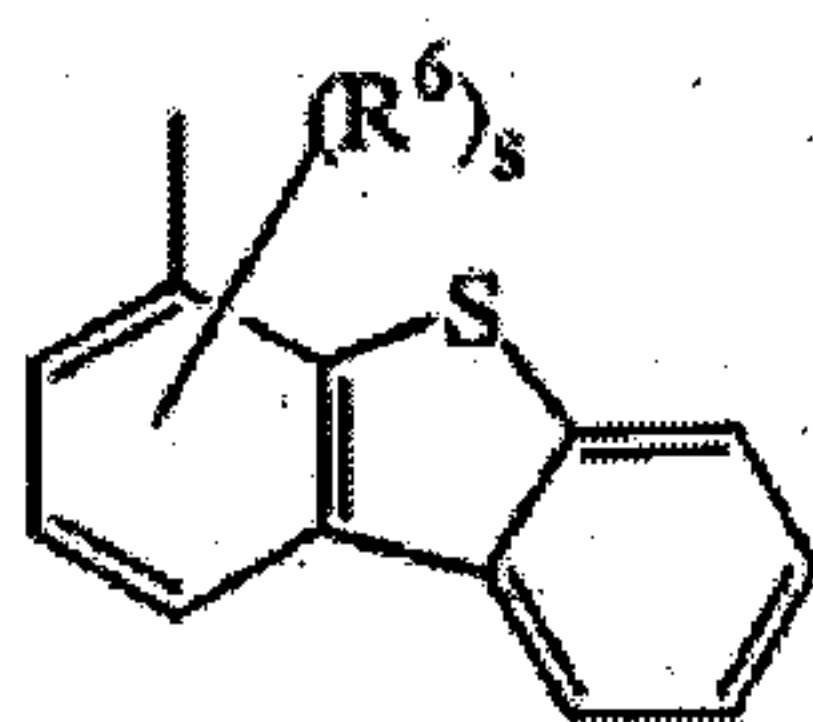
(a-46)



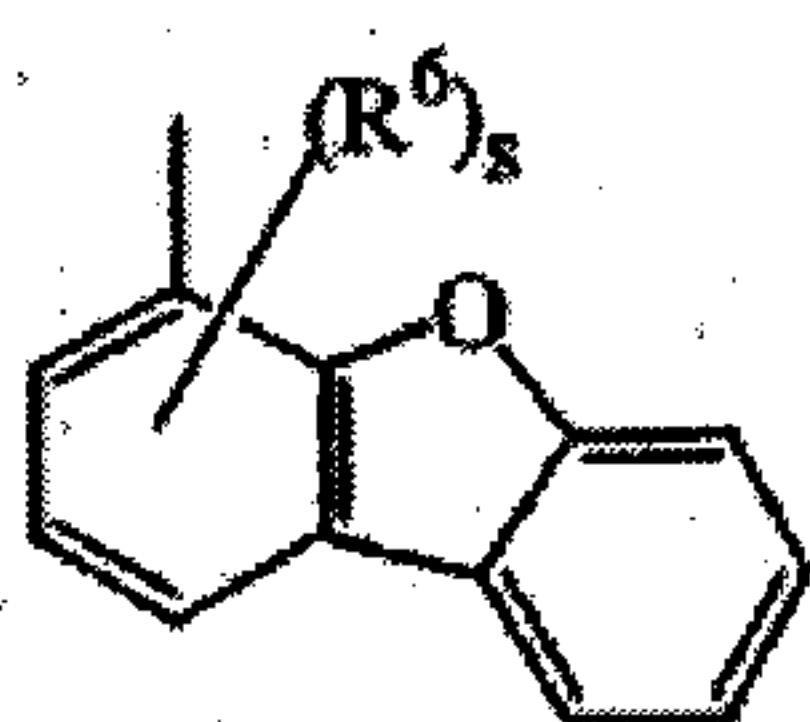
(a-47)



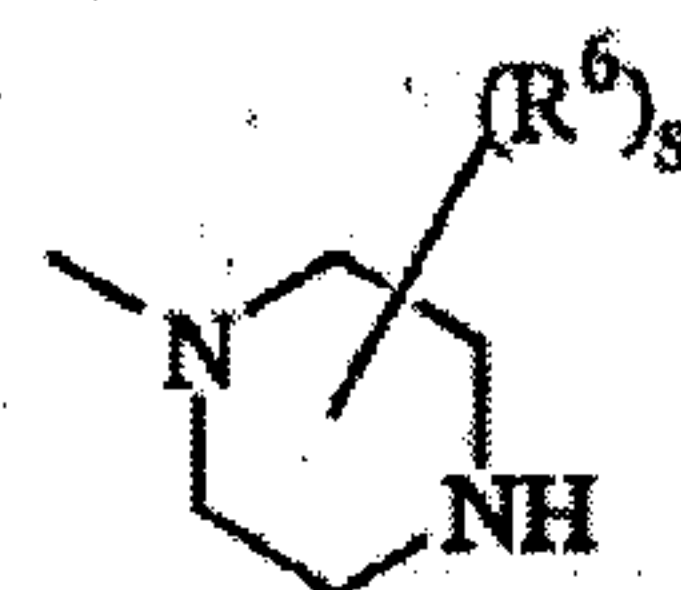
(a-48)



(a-49)



(a-50)



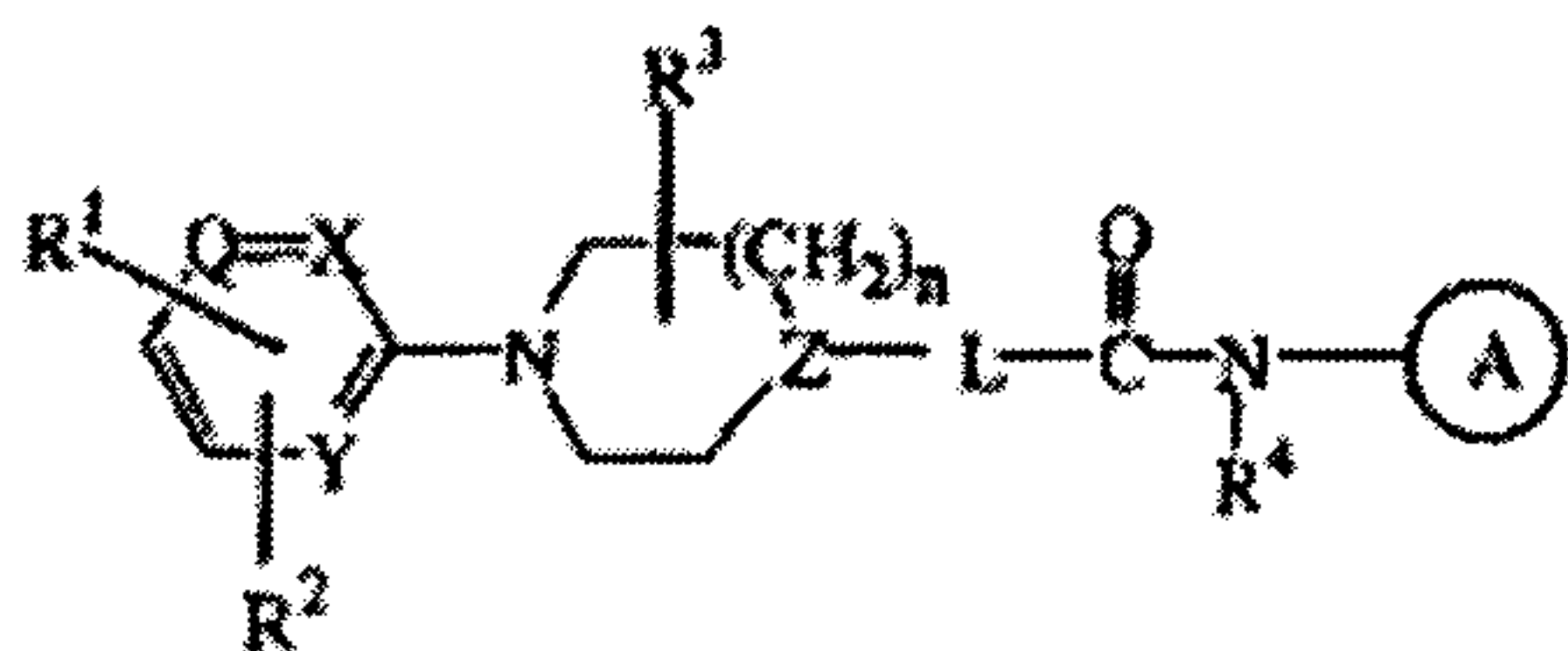
(a-51)

- wherein each s is independently 0, 1, 2, 3, 4 or 5; each R^5 and R^6 are independently selected from hydrogen; halo; hydroxy; amino; nitro; trihaloC₁₋₆alkyl; trihaloC₁₋₆alkyloxy; C₁₋₆alkyl; C₁₋₆alkyl substituted with aryl and C₃₋₁₀cycloalkyl; C₁₋₆alkyloxy; C₁₋₆alkyloxyC₁₋₆alkyloxy; C₁₋₆alkylcarbonyl; C₁₋₆alkyloxycarbonyl, C₁₋₆alkylsulfonyl; cyanoC₁₋₆alkyl; hydroxyC₁₋₆alkyl; hydroxyC₁₋₆alkyloxy; hydroxyC₁₋₆alkylamino; aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminocarbonyl; di(hydroxyC₁₋₆alkyl)amino; (aryl)(C₁₋₆alkyl)amino; di(C₁₋₆alkyl) aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminoC₁₋₆alkylamino;; di(C₁₋₆alkyl) aminoC₁₋₆alkylaminoC₁₋₆alkyl; arylsulfonyl; arylsulfonylamino; aryloxy; aryloxyC₁₋₆alkyl; arylC₂₋₆alkenediyl; di(C₁₋₆alkyl)amino; di(C₁₋₆alkyl) aminoC₁₋₆alkyl; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)amino, di(C₁₋₆alkyl)amino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkylaminoC₁₋₆alkyl(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl; aminosulfonylamino(C₁₋₆alkyl)amino; aminosulfonylamino(C₁₋₆alkyl) aminoC₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; cyano; thiophenyl; thiophenyl substituted with di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl) aminoC₁₋₆alkyl, di(C₁₋

- 6alkyl)aminoC₁₋₆alkyl, C₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, di(C₁₋₆alkyl)aminosulfonylpiperazinylC₁₋₆alkyl, C₁₋₆alkyloxypiperidinyl, C₁₋₆alkyloxypiperidinylC₁₋₆alkyl, morpholinylC₁₋₆alkyl, hydroxyC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, or
 5 di(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkyl; furanyl; furanyl substituted with hydroxyC₁₋₆alkyl; benzofuranyl; imidazolyl; oxazolyl; oxazolyl substituted with aryl and C₁₋₆alkyl; C₁₋₆alkyltriazolyl; tetrazolyl; pyrrolidinyl; pyrrolyl; piperidinylC₁₋₆alkyloxy; morpholinyl; C₁₋₆alkylmorpholinyl; morpholinylC₁₋₆alkyloxy; morpholinylC₁₋₆alkyl; morpholinylC₁₋₆alkylamino; morpholinylC₁₋₆alkylaminoC₁₋₆alkyl; piperazinyl; C₁₋₆alkylpiperazinyl; C₁₋₆alkylpiperazinylC₁₋₆alkyloxy; piperazinylC₁₋₆alkyl; naphtalenylsulfonylpiperazinyl; naphtalenylsulfonylpiperidinyl; naphtalenylsulfonyl; C₁₋₆alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkylpiperazinylC₁₋₆alkylamino; C₁₋₆alkylpiperazinylC₁₋₆alkylaminoC₁₋₆alkyl; C₁₋₆alkylpiperazinylsulfonyl; aminosulfonylpiperazinylC₁₋₆alkyloxy; aminosulfonylpiperazinyl; aminosulfonylpiperazinylC₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylpiperazinyl; di(C₁₋₆alkyl)aminosulfonylpiperazinylC₁₋₆alkyl; hydroxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkyloxypiperidinyl; C₁₋₆alkyloxypiperidinylC₁₋₆alkyl; piperidinylaminoC₁₋₆alkylamino; piperidinylaminoC₁₋₆alkylaminoC₁₋₆alkyl; : (C₁₋₆alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylamino; (C₁₋₆alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl; (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)amino; (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)aminoC₁₋₆alkyl; hydroxyC₁₋₆alkylaminoC₁₋₆alkyl; di(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkyl; pyrrolidinylC₁₋₆alkyl; pyrrolidinylC₁₋₆alkyloxy; pyrazolyl; thiopyrazolyl; pyrazolyl substituted with two substituents selected from C₁₋₆alkyl or trihaloC₁₋₆alkyl; pyridinyl; pyridinyl substituted with C₁₋₆alkyloxy, aryloxy or aryl; pyrimidinyl; tetrahydropyrimidinylpiperazinyl; tetrahydropyrimidinylpiperazinylC₁₋₆alkyl; quinolinyl; indole; phenyl; phenyl substituted with one, two or three substituents independently selected from halo, amino, nitro, C₁₋₆alkyl, C₁₋₆alkyloxy, hydroxyC₁₋₄alkyl, trifluoromethyl, trifluoromethyloxy, hydroxyC₁₋₄alkyloxy, C₁₋₄alkylsulfonyl, C₁₋₄alkyloxyC₁₋₄alkyloxy, C₁₋₄alkyloxycarbonyl, aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminocarbonyl, di(C₁₋₄alkyl)aminoC₁₋₄alkyl,

di(C₁₋₄alkyl) aminoC₁₋₄alkylaminoC₁₋₄alkyl, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄alkyl)aminoC₁₋₄alkyl, aminosulfonylamino(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl) aminosulfonylamino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminosulfonylamino(C₁₋₄alkyl)aminoC₁₋₆alkyl, cyano, piperidinylC₁₋₄alkyloxy, pyrrolidinylC₁₋₄alkyloxy, aminosulfonylpiperazinyl, aminosulfonylpiperazinylC₁₋₄alkyl, di(C₁₋₄alkyl)aminosulfonylpiperazinyl, di(C₁₋₄alkyl)aminosulfonylpiperazinylC₁₋₄alkyl, hydroxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkyloxypiperidinyl, C₁₋₄alkyloxypiperidinylC₁₋₄alkyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)amino, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)aminoC₁₋₄alkyl,; di(hydroxyC₁₋₄alkyl)amino, di(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkyl, furanyl, furanyl substituted with -CH-CH-CH=CH-, pyrrolidinylC₁₋₄alkyl, pyrrolidinylC₁₋₄alkyloxy, morpholinyl, morpholinylC₁₋₄alkyloxy, morpholinylC₁₋₄alkyl, morpholinylC₁₋₄alkylamino, morpholinylC₁₋₄alkylaminoC₁₋₄alkyl, piperazinyl, C₁₋₄alkylpiperazinyl, C₁₋₄alkylpiperazinylC₁₋₄alkyloxy, piperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkylamino, C₁₋₄alkylpiperazinylC₁₋₄alkylaminoC₁₋₆alkyl, tetrahydropyrimidinylpiperazinyl, tetrahydropyrimidinylpiperazinylC₁₋₄alkyl, piperidinylaminoC₁₋₄alkylamino, piperidinylaminoC₁₋₄alkylaminoC₁₋₄alkyl, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylamino, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄alkyl, pyridinylC₁₋₄alkyloxy, hydroxyC₁₋₄alkylamino, hydroxyC₁₋₄alkylaminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylamino, aminothiadiazolyl, aminosulfonylpiperazinylC₁₋₄alkyloxy, or thiophenylC₁₋₄alkylamino; each R⁵ and R⁶ can be placed on the nitrogen in replacement of the hydrogen; aryl in the above is phenyl, or phenyl substituted with one or more substituents each independently selected from halo, C₁₋₆alkyl, C₁₋₆alkyloxy, trifluoromethyl, cyano or hydroxycarbonyl. See, for example, compounds disclosed in WO2003076400.

In one aspect, the inhibitor of histone deacetylase activity may be an aminocarbonyl derivative, such as, for example, compounds disclosed in WO2003076421, having the general formula:



- 5 the *N*- oxide forms, the pharmaceutically acceptable addition salts and the stereochemically isomeric forms thereof, wherein *n* is 0, 1, 2 or 3 and when *n* is 0 then a direct bond is intended;

each Q is nitrogen or —C= ;

each X is nitrogen or —C= ;

each Y is nitrogen or —C= ;

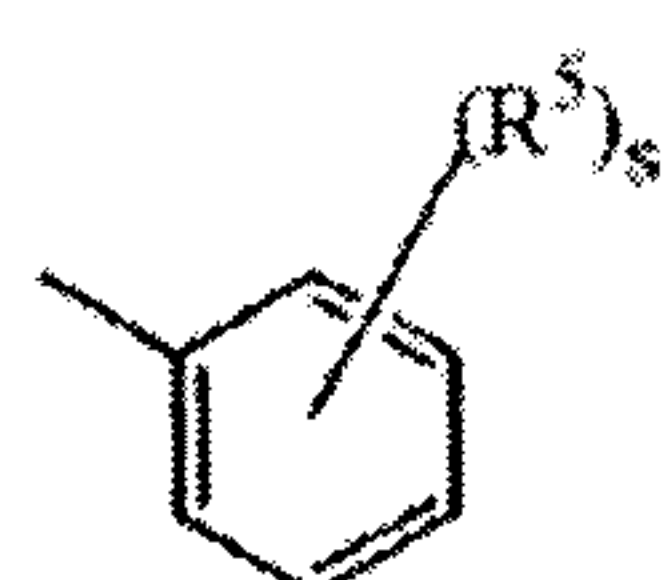
each Z is nitrogen or —CH— ;

- R^1 is —C(O)NR^7R^8 , —N(H)C(O)R^9 , $\text{—C(O)—C}_{1-6}\text{alkanediyISR}^9$, $\text{—NR}^{10}\text{C(O)N(OH)R}^9$, —N
 10 $\text{R}^{10}\text{C(O)C}_{1-6}\text{alkanediyISR}^9$, $\text{—NR}^{10}\text{C(O)C=N(OH)R}^9$ or another Zn-chelating group wherein R^7 and R^8 are each independently selected from hydrogen, hydroxy, C_{1-6} alkyl, hydroxy C_{1-6} alkyl, amino C_{1-6} alkyl or aminoaryl; R^9 is independently selected from hydrogen, C_{1-6} alkyl, C_{1-6} alkylcarbonyl, aryl C_{1-6} alkyl, C_{1-6} alkylpyrazinyl, pyridinone, pyrrolidinone or methylimidazolyl; R^{10} is independently selected from hydrogen or C_{1-}
 15 C_{6} alkyl; R^2 is hydrogen, halo, hydroxy, amino, nitro, C_{1-6} alkyl, C_{1-6} alkyloxy, trifluoromethyl, $\text{di(C}_{1-6}\text{alkyl)amino}$, hydroxyamino or naphthalenylsulfonylpyrazinyl; R^3 is hydrogen, hydroxy, amino, hydroxy C_{1-6} alkyl, C_{1-6} alkyl, C_{1-6} alkyloxy, aryl C_{1-6} alkyl, aminocarbonyl, hydroxycarbonyl, amino C_{1-6} alkyl, aminocarbonyl C_{1-6} alkyl, hydroxycarbonyl C_{1-6} alkyl, hydroxyaminocarbonyl, C_{1-6} alkyloxycarbonyl, C_{1-}
 20 C_{6} alkylamino C_{1-6} alkyl or $\text{di(C}_{1-6}\text{alkyl)aminoC}_{1-6}$ alkyl; when Z is equal to nitrogen, then-L-

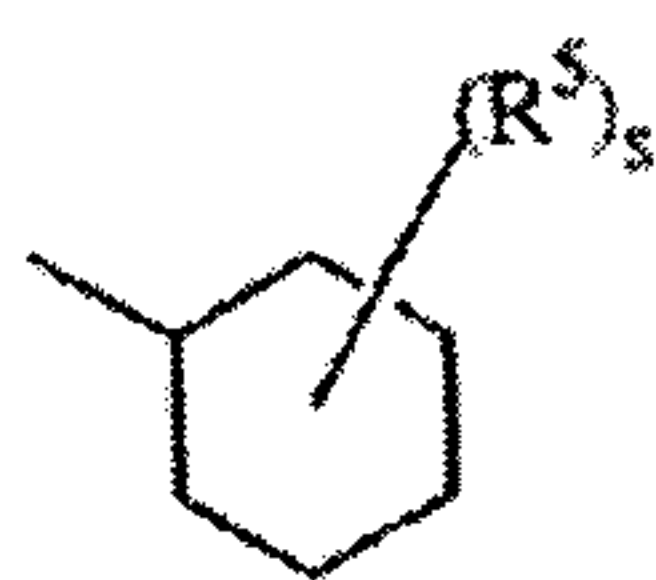
is a direct bond; when Z is equal to —CH— , then -L- is -NH- or the bivalent radical $\text{—C}_{1-6}\text{alkanedlylNH—}$; R^4 is hydrogen, $\text{C}_{1-6}\text{alkyl}$, $\text{C}_{3-10}\text{cycloalkyl}$, hydroxy $\text{C}_{1-6}\text{alkyl}$, $\text{C}_{1-6}\text{alkyloxyC}_{1-6}\text{alkyl}$, di($\text{C}_{1-6}\text{alkyl}$)amino $\text{C}_{1-6}\text{alkyl}$ or aryl;



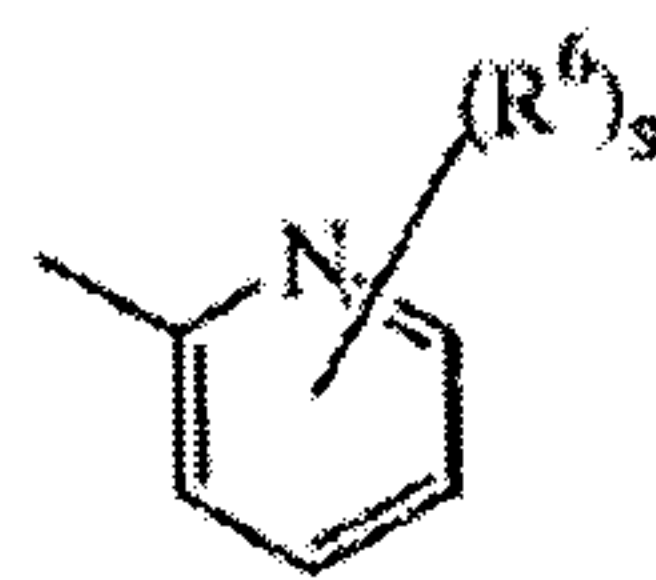
is a radical selected from



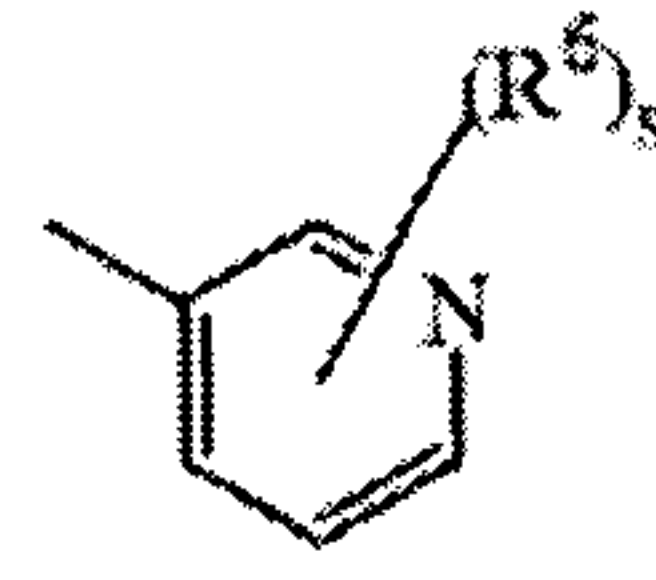
(a-1)



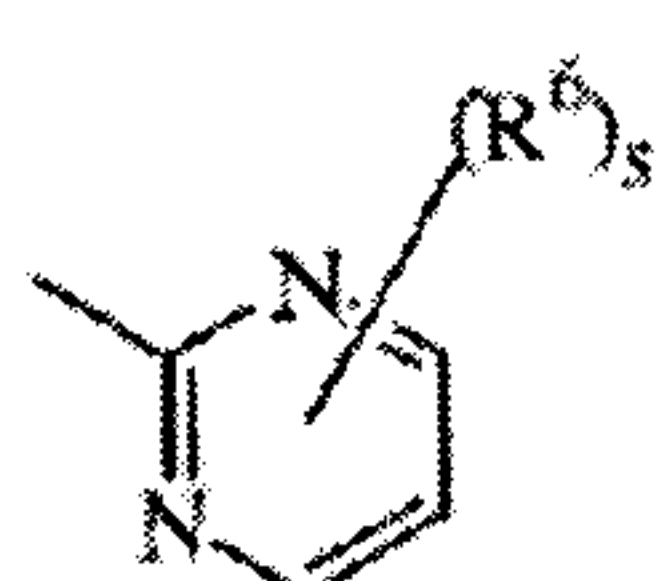
(a-2)



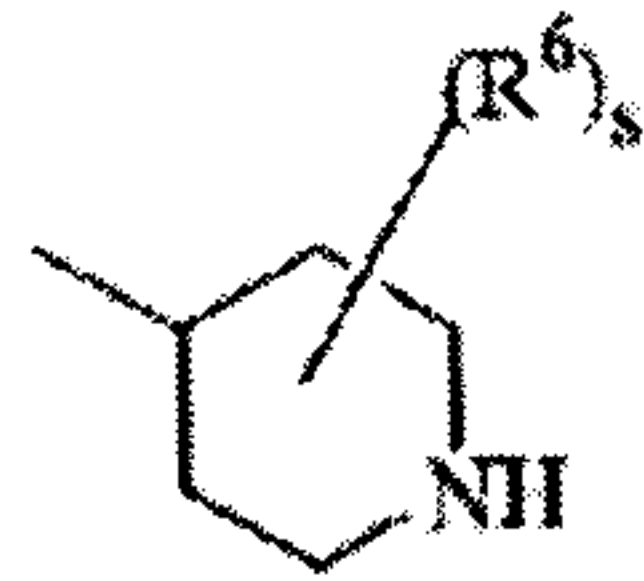
(a-3)



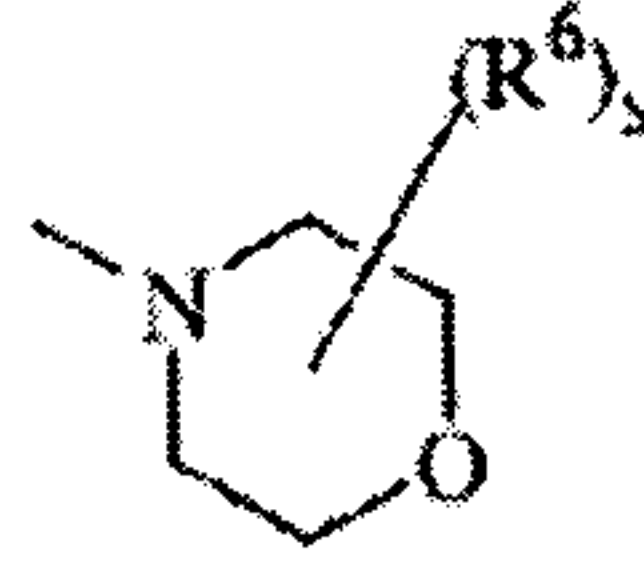
(a-4)



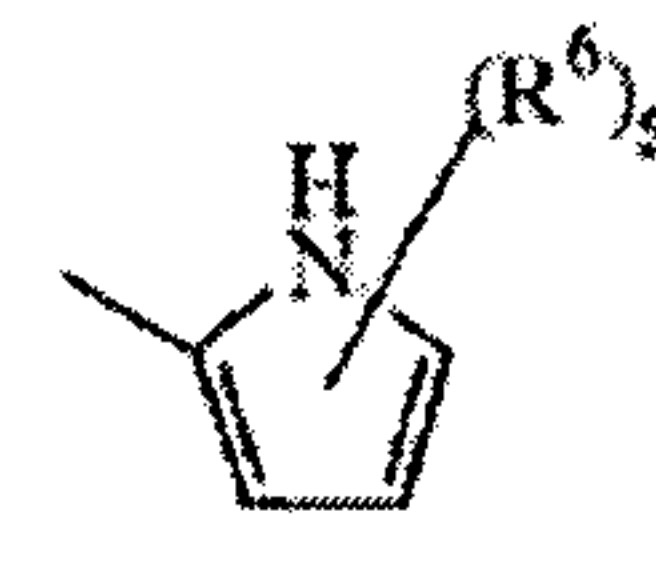
(a-5)



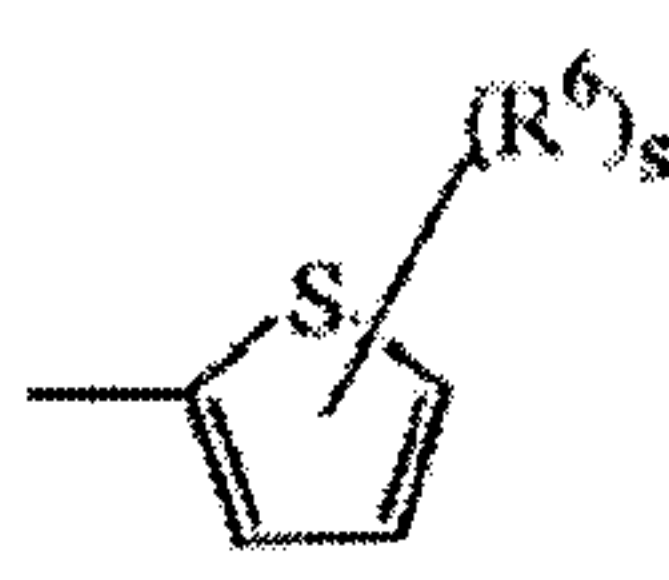
(a-6)



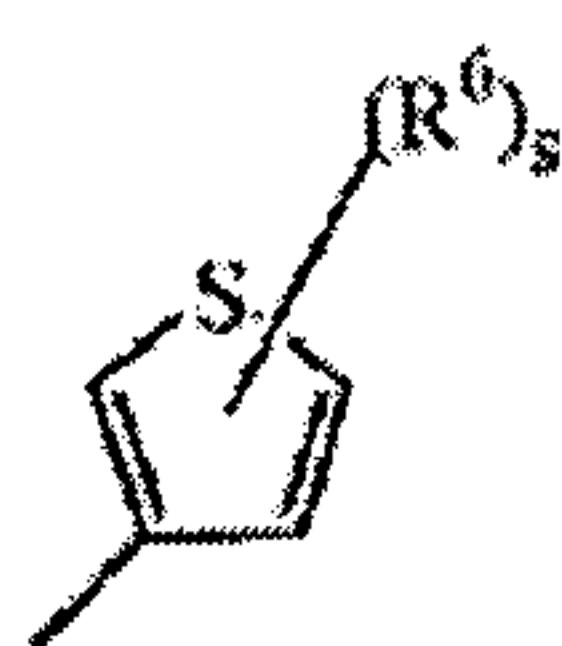
(a-7)



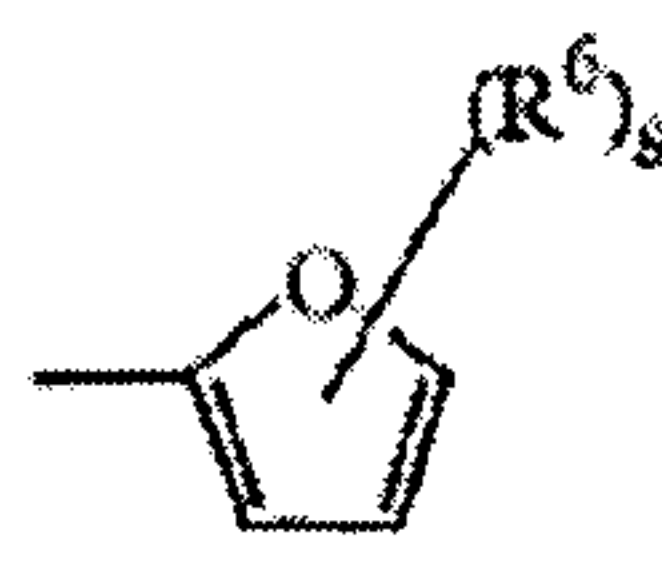
(a-8)



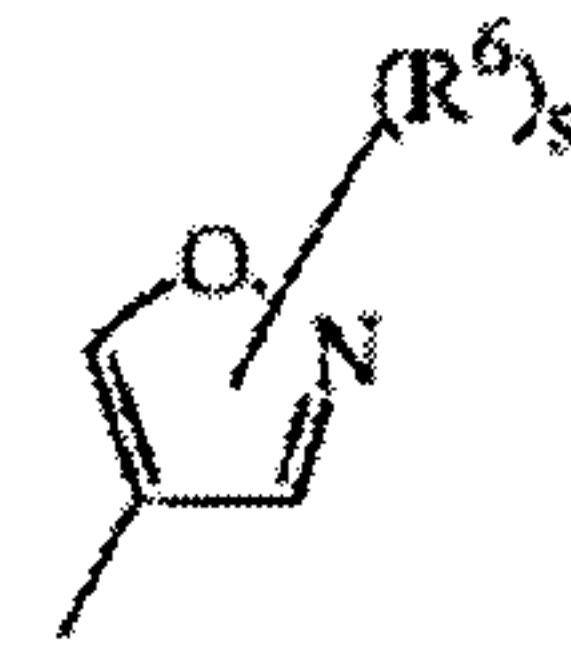
(a-9)



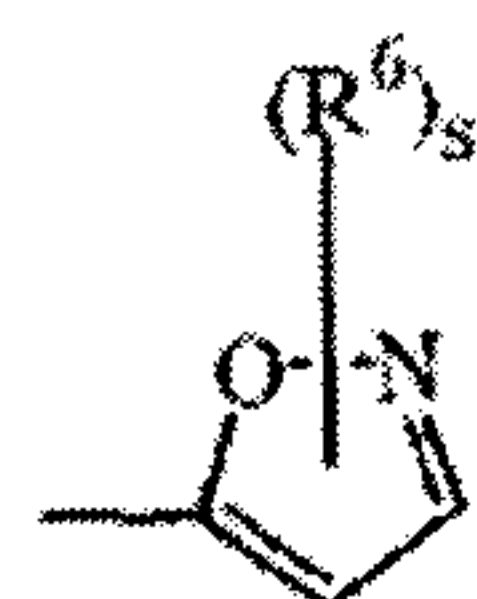
(a-10)



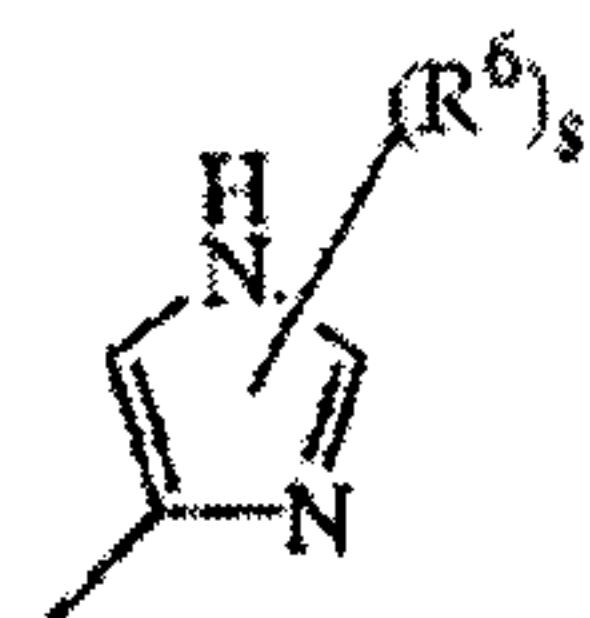
(a-11)



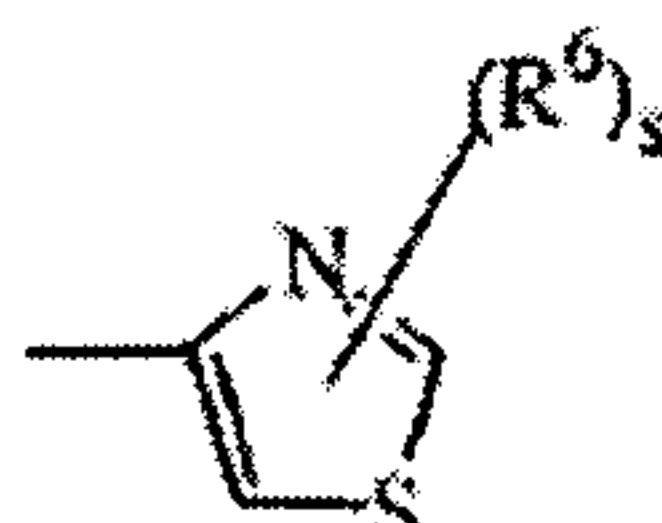
(a-12)



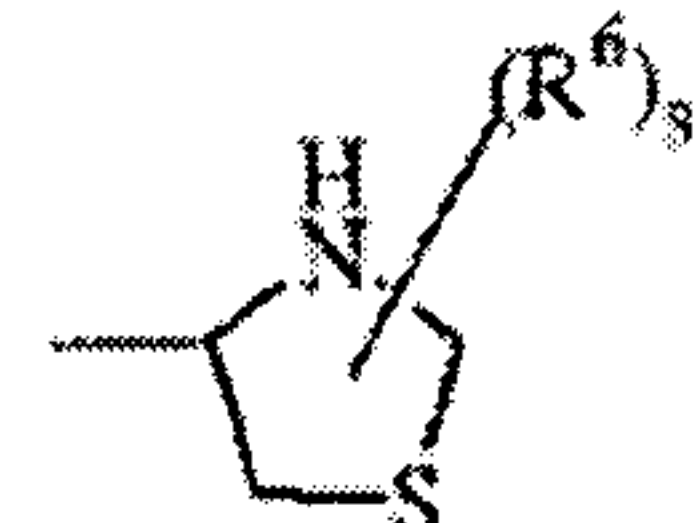
(a-13)



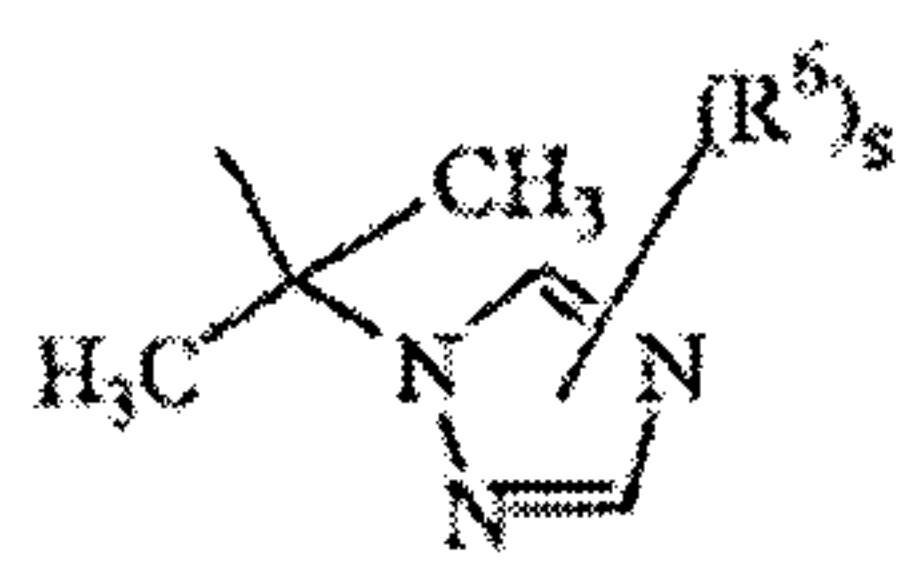
(a-14)



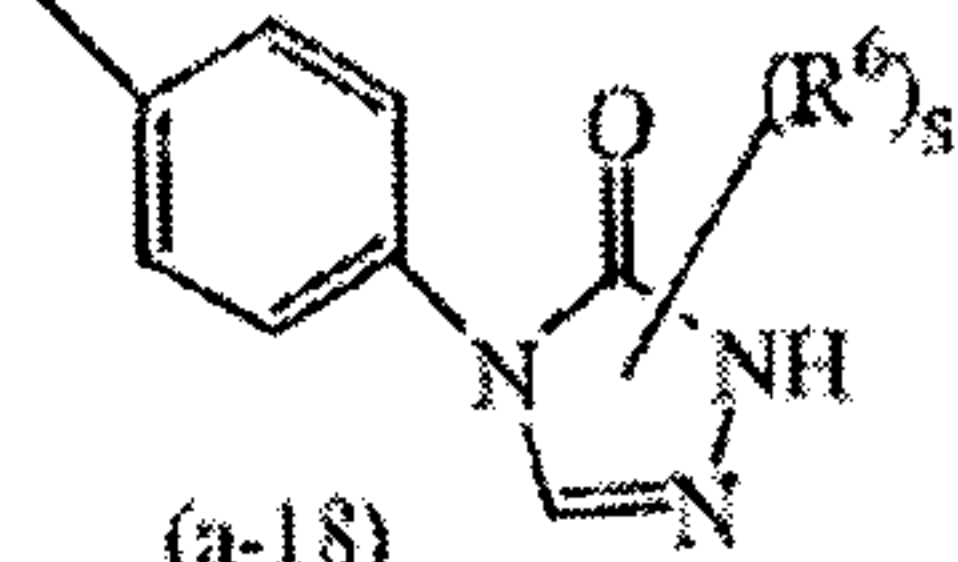
(a-15)



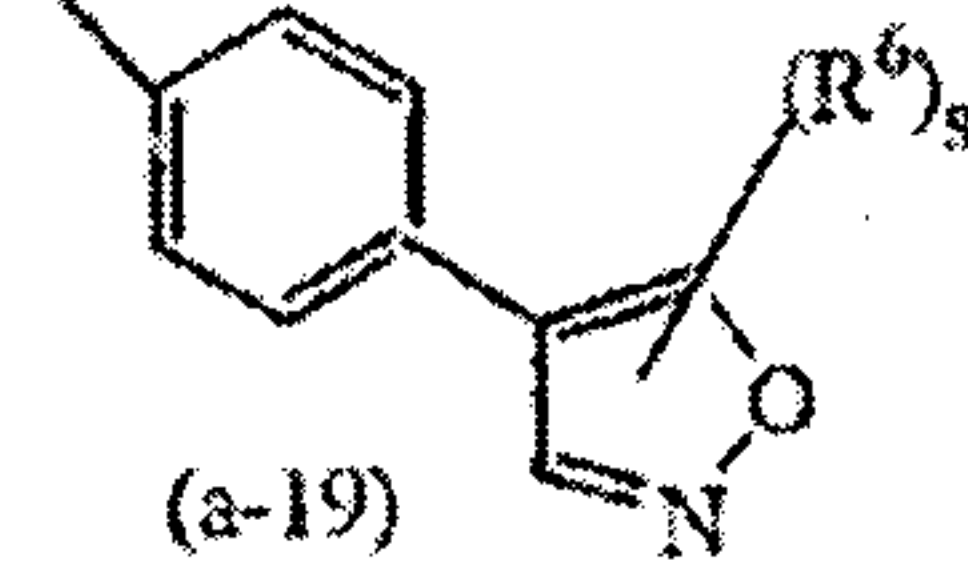
(a-16)



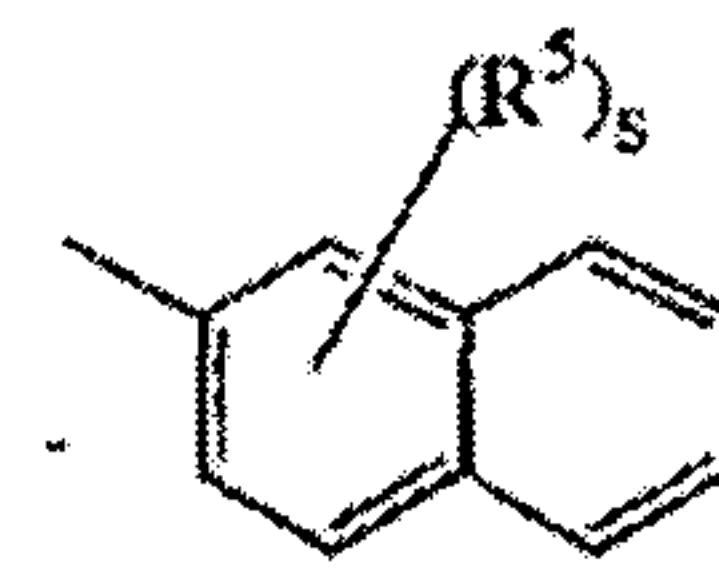
(a-17)



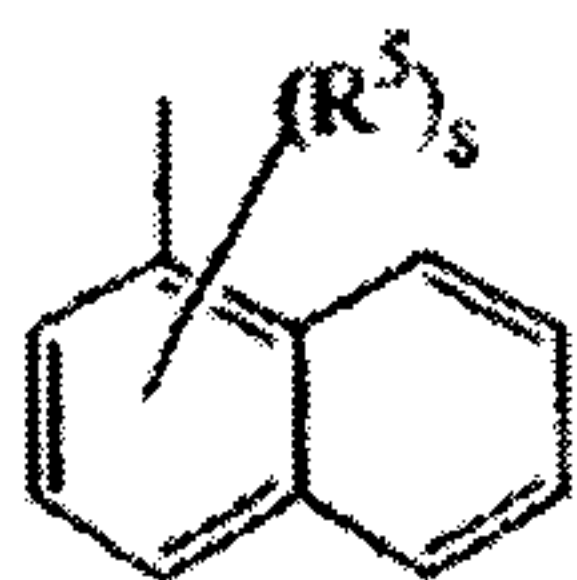
(a-18)



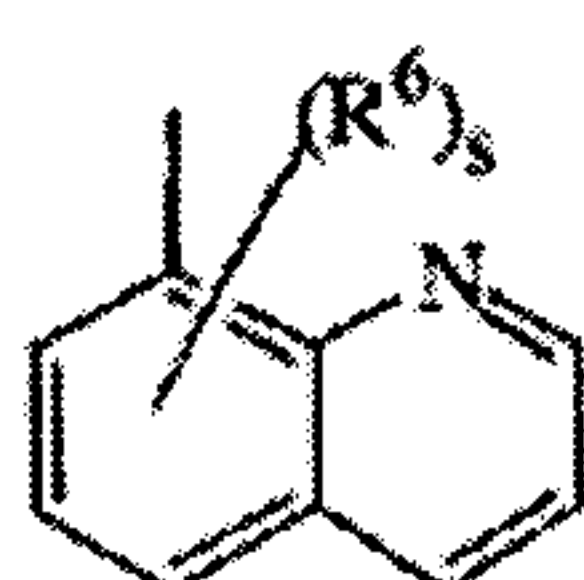
(a-19)



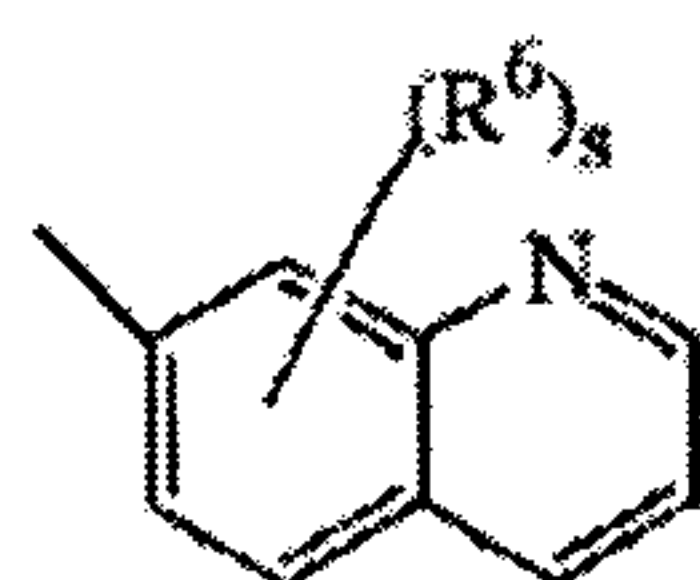
(a-20)



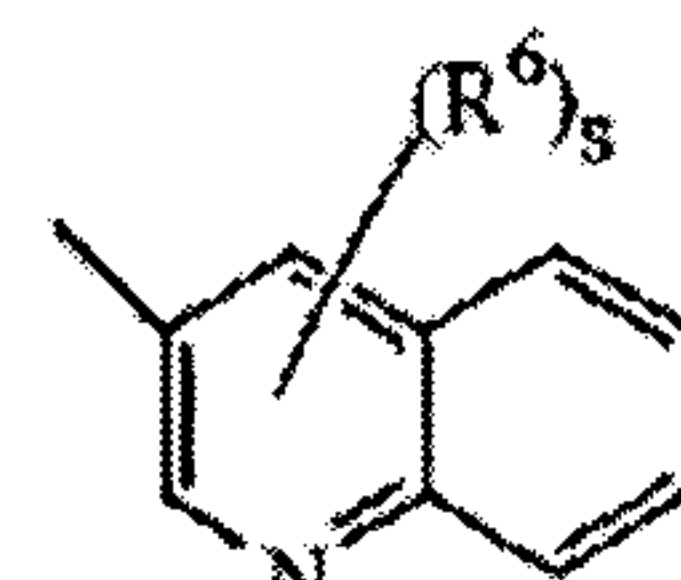
(a-21)



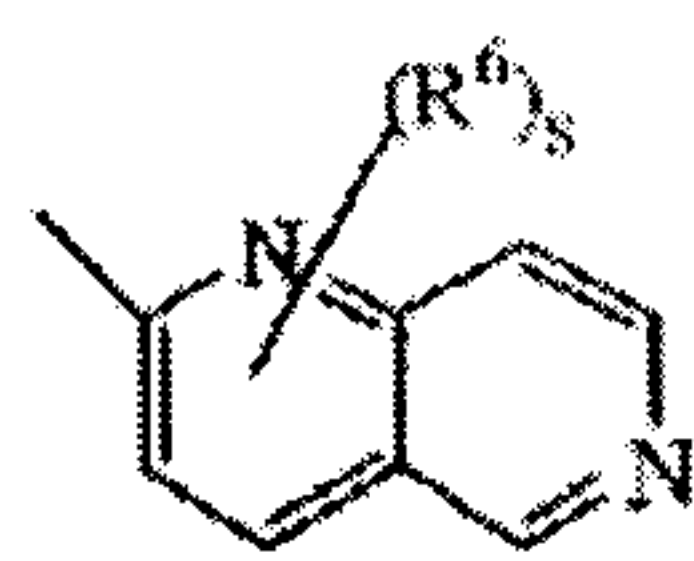
(a-22)



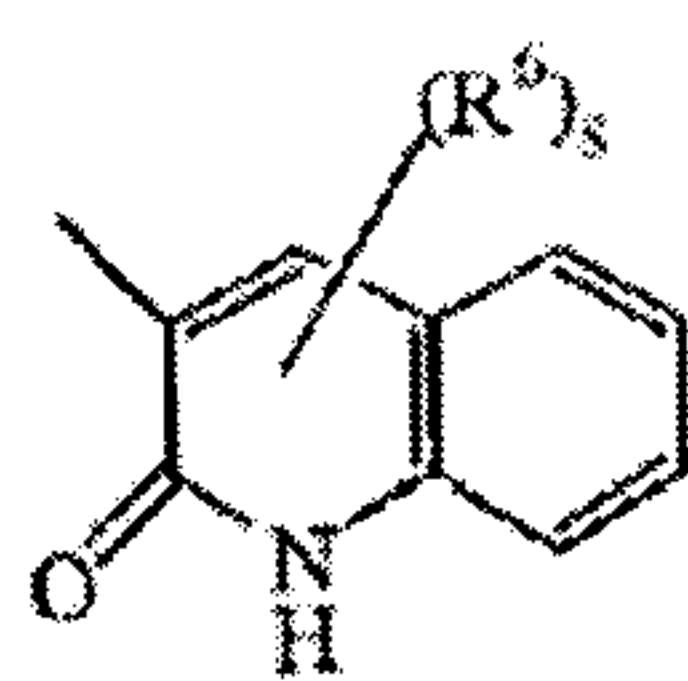
(a-23)



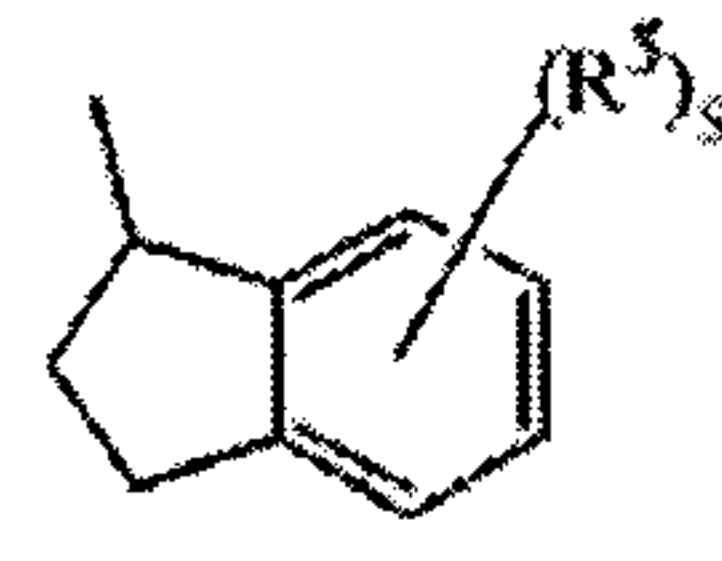
(a-24)



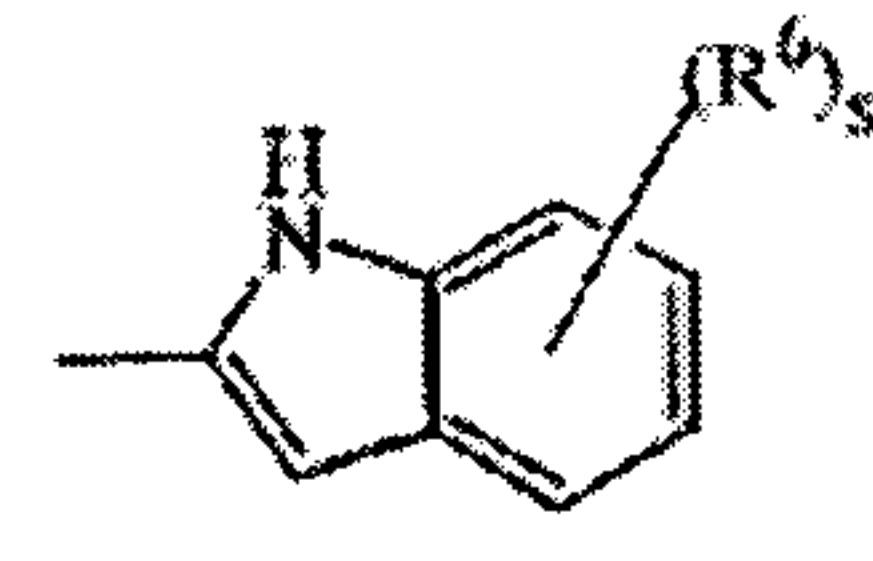
(a-25)



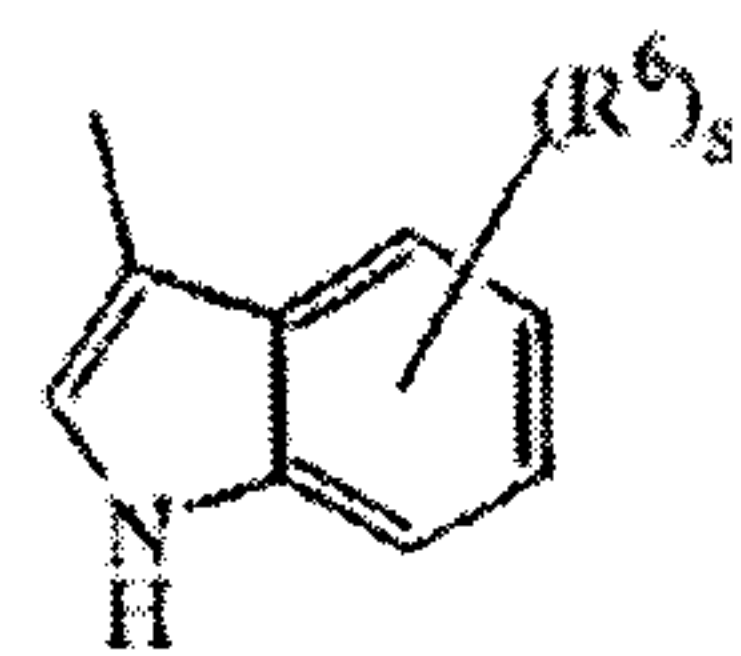
(a-26)



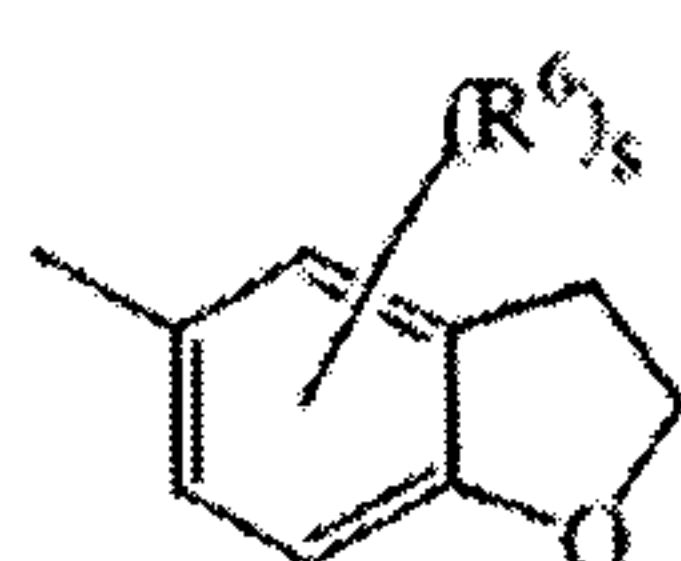
(a-27)



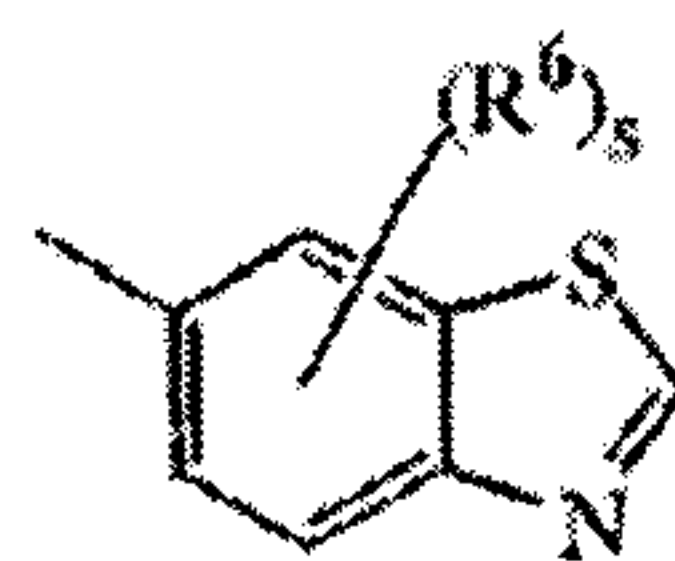
(a-28)



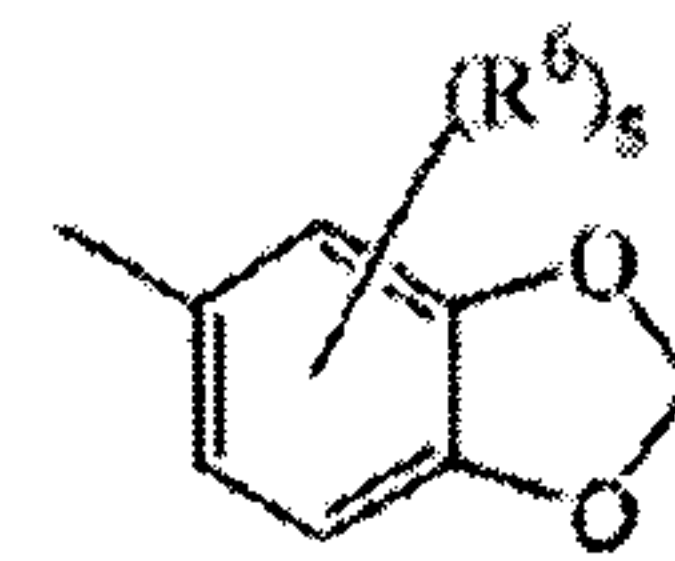
(a-29)



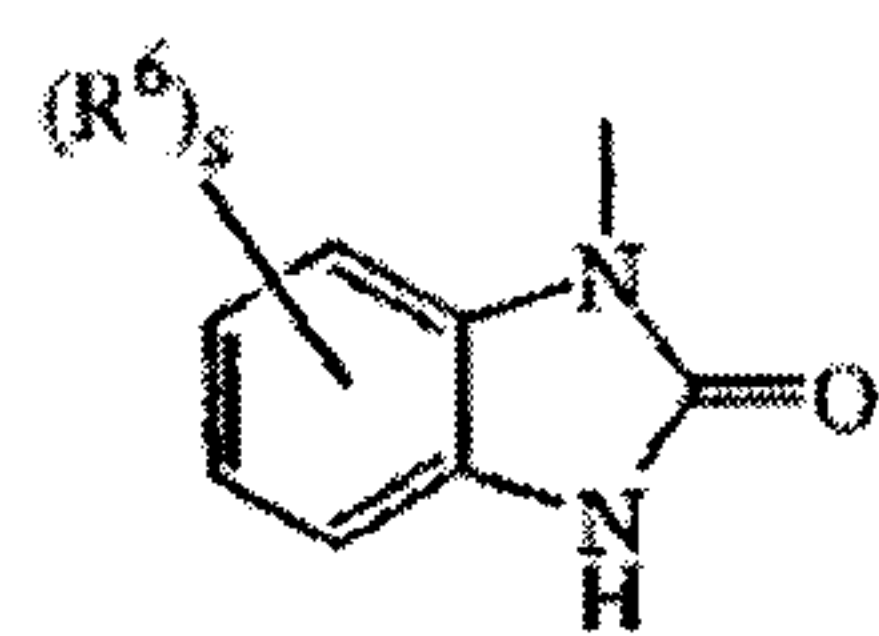
(a-30)



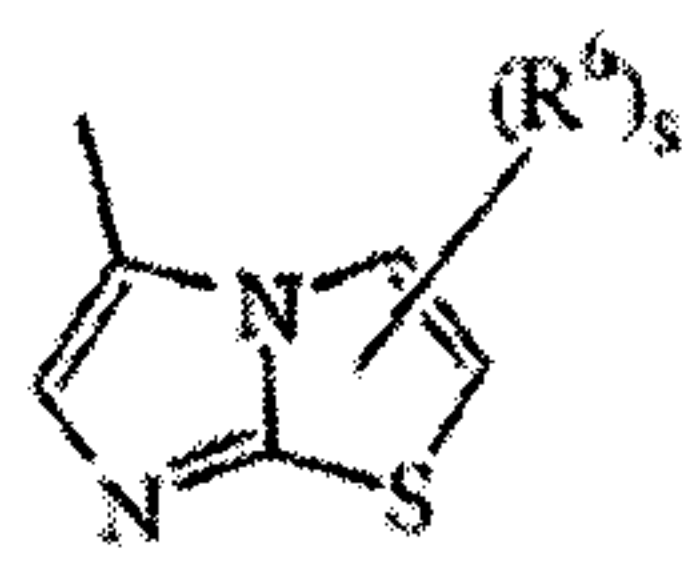
(a-31)



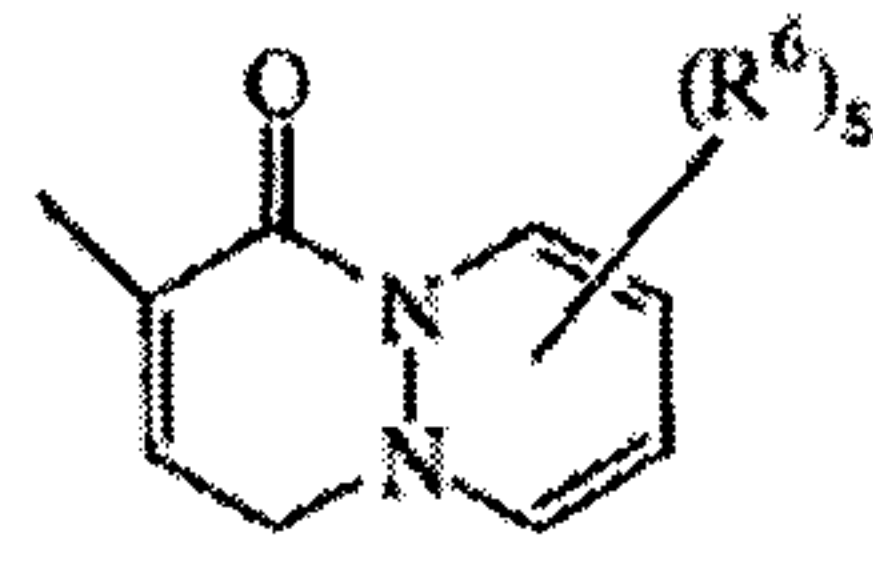
(a-32)



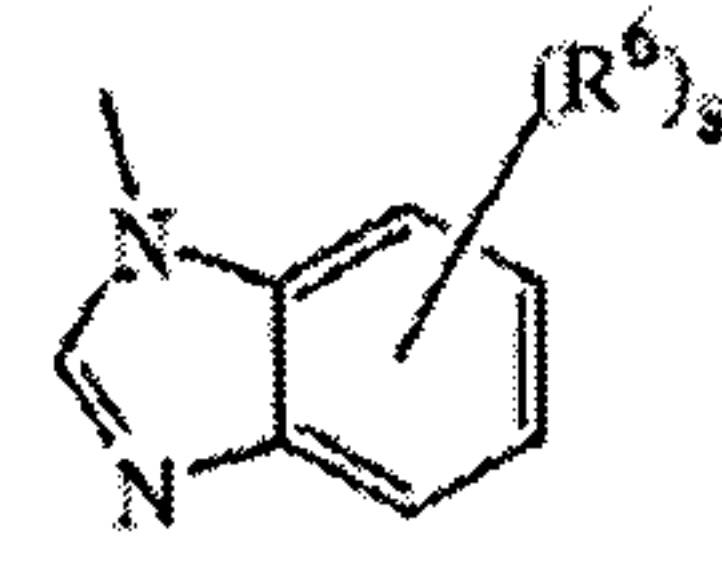
(a-33)



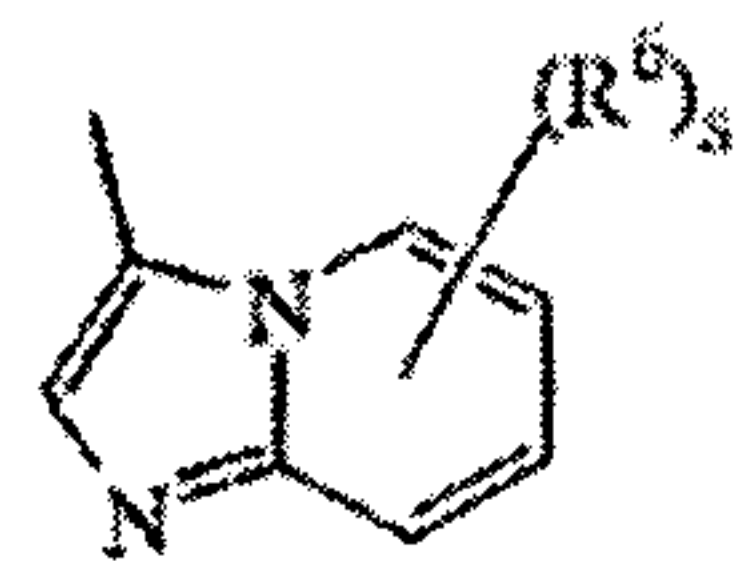
(a-34)



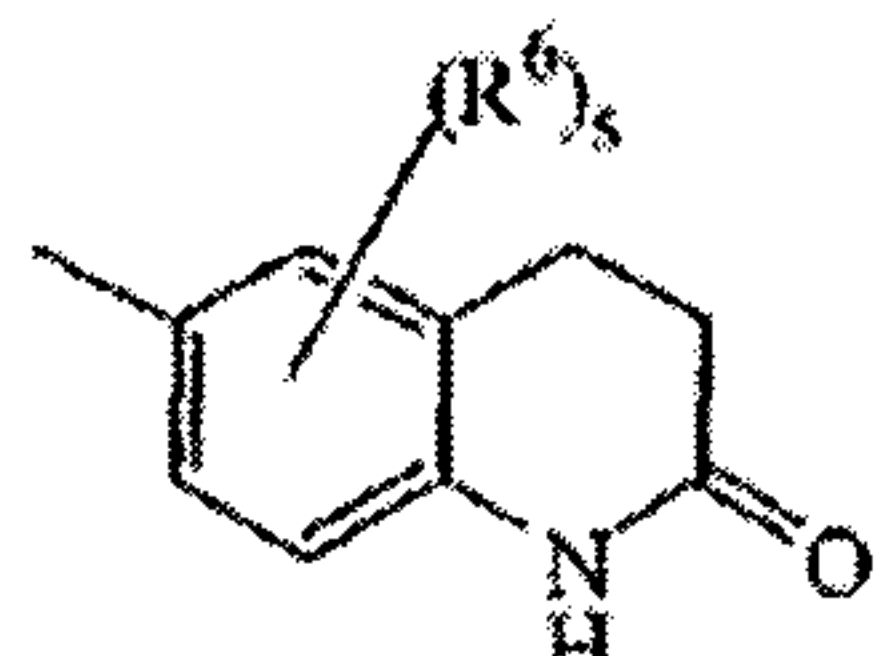
(a-35)



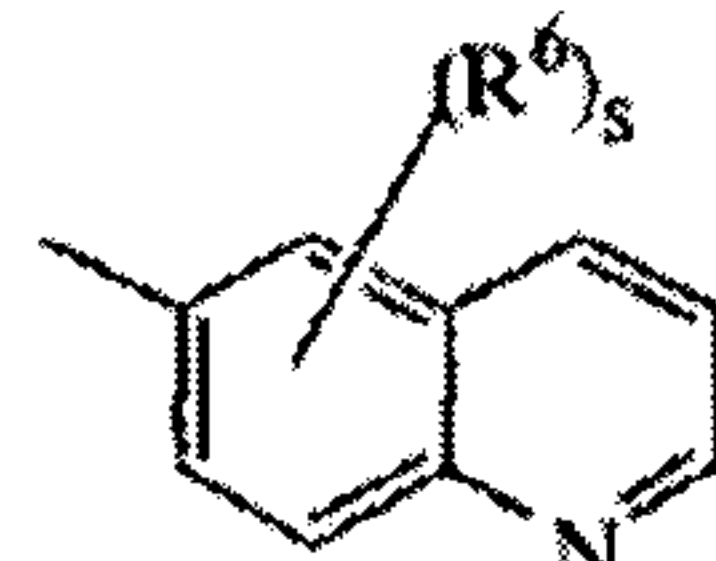
(a-36)



(a-37)



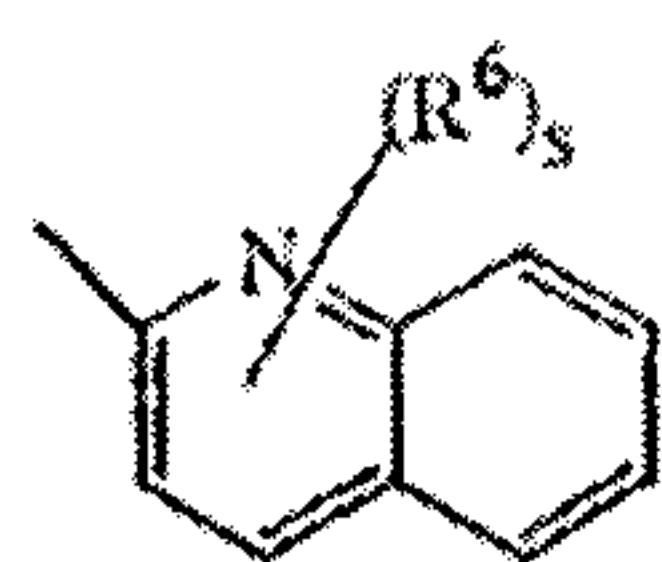
(a-38)



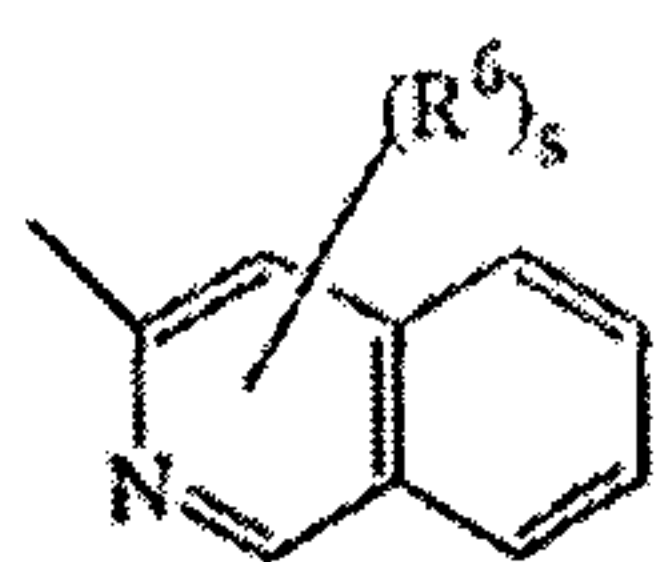
(a-39)



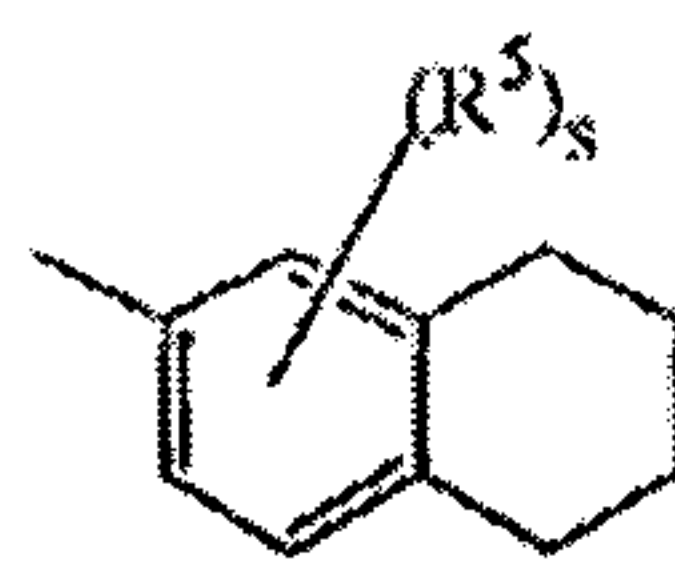
(a-40)



(a-41)



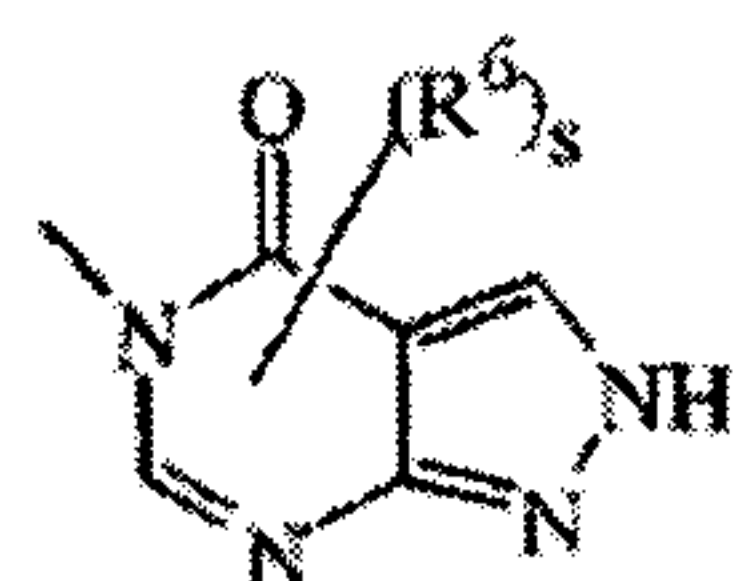
(a-42)



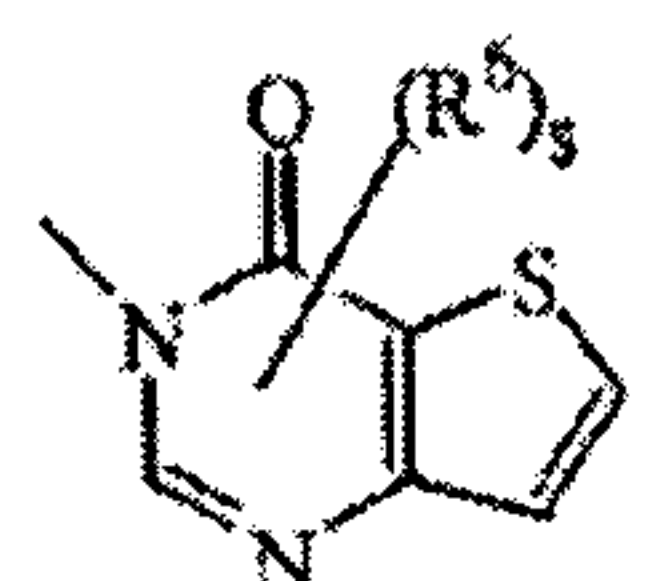
(a-43)



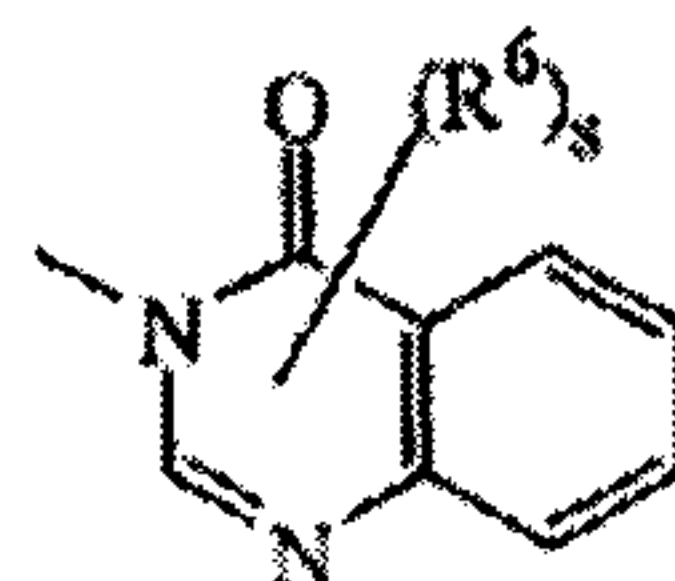
(a-44)



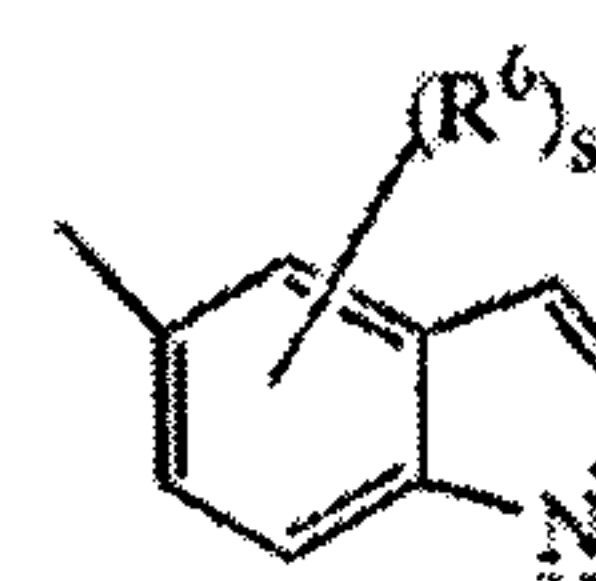
(a-45)



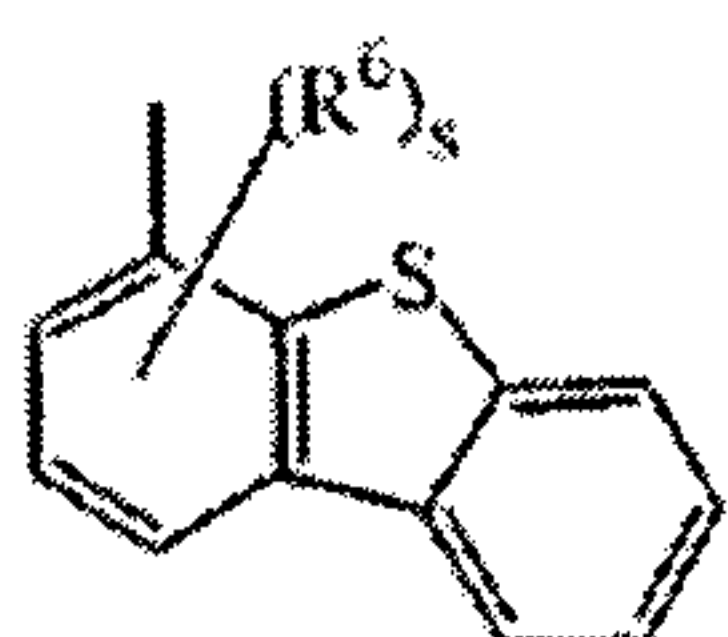
(a-46)



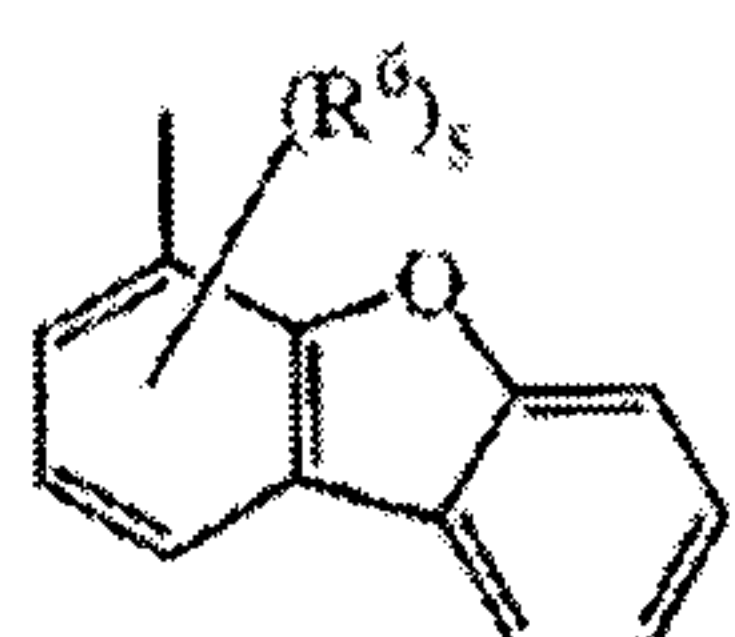
(a-47)



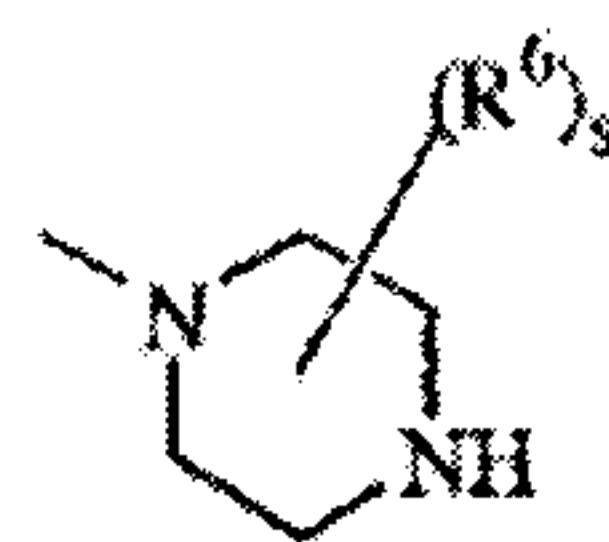
(a-48)



(a-49)



(a-50)



(a-51)

- wherein each s is independently 0, 1, 2, 3, 4 or 5; : each R^5 and R^6 are independently selected from hydrogen; halo; hydroxy; amino; nitro; trihaloC₁₋₆alkyl; trihaloC₁₋₆alkyloxy; C₁₋₆alkyl; C₁₋₆alkyl substituted with aryl and C₃₋₁₀cycloalkyl; C₁₋₆alkyloxy; C₁₋₆alkyloxyC₁₋₆alkyloxy; C₁₋₆alkylcarbonyl; C₁₋₆alkyloxycarbonyl; C₁₋₆alkylsulfonyl; cyanoC₁₋₆alkyl; hydroxyC₁₋₆alkyl; hydroxyC₁₋₆alkyloxy; hydroxyC₁₋₆alkylamino; aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminocarbonyl; di(hydroxyC₁₋₆alkyl)amino; (aryl)(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyloxy; di(C₁₋₆alkyl)aminoC₁₋₆alkylamino; di(C₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; arylsulfonyl; arylsulfonylamino; aryloxy; aryloxyC₁₋₆alkyl; arylC₂₋₆alkenediyl; di(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)amino(C₁₋₆alkyl) amino; di(C₁₋₆alkyl)amino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl) aminoC₁₋₆alkyl(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl; aminosulfonylamino(C₁₋₆alkyl)amino; aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)amino; di(C₁₋₆alkyl)aminosulfonylamino(C₁₋₆alkyl)aminoC₁₋₆alkyl; cyano; thiophenyl; thiophenyl substituted with di(C₁₋₆alkyl)aminoC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, di(C₁₋₆alkyl)aminoC₁₋₆alkyl, C₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl, di(C₁₋

6alkyl)aminosulfonylpiperazinylC₁₋₆alkyl, C₁₋₆alkyloxypiperidinyl, C₁₋₆alkyloxypiperidinylC₁₋₆alkyl, morpholinylC₁₋₆alkyl, hydroxyC₁₋₆alkyl(C₁₋₆alkyl)aminoC₁₋₆alkyl, or di(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkyl; furanyl; furanyl substituted with hydroxyC₁₋₆alkyl; benzofuranyl; imidazolyl; oxazolyl; oxazolyl substituted with aryl and C₁₋₆alkyl; C₁₋₆alkyltriazolyl; tetrazolyl; pyrrolidinyl; pyrrolyl; piperidinylC₁₋₆alkyloxy; morpholinyl; C₁₋₆alkylmorpholinyl; morpholinylC₁₋₆alkyloxy; morpholinylC₁₋₆alkyl; morpholinylC₁₋₆alkylamino; morpholinylC₁₋₆alkylaminoC₁₋₆alkyl; piperazinyl; C₁₋₆alkylpiperazinyl; C₁₋₆alkylpiperazinylC₁₋₆alkyloxy; piperazinylC₁₋₆alkyl; naphtalenylsulfonylpiperazinyl; naphtalenylsulfonylpiperidinyl; naphtalenylsulfonyl: C₁₋₆alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkylpiperazinylC₁₋₆alkylamino; C₁₋₆alkylpiperazinylC₁₋₆alkylaminoC₁₋₆alkyl; C₁₋₆alkylpiperazinylsulfonyl; aminosulfonylpiperazinylC₁₋₆alkyloxy; aminosulfonylpiperazinyl; aminosulfonylpiperazinylC₁₋₆alkyl; di(C₁₋₆alkyl)aminosulfonylpiperazinyl; di(C₁₋₆alkyl)aminosulfonylpiperazinylC₁₋₆alkyl; hydroxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆alkylpiperazinylC₁₋₆alkyl; C₁₋₆alkyloxypiperidinyl; C₁₋₆alkyloxypiperidinylC₁₋₆alkyl; piperidinylaminoC₁₋₆alkylamino; piperidinylaminoC₁₋₆alkylaminoC₁₋₆alkyl; (C₁₋₆alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylamino; (C₁₋₆alkylpiperidinyl)(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkylaminoC₁₋₆alkyl; hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinyl; hydroxyC₁₋₆alkyloxyC₁₋₆alkylpiperazinylC₁₋₆alkyl; (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)amino; (hydroxyC₁₋₆alkyl)(C₁₋₆alkyl)aminoC₁₋₆alkyl; hydroxyC₁₋₆alkylaminoC₁₋₆alkyl; di(hydroxyC₁₋₆alkyl)aminoC₁₋₆alkyl; pyrrolidinylC₁₋₆alkyl; pyrrolidinylC₁₋₆alkyloxy; pyrazolyl; thiopyrazolyl; pyrazolyl substituted with two substituents selected from C₁₋₆alkyl or trihaloC₁₋₆alkyl; pyridinyl; pyridinyl substituted with C₁₋₆alkyloxy, aryloxy or aryl; pyrimidinyl; tetrahydropyrimidinylpiperazinyl; tetrahydropyrimidinylpiperazinylC₁₋₆alkyl; quinolinyl; indolyl; phenyl; phenyl substituted with one, two or three substituents independently selected from halo, amino, nitro, C₁₋₆alkyl, C₁₋₆alkyloxy, hydroxyC₁₋₄alkyl, trifluoromethyl, trifluoromethyloxy, hydroxyC₁₋₄alkyloxy, C₁₋₄alkylsulfonyl, C₁₋₄alkyloxyC₁₋₄alkyloxy, C₁₋₄alkyloxycarbonyl, aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)aminoC₁₋₄alkyloxy, di(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)aminocarbonyl, di(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄alkyl, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)amino(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄alkyl)amino,

- di(C₁₋₄alkyl)aminoC₁₋₄alkyl(C₁₋₄alkyl)aminoC₁₋₄alkyl, aminosulfonylamino(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄alkyl)amino, di(C₁₋₄alkyl)amino, aminosulfonylamino(C₁₋₄alkyl)aminoC₁₋₆alkyl, cyano, piperidinylC₁₋₄alkyloxy, pyrrolidinylC₁₋₄alkyloxy,
- 5 aminosulfonylpiperazinyl, aminosulfonylpiperazinylC₁₋₄alkyl, di(C₁₋₄alkyl)amino, aminosulfonylpiperazinyl, di(C₁₋₄alkyl)amino, aminosulfonylpiperazinylC₁₋₄alkyl, hydroxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkyloxypiperidinyl, C₁₋₄alkyloxypiperidinylC₁₋₄alkyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinyl, hydroxyC₁₋₄alkyloxyC₁₋₄alkylpiperazinylC₁₋₄alkyl, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)amino, (hydroxyC₁₋₄alkyl)(C₁₋₄alkyl)aminoC₁₋₄alkyl, di(hydroxyC₁₋₄alkyl)amino, di(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkyl, furanyl, furanyl substituted with -CH=CH-CH=CH-, pyrrolidinylC₁₋₄alkyl, pyrrolidinylC₁₋₄alkyloxy, morpholinyl, morpholinylC₁₋₄alkyloxy, morpholinylC₁₋₄alkyl, morpholinylC₁₋₄alkylamino, morpholinylC₁₋₄alkylaminoC₁₋₄alkyl, piperazinyl, C₁₋₄alkylpiperazinyl, C₁₋₄alkylpiperazinylC₁₋₄alkyloxy, piperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkyl, C₁₋₄alkylpiperazinylC₁₋₄alkylamino, C₁₋₄alkylpiperazinylC₁₋₄alkylaminoC₁₋₆alkyl, tetrahydropyrimidinylpiperazinyl, tetrahydropyrimidinylpiperazinylC₁₋₄alkyl, piperidinylaminoC₁₋₄alkylamino, piperidinylaminoC₁₋₄alkylaminoC₁₋₄alkyl, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylamino, (C₁₋₄alkylpiperidinyl)(hydroxyC₁₋₄alkyl)aminoC₁₋₄alkylaminoC₁₋₄alkyl, pyridinylC₁₋₄alkyloxy, hydroxyC₁₋₄alkylamino, hydroxyC₁₋₄alkylaminoC₁₋₄alkyl, di(C₁₋₄alkyl)aminoC₁₋₄alkylamino, aminothiadiazolyl, aminosulfonylpiperazinylC₁₋₄alkyloxy, or thiophenylC₁₋₄alkylamino; each R⁵ and R⁶ can be placed on the nitrogen in replacement of the hydrogen; aryl in the above is phenyl, or phenyl substituted with one
- 25 or more substituents each independently selected from halo, C₁₋₆alkyl, C₁₋₆alkyloxy, trifluoromethyl, cyano or hydroxycarbonyl.

In one aspect, the inhibitor of histone deacetylase activity may be a compound having the general formula:



wherein A is a cyclic moiety selected from the group consisting of C3-14 cycloalkyl, 3-14 membered heterocycloalkyl, C4-14 cycloalkenyl, 3-8 membered heterocycloalkenyl, aryl, or heteroaryl; the cyclic moiety being optionally substituted with alkyl, alkenyl, alkynyl, alkoxy, hydroxyl, hydroxylalkyl, halo, haloalkyl, amino, alkylcarbonyloxy, alkyloxycarbonyl, alkylcarbonyl, alkylsulfonylamino, aminosulfonyl, or alkylsulfonyl; or A is a saturated branched C3-12 hydrocarbon chain or an unsaturated branched C3-12 hydrocarbon chain optionally interrupted by -O-, -S-, -N(R^a)-, -C(O)-, -N(R^a)-SO₂-, -SO₂-N(R^a)-, -N(R^a)-C(O)-O-, -O-C(O)-N(R^a)-, -N(R^a)-C(O)-N(R^b)-, -O-C(O)-, -C(O)-O-, -O-SO₂-, -SO₂-O-, or -O-C(O)-O-, where each of R^a and R^b, independently, is hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; each of the saturated and the unsaturated branched hydrocarbon chain being optionally substituted with alkyl, alkenyl, alkynyl, alkoxy, hydroxyl, hydroxylalkyl, halo, haloalkyl, amino, alkylcarbonyloxy, alkyloxycarbonyl, alkylcarbonyl, alkylsulfonylamino, aminosulfonyl, or alkylsulfonyl; each of Y¹ and Y², independently, is -CH₂-, -O-, -S-, -N(R)-, -N(R^c)-C(O)-O-, -O-C(O)-N(R^c)-, -N(R^c)-C(O)-N(R^d)-, -O-C(O)-O-, or a bond; each of R^c and R^d, independently, being hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; L is a straight C2-12 hydrocarbon chain optionally containing at least one double bond, at least one triple bond, or at least one double bond and one triple bond; said hydrocarbon chain being optionally substituted with C1-4alkyl, C2-4alkenyl, C2-4alkynyl, C1-4alkoxy, hydroxyl, halo, amino, nitro, cyano, C3-5cycloalkyl, 3-5 membered heterocycloalkyl, monocyclic aryl, 5-6 membered heteroaryl, C1-4alkylcarbonyloxy, C1-4alkyloxycarbonyl, C1-4alkylcarbonyl, or formyl; and further being optionally interrupted by -O-, -N(R^e)-, -N(R^e)-C(O)-O-, -O-C(O)-N(R^e)-, -N(R^e)-C(O)-N(R^f)-, or -O-C(O)-O-; each of R^e and R^f independently, being hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, or haloalkyl; X¹ is O or S; and X² is -OR¹, -SR¹, -NR¹-OR¹, -NR-SR¹, -C(O)-OR¹, -CHR⁴-OR¹, -N=N-C(O)-N(R³)₂, or -O-CHR⁴-O-C(O)-R⁵, where each of R¹ and R², independently, is hydrogen, alkyl,

hydroxylalkyl, haloalkyl, or a hydroxyl protecting group; R³ is hydrogen, alkyl, alkenyl, alkynyl, alkoxy, hydroxylalkyl, hydroxyl, haloalkyl, or an amino protecting group; R⁴ is hydrogen, alkyl, hydroxylalkyl, or haloalkyl; R⁵ is alkyl, hydroxylalkyl, or haloalkyl; and provided that when L is a C2-3 hydrocarbon containing no double bonds and X² is –OR¹,
 5 Y¹ is not a bond and Y² is not a bond; or a salt thereof.

Therapeutic Use of The Cells of The Present Invention.

In one aspect, the present invention provides a method for treating a patient suffering from, or at risk of developing Type 1 diabetes. This method involves isolating and culturing stem cells or progenitor cells, expanding the isolated population of cells,
 10 differentiating the cultured cells *in vitro* into a pancreatic lineage, or into a pancreatic hormone-producing cell, or into a β -cell lineage, and implanting the differentiated cells either directly or in a pharmaceutical carrier into the patient. If appropriate, the patient may be further treated with pharmaceutical agents or bioactives that facilitate the survival and function of the transplanted cells. These agents may include, for example, insulin,
 15 members of the TGF- β family, including TGF- β 1, 2, and 3, bone morphogenic proteins (BMP-2, -3, -4, -5, -6, -7, -11, -12, and -13), fibroblast growth factors-1 and -2, platelet-derived growth factor-AA, and –BB, platelet rich plasma, insulin growth factor (IGF-I, II) growth differentiation factor (GDF-5, -6, -8, -10, -15), vascular endothelial cell-derived growth factor (VEGF), pleiotrophin, endothelin, among others. Other
 20 pharmaceutical compounds can include, for example, nicotinamide, glucagon like peptide-I (GLP-1) and II, GLP-1 and 2 mimetibody, Exendin-4, retinoic acid, parathyroid hormone, MAPK inhibitors, such as, for example, compounds disclosed in U.S. Published Application 2004/0209901 and U.S. Published Application 2004/0132729.

In yet another aspect, this invention provides a method for treating a patient suffering
 25 from, or at risk of developing Type 2 diabetes. The method involves isolating and culturing stem cells or progenitor cells, expanding the isolated population of cells, differentiating the cultured cells *in vitro* into a pancreatic lineage, or into a pancreatic hormone-producing cell, or into a β -cell lineage, and implanting the differentiated cells either directly or in a pharmaceutical carrier into the patient.

- The cells of the present invention may be genetically modified. For example, the cells may be engineered to over express markers characteristic of a cell of a β -cell lineage, such as, for example, NGN-3 (neurogenin-3), Hlxb9, Nkx6, Isl1, Pax6, NeuroD, Hnf1a, Hnf6, Hnf3 Beta, and Mafa, or insulin. The cells may be engineered to over express with
- 5 any suitable gene of interest. Techniques useful to genetically modify the amniotic fluid-derived cells of the present invention can be found, for example, in standard textbooks and reviews in cell biology. Methods in molecular genetics and genetic engineering are described, for example, in Molecular Cloning: A Laboratory Manual, 2nd Ed. (Sambrook *et al.*, 1989); Oligonucleotide Synthesis (M. J. Gait, ed., 1984); Animal Cell Culture (R.
- 10 I. Freshney, ed., 1987); the series Methods in Enzymology (Academic Press, Inc.); Gene Transfer Vectors for Mammalian Cells (I. M. Miller & M. P. Calos, eds., 1987); Current Protocols in Molecular Biology and Short Protocols in Molecular Biology, 3rd Edition (F. M. Ausubel *et al.*, eds., 1987 & 1995); and Recombinant DNA Methodology II (R. Wu ed., Academic Press 1995).
- 15 The nucleic acid molecule, encoding the gene of interest may be stably integrated into the genome of the cell, or the nucleic acid molecule may be present as an extrachromosomal molecule, such as a vector or plasmid. Such an extrachromosomal molecule may be auto-replicating. The term "transfection," as used herein, refers to a process for introducing heterologous nucleic acid into the host cell.
- 20 The cells, undifferentiated or otherwise, may be used as dispersed cells or formed into clusters that may be infused into the hepatic portal vein. Alternatively, the cells may be provided in biocompatible degradable polymeric supports, porous non-degradable devices or encapsulated to protect from host immune response. The cells may be implanted into an appropriate site in a recipient. The implantation sites include, for
- 25 example, the liver, natural pancreas, renal subcapsular space, omentum, peritoneum, subserosal space or a subcutaneous pocket.

To enhance further differentiation, survival or activity of implanted cells, additional factors, such as growth factors, antioxidants or anti-inflammatory agents, can be administered before, simultaneously with, or after the administration of the cells. In

certain embodiments, growth factors are utilized to differentiate the administered cells *in vivo*. These factors can be secreted by endogenous cells and exposed to the administered amniotic fluid-derived cells *in situ*. Implanted cells can be induced to differentiate by any combination of endogenous and exogenously administered growth factors known in
5 the art.

The amount of cells used in implantation depends on a number of factors including the patient's condition and response to the therapy, and can be determined by one skilled in the art.

In one aspect, this invention provides a method for treating a patient suffering from, or at
10 risk of developing diabetes. The method includes isolating and culturing stem cells or progenitor cells, expanding the isolated population of cells, differentiating *in vitro* the cultured cells into a pancreatic lineage, or into a pancreatic hormone-producing cell, or into a β -cell lineage, and incorporating the cells into a three-dimensional support. The cells can be maintained *in vitro* on this support prior to implantation into the patient.
15 Alternatively, the support containing the cells can be directly implanted in the patient without additional *in vitro* culturing. The support can optionally be incorporated with at least one pharmaceutical agent that facilitates the survival and function of the transplanted cells.

Support materials suitable for use for purposes of the present invention include tissue
20 templates, conduits, barriers, and reservoirs useful for tissue repair. In particular, synthetic and natural materials in the form of foams, sponges, gels, hydrogels, textiles, and nonwoven structures, which have been used *in vitro* and *in vivo* to reconstruct or regenerate biological tissue, as well as to deliver chemotactic agents for inducing tissue growth, are suitable for use in practicing the methods of the present invention. See, e.g.,
25 the materials disclosed in U.S. Patent 5,770,417, U.S. Patent 6,022,743, U.S. Patent 5,567,612, U.S. Patent 5,759,830, U.S. Patent 6,626,950, U.S. Patent 6,534,084, U.S. Patent 6,306,424, U.S. Patent 6,365,149, U.S. Patent 6,599,323, U.S. Patent 6,656,488, and U.S. Patent 6,333,029. Exemplary polymers suitable for use in the present invention are disclosed in U.S. Published Application 2004/0062753 A1 and U.S. Patent 4,557,264.

To form a support incorporated with a pharmaceutical agent, the pharmaceutical agent can be mixed with the polymer solution prior to forming the support. Alternatively, a pharmaceutical agent could be coated onto a fabricated support, preferably in the presence of a pharmaceutical carrier. The pharmaceutical agent may be present as a liquid, a finely divided solid, or any other appropriate physical form. Alternatively, excipients may be added to the support to alter the release rate of the pharmaceutical agent. In an alternate embodiment, the support is incorporated with at least one pharmaceutical compound that is an anti-inflammatory compound, such as, for example compounds disclosed in U.S. Patent 6,509,369.

10 In one embodiment, the support is incorporated with at least one pharmaceutical compound that is an anti-apoptotic compound, such as, for example, compounds disclosed in U.S. Patent 6,793,945.

In another embodiment, the support is incorporated with at least one pharmaceutical compound that is an inhibitor of fibrosis, such as, for example, compounds disclosed in
15 U.S. Patent 6,331,298.

In a further embodiment, the support is incorporated with at least one pharmaceutical compound that is capable of enhancing angiogenesis, such as, for example, compounds disclosed in U.S. Published Application 2004/0220393 and U.S. Published Application 2004/0209901.

20 In still another embodiment, the support is incorporated with at least one pharmaceutical compound that is an immunosuppressive compound, such as, for example, compounds disclosed in U.S. Published Application 2004/0171623.

In a further embodiment, the support is incorporated with at least one pharmaceutical compound that is a growth factor, such as, for example, members of the TGF- β family, including TGF- β 1, 2, and 3, bone morphogenic proteins (BMP-2, -3, -4, -5, -6, -7, -11, -12, and -13), fibroblast growth factors-1 and -2, platelet-derived growth factor-AA, and – BB, platelet rich plasma, insulin growth factor (IGF-I, II) growth differentiation factor (GDF-5, -6, -8, -10, -15), vascular endothelial cell-derived growth factor (VEGF),

pleiotrophin, endothelin, among others. Other pharmaceutical compounds can include, for example, nicotinamide, hypoxia inducible factor 1-alpha, glucagon like peptide-I (GLP-1), GLP-1 and GLP-2 mimetibody, and II, Exendin-4, nodal, noggin, NGF, retinoic acid, parathyroid hormone, tenascin-C, tropoelastin, thrombin-derived peptides, cathelicidins, defensins, laminin, biological peptides containing cell- and heparin-binding domains of adhesive extracellular matrix proteins such as fibronectin and vitronectin, MAPK inhibitors, such as, for example, compounds disclosed in U.S. Published Application 2004/0209901 and U.S. Published Application 2004/0132729.

The incorporation of the cells of the present invention into a scaffold can be achieved by the simple depositing of cells onto the scaffold. Cells can enter into the scaffold by simple diffusion (*J. Pediatr. Surg.* 23 (1 Pt 2): 3-9 (1988)). Several other approaches have been developed to enhance the efficiency of cell seeding. For example, spinner flasks have been used in seeding of chondrocytes onto polyglycolic acid scaffolds (*Biotechnol. Prog.* 14(2): 193-202 (1998)). Another approach for seeding cells is the use of centrifugation, which yields minimum stress to the seeded cells and enhances seeding efficiency. For example, Yang *et al.* developed a cell seeding method (*J. Biomed. Mater. Res.* 55(3): 379-86 (2001)), referred to as Centrifugational Cell Immobilization (CCI).

The present invention is further illustrated, but not limited by, the following examples.

Example 1

The Establishment of Human Pancreatic Cell Lines.

Pancreas Preparation - Human pancreata not suitable for clinical transplantation were obtained from The National Disease Research Interchange (Philadelphia, PA) following appropriate consent for research use. The pancreas was transferred with organ preservation solution to a stainless steel pan on ice and trimmed of all extraneous tissue. The pancreatic duct was cannulated with an 18 gauge catheter and the pancreas was injected with an enzyme solution, which contained the LIBERASE HI™ enzyme (Roche 0.5 mg/ml, Roche) and DNase I (0.2 mg/ml) dissolved in Dulbecco's Phosphate Buffered Saline (DPBS).

Rapid Mechanical Dissociation Followed by Enzymatic Digestion - The enzyme infused pancreata were homogenized in a tissue processor, pulsed 3-5 times for 3-5 seconds/pulse, and the dissociated tissue was transferred to two 500 ml trypsinizing flasks (Bellco) containing magnetic stir bars. Thereafter, 50-100 ml of the enzyme solution was added to each flask. The flasks were placed in a 37°C water bath on submersible stir plates and allowed to incubate with an intermediate stir rate for 10 minutes. The stirring was stopped, and the finely digested tissue was removed from the flask and transferred into a 250 ml tube containing DPBS, 5% Fetal Bovine Serum (FBS) and 0.1 mg/ml DNase I (DPBS+) at 4°C to quench the digestion process. The flasks were replenished with 50-100 ml of the enzyme solution and returned to the water bath, and the stirring was re-initiated for an additional ten minutes. Again, the flasks were removed and the fine digest was collected and transferred to the 250 ml tubes on ice. This process was repeated for an additional 3-5 times until the pancreas was completely digested.

Gradual Mechanical Dissociation with Simultaneous Enzyme Digestion - The enzyme infused pancreata were processed according to methods as described in *Diabetes* 37:413-420 (1988). Briefly, the pancreata were cleaned of extraneous tissue and injected with the enzyme solution as described above. The pancreata were then placed into a Ricordi Chamber with beads and covered with a screen with a mesh size of 400-600 µm to retain larger clusters of tissue. The chamber was covered; the enzyme solution was circulated through the chamber at approximately 37°C, and the chamber was shaken to allow beads to disrupt pancreatic tissue during enzymatic digestion. Once adequate dissociation and digestion was achieved, the digestion was terminated and the tissue was collected.

Tissue Separation - The collected tissue was centrifuged at 150 x g for 5 minutes at 4°C. The supernatant was aspirated and the tissue was washed two additional times in DPBS+. Following the final wash, the tissue was applied to a discontinuous gradient for purification. The digested tissue was suspended in polysucrose (Mediatech, VA) with a density of 1.108 g/ml at a ratio of 1-2 ml tissue pellet per 10 ml of polysucrose solution. The tissue suspension was then transferred to round-bottom polycarbonate centrifuge

tubes, and polysucrose solutions with densities of 1.096 and 1.037 were carefully applied to the tubes. A final layer of DMEM completed the discontinuous purification gradient. The gradient tubes were centrifuged at 2000 rpm for 20 minutes at 4°C with no brake applied. Following centrifugation, the tissue was collected from each interface (three
5 interfaces total), washed several times in DPBS+ as described above, and collected in a 50 ml test tube.

Further Cell Cluster Dissociation - Optionally, one can further dissociate large cell clusters obtained using the above protocol into smaller clusters or single cell suspensions. After the final wash, the tissue from each fraction was suspended in 10 ml 1X
10 trypsin/EDTA solution containing 200U/mL DNase I. The tubes were placed in the water bath and repeatedly aspirated and discharged from a 10 ml serological pipette for 5-6 minutes until a near single cell suspension was achieved. The digestion was quenched with the addition of 4°C DPBS+ and the tubes centrifuged at 800 rpm for 5 minutes. The cell suspensions were washed with DPBS+ and cultured as described below.

15 *Pancreatic Cell Culture* - Following the final wash, the cells from each interface were resuspended in DMEM, 2% FBS, 100 U/μg penicillin/streptomycin, ITS, 2 mM L-Glutamine, 0.0165 mM ZnSO₄ (Sigma), and 0.38 μM 2-mercaptoethanol (Invitrogen, CA) (hereinafter "the selection medium"). Six ml of the cell suspension was seeded in T-25 tissue culture flasks and 12 ml of the cell suspension was seeded into T-75 flasks. The
20 flasks were placed in 37°C incubators with 5% CO₂. Following 2-4 weeks culture, a complete medium change was performed and adherent cells were returned to culture in DMEM (2750 mg/L D-glucose, 862 mg/L glutamine) (Gibco, CA) with 5% FBS (HyClone, UT), 1% P/S, 0.0165 mM ZnSO₄ (hereinafter "the growth medium") and allowed to reach near confluence (this stage is referred to as "passage 0" or "P0"), at
25 which point they were passaged. Subsequent culturing of the cells was at 5000 cell/cm² in the growth medium. Cultures were passaged every 7-10 days at ~70-90% confluency.

Example 2

The Establishment of Human Amniotic Fluid-Derived Cell Lines.

Amniotic fluid used to isolate the cells of the present invention was taken from samples obtained through routine amniocentesis performed at 17-22 weeks of gestation for fetal karyotyping (Drexel University). The amniotic fluid was centrifuged for 7 minutes at 400 x g and the supernatant removed. The resulting cell pellet was resuspended in growth medium. The cells were cultured either on collagen type IV (1mg/100 mm plate) or fibronectin (10 micrograms/ml) coated plates. The cell yield from AF samples had a large variation (8000-300000 cell/sample), and some samples also contained a significant degree of red blood cell contamination. The cultures were left undisturbed for at least 5-10 days under hypoxic conditions (3% O₂). Thereafter, the cultures were fed with the same growth medium and cultured until the cultures reached 70-80% confluency. Cells at this stage were referred to as "P0". In some cultures, colonies of cells were isolated using a cloning ring and sub-cultured into a different culture plate. Cells were released from P0 culture by using TrypLE Express™ (Invitrogen) and seeded into fibronectin or collagen type IV coated flasks/dishes/plates at various densities (50-10,000 cell/cm²). Some of the P0 cells were used for serial dilution cloning. The population doubling time of the fastest growing cells was ~24 hrs at early passages. Cells were typically split at 60% confluency and reseeded at 100-10000 cells/cm².

Example 3

PCR Analysis Of Cells.

RNA was extracted from cells cultured in the growth media. Total RNA from human pancreas (Ambion, INC) was included as a positive control.

RNA extraction, purification, and cDNA synthesis. RNA samples were purified through binding to a silica-gel membrane (Rneasy Mini Kit, Qiagen, CA) in the presence of an ethanol-containing, high-salt buffer while contaminants were washed away. High-quality RNA was then eluted in water. Yield and purity were assessed by A260 and A280 readings on the spectrophotometer. cDNA copies were made from purified RNA using the iScript™ cDNA synthesis kit (BioRad, CA).

Real-time PCR amplification and quantitative analysis. Unless otherwise stated, all reagents were purchased from Applied Biosystems. Real-time PCR reactions were performed using the ABI PRISM™ 7500 Sequence Detection System. TAQMAN™ FAST UNIVERSAL PCR MASTER MIX™ (ABI, CA) was used with 20 ng of reverse transcribed RNA in a total reaction volume of 20 µl. Each cDNA sample was run in duplicate to allow correction of pipetting errors. Primers and FAM-labeled TAQMAN™ probes were used at concentrations of 200 nM. The level of expression for each target gene was normalized using the pre-developed Applied Biosystem's human glyceraldehyde-3-phosphate dehydrogenase (GAPDH) endogenous control kit. Primers and probes were designed using either ABI PRISM PRIMER EXPRESS™ software or a pre-developed ABI gene analysis kit. For each gene, either one of the primers or the probe were designed to be exon-boundary spanning. This eliminated the possibility of the primers/probe binding to any genomic DNA present. The primer and probe sets are listed as follows: Pdx-1 (Hs00426216), Insulin (Hs00355773), glucagon (Hs00174967), and FoxA2 (HNF 3-beta) (Hs00232764). The remaining primers were designed using the PRIMERS program (ABI, CA). After an initial 95°C incubation for 20 sec, samples were cycled 40 times in two stages: a denaturation step at 95°C for 3 sec, followed by an annealing/extension step at 60°C for 30 sec.

For each primer/probe set, a cycle time value was determined as the cycle number at which the fluorescence intensity of the PCR reaction reached a specific value in the middle of the exponential region of amplification. An increase in expression of a gene corresponded to a decrease in the number of cycles required for the fluorescence intensity to reach this value.

Example 4

25 Fluorescence-Activated Cell Sorting (FACS) Analysis.

Adhered cells were removed from culture plates by five-minute incubation with the TRYPLE™ express solution (Gibco, CA). Released cells were resuspended in DMEM supplemented with 10% FBS and recovered by centrifugation, followed by washing and

resuspending the cells in a staining buffer consisting of 2% BSA, 0.05% sodium azide (Sigma, MO) in PBS. If appropriate, the cells were Fc-receptor blocked using a 0.1% γ -globulin (Sigma) solution for 15 min. Aliquots (approximately 10^5 cells) were incubated with either phycoerythrin (PE) or allophycocyanin (APC) conjugated monoclonal antibodies (5 μ l antibody per 10^6 cells), as indicated in **Table I**, or with an unconjugated primary antibody. Controls included appropriate isotype matched antibodies, non-stained cells, and cells only stained with secondary conjugated antibody. All incubations with antibodies were performed for 30 mins at 4°C after which the cells were washed with the staining buffer. Samples that were stained with unconjugated primary antibodies were incubated for an additional 30 mins at 4°C with secondary conjugated PE or -APC labeled antibodies. See **Table II** for a list of secondary antibodies used. Washed cells were pelleted and resuspended in the staining buffer and the cell surface molecules were identified by using a FACS Array (BD Biosciences) by collecting at least 10,000 events.

For intracellular staining, cells were first fixed for 10 mins with 4% paraformaldehyde, followed by two rinses in the staining buffer, centrifugation of cells and resuspension of the cells in a permeabilization buffer containing 0.5% Triton-XTM (Sigma) in PBS for 5 mins at room temperature (RT). The permeabilized cells were rinsed twice with a rinsing buffer, centrifuged, and resuspended in the staining buffer, and incubated with an appropriate conjugated antibody (5 μ l antibody per 10^6 cells) for 30 mins at 4°C. Samples that were stained with unconjugated primary antibodies were incubated for an additional 30 mins at 4°C with secondary conjugated PE or -APC labeled antibodies (**Table II**). Washed cells were pelleted and resuspended in the staining buffer and the internal proteins were identified by using a FACSArray (BD Biosciences) by collecting at least 10,000 events.

Example 5

Immunostaining of Cells.

10,000 cells/cm² cells were seeded into glass bottom 35 mm microwell dishes (Matek Corp, MA) in growth medium. Following three days in culture, the cells were fixed for

10 mins with 4% paraformaldehyde, followed by two rinses in PBS and addition of a permeabilization buffer containing 0.5% Triton-X (Sigma) for 5 mins at room temperature (RT), followed by an additional three rinses with PBS. The fixed and permeabilized cells were blocked with either 1% bovine serum albumin (BSA) or 4% serum from the species where the secondary antibody was raised in (goat, donkey, or rabbit). Control samples included reactions with the primary antibody omitted or where the primary antibody was replaced with corresponding immunoglobulins at the same concentration as the primary antibodies. Stained samples were rinsed with a PROLONG® antifade reagent (Invitrogen, CA) containing diamidino-2-phenylindole, dihydrochloride (DAPI) to counter-stain the nucleus. Images were acquired using a Nikon™ Confocal Eclipse C-1 inverted microscope (Nikon, Japan) and a 60X objective.

Example 6

Effects of Trichostatin A Treatment on Gene Expression in Panc-1 Cells and Neonatal Fibroblasts.

15 Neonatal fibroblasts, also designated Hs27, were derived from human foreskins and obtained from the American Type Culture Collection (ATCC). Panc-1 cells are a transformed cell line derived from a pancreatic epitheloid carcinoma of ductal origin, also obtained from ATCC.

20 Fibroblasts or Panc-1 cells were seeded into a 6-well tissue culture plate at a density of 50,000 cells/cm². Both cell types were cultured in medium containing 10%FBS and DMEM under standard cell culture conditions (37°C, 5%CO₂). After reaching confluence (2-3 days), trichostatin A diluted in dimethyl sulfoxide (DMSO) and medium was added at either 2.5 µM or 5 µM to the cultures. Parallel cultures were treated with an equivalent concentration of DMSO as a vehicle control.

25 RNA samples were obtained from the treated cultures 48 hours after the addition of trichostatin A or DMSO. The culture medium was removed, the cells were washed with phosphate buffered saline (PBS), and RLT Lysis buffer containing β-mercaptoethanol (Qiagen) was added. The samples were homogenized using Qiashredder columns

(Qiagen), and RNA was purified using the RNeasy[™] Mini Kit (Qiagen). RNA quantity and quality was determined using a spectrophotometer, and cDNA was made using the iScript cDNA synthesis kit (BioRad).

The expression levels of Sox17, HNF-3 beta, Pdx-1, insulin, and glucagon were determined by Real-Time PCR (RT-PCR), as described in **Example 3**. Samples of 20ng cDNA were used in each reaction. RT-PCR reactions were performed on the Applied Biosystems 7500, and data was analyzed using the accompanying software. Human pancreas cDNA was included as a positive control. Results were normalized against GAPDH expression levels.

A basal level of expression for Sox17, HNF-3 beta, Pdx-1 and glucagon was detected in untreated Panc-1 cells. However, expression of these genes was not detectable in untreated neonatal fibroblasts. (**Table I**). Treatment of neonatal fibroblasts and Panc-1 cells with the HDAC inhibitor, trichostatin A, caused an increase in expression of Sox17, HNF-3 beta, Pdx-1, and glucagon (**Figure 1, panels a-d & Table III**). Expression of insulin did not change relative to untreated controls in samples for either cell type under the conditions tested.

Basal expression levels of Sox17, HNF-3 beta, Pdx-1, and glucagon were higher in untreated Panc-1, compared to untreated neonatal fibroblast cells. Trichostatin A treatment evoked a more robust up-regulation of pancreatic gene expression in Panc-1 cells relative to fibroblasts, as measured for the representative endocrine and pancreas genes evaluated. Up-regulated expression of these genes also correlated in a dose-dependent manner with the concentration of trichostatin A used during treatment, again with a more robust effect noted in Panc-1 cells for these genes of interest. Panc-1 cells treated for 48 hours increased Sox-17 expression 60 times higher, Pdx-1 expression 11 times higher, and glucagon expression 5 times higher with 5.0 μ M versus 2.5 μ M trichostatin A. Similar dose response effects were noted for fibroblasts although the up-regulation was less pronounced overall (**Figure 1, panels a-d & Table III**).

These data suggest that the potency of the HDAC inhibitor, trichostatin A, with respect to increasing expression of Sox17, HNF-3 beta, Pdx-1, and glucagon, is greater in Panc-1 cells than neonatal fibroblasts. This may also suggest that with a given treatment protocol, lineage specific gene expression can be enhanced to a greater extent in cells previously differentiated (or partially differentiated) along that same lineage pathway. However, the effect of treatment is not restricted to differentiated (or partially differentiated) cells of that pathway but may encompass cells from other lineage pathways.

Example 7

10 **Effects of Trichostatin A on Gene Expression in Amniotic Fluid-Derived Cells.**

Amniotic fluid derived cells were seeded into 24-well tissue culture plates at a density of 5000/cm² and cultured in AMNIOMAX medium (Invitrogen) under standard cell culture conditions until confluent. Cells were obtained according to methods described in **Example 2**. After reaching confluence, 1.25μM trichostatin A diluted in DMSO and medium was added to sample wells; an equivalent concentration of DMSO was added to control wells as a no treatment control.

RNA samples were obtained from treated cultures at 30 minutes, 1.5 hours, 3 hours, 6 hours, 12 hours, and 24 hours following addition of trichostatin A or DMSO. Culture medium was removed, cells were washed with PBS, and RLT lysis buffer with β-mercaptoethanol (Qiagen) was added. RNA was purified using the RNeasy Mini Kit (Qiagen). RNA quantity and quality was determined using a spectrophotometer, and cDNA was made using the iScript cDNA synthesis kit (BioRad).

Expression levels of Sox17, HNF-3 beta, Pdx-1, insulin, and glucagon were determined by Real-Time PCR. Samples of 20ng cDNA were used in each reaction, performed on the Applied Biosystems 7500 according to methods described in **Example 3**. Data analysis was performed using the accompanying software. Human pancreas cDNA was included as a positive control, and results were normalized against GAPDH expression levels.

Basal expression of insulin and Sox-17 were consistently detected in untreated cells whereas low level expression of HNF-3 beta was detected intermittently at various time points in untreated cells. Glucagon and Pdx-1 gene expression were not detectable in untreated cells (**Table IV-A**).

- 5 Treatment of amniotic fluid-derived cells with trichostatin A caused a decrease in the gene expression of insulin, had relatively little or no effect on Sox-17 expression, but induced an increase in gene expression of glucagon, HNF-3 beta and Pdx-1 over time (**Figure 2, panels a-d & Table IV-B**). HNF-3 beta gene expression in amniotic fluid-derived cells was detectable by RT-PCR at >35 cycles by 30 minutes after addition of
- 10 trichostatin A, increasing with time to <35 cycles at 24 hours. Pdx-1 gene expression was undetectable 30 minutes after addition of trichostatin A, first detectable at >35 cycles by RT-PCR at 6 hours, increasing to <35 cycles or ~0.1% of human pancreas levels at 24 hours. Glucagon expression was undetectable 30 minutes after addition of trichostatin A, first detectable at >35 cycles by RT-PCR at 12 hours, increasing to <24 cycles at 24
- 15 hours (**Figure 2, panels c-d**).

These results, in conjunction with results from Panc-1 cells in **Example 6**, suggest a pattern in regulation of gene sets inherent in a particular cell lineage differentiation program. Differentiated cells treated with a chromatin-remodeling agent may down-regulate some genes and up-regulate other genes in response to both the presence of the

20 HDAC inhibitor and environmental or other stimulatory signals.

Example 8

Effects of Trichostatin A on Gene Expression in Late Passage (P14) Pancreatic-Derived Stromal Cells.

Human pancreatic-derived stromal cells were obtained according to the methods

25 described in **Example 1**. Cells were seeded into a 24-well tissue culture plate at a density of 5000/cm² and cultured in DMEM containing 10% fetal bovine serum under standard cell culture conditions until confluent. After the cells reached confluency, 2.5 μM

trichostatin A, diluted in DMSO and medium was added to the wells. Parallel cultures were treated with an equivalent concentration of DMSO as a vehicle control.

RNA samples were obtained from treated cultures at 30 minutes, 1.5 hours, 3 hours, 6 hours, 12 hours and 24 hours following the addition of trichostatin A or DMSO. Culture medium was removed, the cells were washed with PBS, and RLT lysis buffer with β -mercaptoethanol (Qiagen) was added. RNA was purified using the RNeasy Mini Kit (Qiagen). RNA quantity and quality were determined using a spectrophotometer, and cDNA was made using the iScript cDNA synthesis kit (BioRad).

The expression levels of Sox17, HNF-3 beta, Pdx-1, insulin, and glucagon were determined by Real-Time PCR. Samples of 20ng cDNA were used in each reaction, which was performed on the Applied Biosystems[™] 7500 according to the methods described in **Example 3**. Data were analyzed using the accompanying software. Human pancreas cDNA was included as a positive control, and results were normalized against GAPDH expression levels.

Expression of insulin, Pdx-1, glucagon or HNF-3 beta genes was not detected in untreated late passage pancreatic-derived stromal cells. However, Sox-17, was detected at low levels intermittently in untreated cells at various time points during the course of the experiment (**Table V-A**). Treatment of late passage pancreatic-derived stromal cells with 2.5 μ M of trichostatin A caused an increase in gene expression of Sox-17, glucagon, HNF-3 beta, and Pdx-1 genes over time. However, no changes in insulin gene expression were observed (**Figure 3, panels a-c & Table V-B**).

Sox-17 gene expression in late passage pancreatic-derived stromal cells was consistently detectable at >35 cycles by RT-PCR 3 hours after addition trichostatin A, increasing over time to levels <35 cycles or ~3% of human pancreas levels at 24 hours (**Figure 3, panel a**). HNF-3 beta gene expression was detectable at >35 cycles by RT-PCR by 6 hours after addition of trichostatin A, increasing to <35 cycles or ~0.075% of human pancreas at 24 hours (**Figure 3, panel b**). Pdx-1 gene expression was detectable at >35 cycles by RT-PCR by 12 hours after addition of trichostatin A, increasing to <35 cycles or ~0.2%

of human pancreas levels at 24 hours (**Figure 3, panel b**). Glucagon expression was undetectable until 24 hours following addition of trichostatin A, reaching detectable levels of 35-40 cycles by RT-PCR at that time point (**Figure 3, panel c**). Collectively these data indicate that treatment with the HDAC inhibitor agent trichostatin A can

5 induce or enhance expression of endocrine pancreatic genes in cells that have low basal expression rates or that have lost previous expression patterns over time in culture.

Example 9

Effects of Chronic Trichostatin A Treatment on Gene Expression in Amniotic Fluid-Derived Cells.

10 Amniotic fluid derived cells were obtained according to the methods described in **Example 2**. Cells were seeded into a 24-well tissue culture plate at a density of 5000/cm² and cultured in AMNIOMAX (Invitrogen) under standard cell culture conditions until confluent. After the cells reached confluency, sample wells were treated with either 500 nM or 1.0 μ M trichostatin A diluted in DMSO and medium; control wells

15 were treated with an equivalent concentration of DMSO. At 24 hour intervals over the three day incubation period, cultures underwent a complete medium change, and a fresh dilution of trichostatin A or DMSO was added as appropriate.

RNA samples were obtained from the treated cultures at 24 hour intervals after the initial addition of trichostatin A or DMSO. The culture medium was removed, cells were

20 washed with PBS, and RLT lysis buffer with β -mercaptoethanol (Qiagen) was added. RNA was purified using the RNeasy Mini Kit (Qiagen); RNA quantity and quality was determined using a spectrophotometer. cDNA was made using the iScript cDNA synthesis kit (BioRad).

Expression levels of Sox17, HNF-3 beta, Pdx-1, insulin, and glucagon were determined

25 by RT-PCR. Samples of 20ng cDNA were used in each reaction, performed on an Applied Biosystems 7500 according to the methods described in **Example 3**. Data were analyzed using the accompanying software. Human pancreas cDNA was included as a control. Results were normalized against GAPDH expression levels.

Basal expression of insulin and Sox-17 genes was detectable in untreated amniotic fluid-derived cells. However, expression of glucagon and Pdx-1 genes was not detectable in untreated cells by RT-PCR up to cycle 40. HNF-3 beta was not detected in untreated cells at 24-hours in culture but was weakly expressed at 48 and 72 hours culture time.

5 Following treatment with trichostatin A, amniotic fluid-derived cells expressed glucagon, HNF-3 beta, and Pdx-1 above basal levels (**Figure 4, panels a-e, Table VI**). Gene expression for glucagon and Pdx-1 increased in a dose and time dependent manner after treatment with trichostatin A, with highest expression seen at the final 72 hour time point and with the higher 1 μ M treatment dose (**Figure 4, panels a & d**). Similarly, HNF-3
10 beta gene expression in this example also increased in a time dependent manner with highest expression observed at the final 72 hour time point. However, HNF-3 beta expression was essentially equivalent with both treatment doses of 1 μ M and 500nM trichostatin A (**Figure 4, panel b**). In contrast, insulin gene expression decreased after treatment to non-detectable levels at all time points. Sox-17 expression was affected to a
15 less significant degree relative to initial basal expression levels with both treatment doses of trichostatin A. This suggests that the extent of the induced gene expression in response to treatment with an HDAC inhibitor may be variable.

Example 10

20 Effects of Chronic Trichostatin A Treatment on Gene Expression in Late Passage Pancreatic-Derived Stromal Cells.

Pancreatic-derived stromal cells were obtained according to the methods described in **Example 1**. Cells were seeded into a 24-well tissue culture plate at a density of 5000/cm² and cultured in DMEM with 10% FBS under standard cell culture conditions until confluent. After the cells reached confluency, sample wells were treated with either
25 1.25 μ M or 2.5 μ M trichostatin A diluted in DMSO and medium; control wells received DMSO at an equivalent concentration. At 24 hour intervals over the three day culture period, cultures underwent a complete medium change, and a fresh dilution of trichostatin A or DMSO was added as appropriate. RNA samples were obtained from treated cultures

daily after the initial addition of trichostatin A or DMSO. Culture medium was removed, cells were washed with PBS, and RLT lysis buffer with β -mercaptoethanol (Qiagen) was added. RNA was purified using the RNeasy Mini Kit (Qiagen), and RNA quantity and quality was determined using a spectrophotometer. cDNA was made using the iScript
 5 cDNA synthesis kit (BioRad).

Expression levels of Sox17, HNF-3 beta, Pdx-1, insulin, and glucagon were determined by RT-PCR. Samples of 20ng cDNA were used in each reaction, which was performed on the Applied Biosystems 7500, according to the methods described in **Example 3**. Data were analyzed using the accompanying software. Human pancreas cDNA was
 10 included as a control. Results were normalized against GAPDH expression levels.

Glucagon, HNF-3 beta, Pdx-1 and Sox-17 gene expression was not detectable by RT-PCR in untreated late passage pancreatic-derived stromal cells. After addition of trichostatin A, gene expression was detectable for all of the aforementioned genes. Insulin gene expression was undetectable prior to treatment and did not increase
 15 following trichostatin A treatment. Glucagon, HNF-3 beta, Pdx-1, and Sox-17 gene expression levels all increased in a time dependent manner with highest expression observed for all three genes at 72 hours. In some cases differences in expression levels could be seen when a higher concentration of trichostatin A was added to the cells (**Figure 5, panels a-d & Table VII**). Increases in gene expression were equivalent with
 20 these two treatment concentrations of 1.25 and 2.5 μ M trichostatin A; differences at each time point for each gene were minimal or did not appear to be significant. The data imply that for a given gene, there may be a maximal threshold level for treatment by an HDAC inhibitor to have an effect on gene expression at a given time point and that increasing the concentration of HDAC inhibitor has no added benefit. The data may also
 25 suggest that continuous replenished addition of trichostatin A during the treatment protocol may be necessary to sustain escalating increases in gene expression over time.

Example 11

Effects of Chronic Trichostatin A Treatment on Gene Expression in Amniotic Fluid-Cells and Pancreatic-Derived Stromal Cells.

Several cell lines obtained from different amniotic fluid specimens (see **Example 2**) and pancreas donors (see **Example 1**) were tested with similar results. Two lines at similar
 5 passage number but derived from different amniotic fluid specimens are shown in **Table VIII-A** and **Table VIII-B** for this example. One of these cell lines was also used in examples 2 and 4 above. In addition, this example also contains comparison data in **Table VIII-C** and **Table VIII-D** for a single pancreatic-derived stromal line grown to early and late passage number.

- 10 Amniotic fluid derived cells or pancreatic-derived stromal cells were seeded into 24-well tissue culture plates at a density of 5000/cm² and cultured in AMNIOMAX (Invitrogen) or DMEM with 10% FBS, respectively, under standard cell culture conditions until confluent. After the cells reached confluency, amniotic fluid derived cells were treated once at time 0 hours with 500 nM trichostatin A. Pancreas-derived stromal cells were
 15 treated once at time 0 hours with 1.25 μ M trichostatin A. Samples for RT-PCR were taken daily from zero to six days at the times indicated in **Table VIII**.

RNA samples were obtained from the treated cultures up to 144 hours after the initial addition of trichostatin A or DMSO. Culture media was removed, the cells were washed with PBS, and RLT lysis buffer containing β -mercaptoethanol (Qiagen) was added.

- 20 During culture, the medium was not changed nor was freshly prepared trichostatin A added. RNA was purified using the RNeasy Mini Kit (Qiagen), and RNA quantity and quality was determined using a spectrophotometer. cDNA was made using the iScript cDNA synthesis kit (BioRad).

- 25 Samples of 20ng cDNA were used in each reaction to determine the expression levels of the following genes in amniotic fluid-derived cells: Gata1, HNF-3 beta, Pdx-1, insulin, and Sox17. Similarly, samples of 20ng cDNA were used in each reaction to determine the expression level of the following genes in pancreatic-derived stromal cells: glucagon, HNF-3 beta, insulin and Pdx-1. Real-Time PCR was performed on the Applied

Biosystems 7500, and data was analyzed using the accompanying software according to the methods described in **Example 3**.

Analysis of samples obtained from the untreated amniotic fluid-derived cell line used in Examples 2 & 4 above showed that these cells did not express HNF-3 beta or Gata1 but did express Sox-17 and very low levels of insulin and Pdx-1 (**Table VIII-A**). After addition of trichostatin A, HNF-3 beta expression increased, but only during the first 48 hours after initial treatment. Pdx-1 was expressed continuously for 24 hours following treatment, but expression was not detectable after that time point. The insulin gene was not expressed for 48 hours following initial treatment but was detectable after 48 hours. There was no change in Sox17 or Gata1 expression observed (**Table VIII-A**). These data suggest that trichostatin A may inhibit insulin gene expression in these cells within the initial 24-48 hours of culture but is associated with up regulation of Pdx-1 and HNF-3 beta expression within the same time period, followed by a return to undetectable or very weak expression after 48 hours. Trichostatin A may degrade in culture and may not have a significant sustained impact on gene expression at later time points after 24-48 hours. Consequently, the net effect over long time periods using a single initial dose of trichostatin A may reflect the reversible nature of this reagent.

Analysis of samples obtained from an additional untreated amniotic fluid-derived cell line showed that these cells did not express basal levels of HNF-3 beta, Pdx-1 or Gata-1 but did express insulin and Sox-17. Following trichostatin A treatment, HNF-3 beta expression was detected at 48 hours, but as seen in the first amniotic fluid derived cell line, HNF-3 beta decreased to very weak expression levels after 48 hours (**Table VIII-B**). Pdx-1 gene expression was only detected at 24 hours following trichostatin A treatment and returned to undetectable levels for the remainder of the experiment. Insulin gene expression fell to undetectable levels following the addition of 500 nM trichostatin A and then returned to detectable levels starting at 72 hours after the addition of trichostatin A (**Table VIII-B**). Expression of Sox17 and Gata1 genes did not change with the addition of trichostatin A. These data suggest that trichostatin A may be metabolized within 24-48 hours of addition to cell culture samples, that trichostatin A

inhibits insulin gene expression in these cells but has a reversible stimulatory effect on other genes including HNF-3 beta and Pdx-1 (**Table VIII-B**).

Prior to treatment, early passage (P5) pancreatic-derived stromal cells expressed Pdx-1, while expression of the glucagon, HNF-3 beta and insulin genes was not detectable. At 5 24 hours following treatment with 2.5 μ M trichostatin A, HNF-3 beta, Pdx-1, and glucagon genes all demonstrated up-regulated expression, but the effect was not sustained and only glucagon expression was still detectable 48 hours after initial treatment, albeit decreased to a lower level than observed at 24 hours. Insulin gene expression remained undetectable and unchanged throughout the course of the experiment (**Table VIII-C**).

10 These data suggest that following trichostatin A treatment, expression of some genes, e.g. transcription factors, may be short-lived depending on the inherent instability of the corresponding mRNA, and/or secondary effects of an HDAC inhibitor on mRNA stability, and/or additional negative regulatory pathways operating in these cells. More persistent expression of other genes over a similar time period may reflect greater

15 message stability and/or additional positive regulatory effects.

Untreated late passage (P14) pancreatic-derived stromal cells did not express any of the genes of interest, suggesting that the expression of these endocrine pancreatic markers declines with time during in vitro culture maintenance. Following treatment with trichostatin A, insulin gene expression remained undetectable and unchanged throughout

20 the course of the experiment (**Table VIII-D**). Glucagon, Pdx-1, and HNF-3 beta gene expression were detected by RT-PCR at 24 hours (**Table VIII-D**). However, only glucagon expression remained detectable 48 hours after initial treatment albeit at a lower expression level than observed at 24 hours and declined to undetectable levels thereafter. The glucagon gene was expressed for a shorter period of time in these late passage cells

25 as compared to early passage pancreatic-derived stromal cells which may reflect a less plastic stage of response to the effects of HDAC inhibitors.

Example 12

Effects of Two Sequential Low Dose Trichostatin A Treatments on Gene Expression in Amniotic Fluid-Cells and Pancreatic-Derived Stromal Cells.

Several cell lines obtained from different amniotic fluid specimens (see **Example 2**) and pancreas donors (see **Example 1**) were tested with similar results. Two lines at similar
 5 passage number but derived from different amniotic fluid specimens are shown in **Table IX-A** and **Table IX-B** for this example. One of these cell lines was also used in **examples 7 and 9** above. In addition, this example also contains comparison data in **Table IX-C** and **Table IX-D** for a single pancreatic-derived stromal line grown to early and late passage number.

10 Amniotic fluid derived cells or pancreatic-derived stromal cells were seeded into 24-well tissue culture plates at a density of 5000/cm² and cultured in AMNIOMAX (Invitrogen) or DMEM with 10% FBS respectively under standard cell culture conditions until confluent. After the cells reached confluency, amniotic fluid derived cells were treated at
 15 time 0 hours with a dose of 500 nM trichostatin A, and pancreatic-derived stromal cells were treated with a dose of 1.25 µM trichostatin A solubilized in DMSO and medium. At time 24 hours, cell cultures underwent a complete medium change to remove all traces of trichostatin A. At time 96 hours, cell cultures were re-fed with fresh medium and received a second dose of trichostatin A at the same concentration as used previously. At
 20 time 120 hours, cell cultures again underwent a complete medium change and were cultured for an additional 24 hours or 148 hours total incubation time.

Samples were taken daily for RT-PCR at the times indicated in **Table IX-A to D**. The culture medium was removed, and samples were rinsed in PBS then collected in RLT with β-mercaptoethanol (Qiagen). RNA was purified using the RNeasy Mini Kit (Qiagen) and RNA quantity and quality were determined using a spectrophotometer.
 25 cDNA was made using the iScript cDNA synthesis kit (BioRad).

Samples of 20ng cDNA were used in each reaction to determine the expression levels of the following genes in amniotic fluid-derived cells: Gata1, HNF-3 beta, Pdx-1, insulin, and Sox17. Similarly, samples of 20ng cDNA were used in each reaction to determine

the expression level of the following genes in pancreatic-derived cells: glucagon, HNF-3 beta, insulin and Pdx-1. Real-Time PCR was performed on the Applied Biosystems 7500, and data was analyzed using the accompanying software according to the methods described in **Example 3**.

- 5 Prior to treatment with trichostatin A, the amniotic fluid-derived cell line used in **Examples 7 & 9** did not express Gata-1 or HNF-3 beta. However, expression of the insulin and Pdx-1 and Sox-17 genes was detected by RT-PCR at 37 cycles and 27 cycles respectively (**Table IX-A**). Following treatment with 0.5 μ M trichostatin A, Sox-17 and Gata-1 gene expression levels did not change at any subsequent time point throughout the
10 experiment. Insulin expression was detected by RT-PCR at 36 cycles prior to trichostatin A treatment, decreased to undetectable levels at 24 hours following the first addition of trichostatin A, reappeared at detectable levels of 36 cycles by 48 hours, and remained at 36 cycles for the duration of the experiment.. HNF-3 beta was detected by RT-PCR at 33 cycles following the first trichostatin A treatment, decreasing to undetectable levels
15 following the first medium change, reappearing at 37 cycles following the second treatment with trichostatin A, and remaining for the duration of the experiment. Pdx-1 gene expression was detected at 37 cycles by RT-PCR, continuing at this level for 24 hours following the addition of trichostatin A, but was not detectable after that time point for the remainder of the experiment (**Table IX-A**).
- 20 Prior to treatment with trichostatin A, the amniotic fluid-derived cell line used in **Example 11** did not express Gata-1, HNF-3 beta or Pdx-1. Expression of insulin and Sox-17 was detected by RT-PCR at cycle 35 and cycle 27 respectively (**Table IX-B**). Following treatment with 0.5 μ M trichostatin A, HNF-3 beta was expressed at 34 cycles by RT-PCR until 72 hours; thereafter the expression level declined for the remainder of
25 the experiment to cycle 37 as detected by RT-PCR. Pdx-1 gene expression was detected by 24 hours at cycle 39 by RT-PCR following trichostatin A treatment, but thereafter declined and was undetectable for the remainder of the experiment. Insulin gene expression was not detectable for the first 48 hours of the experiment following trichostatin A treatment but was detected by RT-PCR at cycle 34 at 72 hours and for the

remainder of the experiment. Sox-17 and Gata-1 gene expression levels did not change throughout the course of the experiment (Table IX-B).

Early passage (P5) pancreatic-derived stromal cells did not express glucagon, HNF-3 beta or insulin prior to treatment with trichostatin A. However, Pdx-1 expression was
 5 detected by RT-PCR at cycle 38. Following treatment with 1.25 μ M trichostatin A, there was no change in insulin expression. Pdx-1 and HNF-3 beta gene expression were detectable by RT-PCR at cycle 34 for both genes 24 hours following the addition of trichostatin A; thereafter expression fell to undetectable levels until after the second addition of trichostatin A, after which detection was at cycle 33 for Pdx-1 and HNF-3
 10 beta. Glucagon gene expression was detected by RT-PCR at cycle 34 for the first 48 hours after addition of trichostatin A but fell to undetectable levels until after the second treatment cycle of trichostatin A, at which time the expression level increased to cycle 37 by RT-PCR (Table IX-C).

Similar results were seen for late passage (P11) pancreatic-derived stromal cells:
 15 Glucagon, HNF-3 beta, insulin, and Pdx-1 were undetectable prior to treatment. Following treatment with 1.25 μ M trichostatin A there was no change in insulin gene expression; however, expression of glucagon, HNF-3 β and Pdx-1 genes could be detected by RT-PCR at cycle 33 for all three genes. Gene expression decreased thereafter or was undetectable until after the second treatment cycle of trichostatin A, where
 20 expression levels were detected by RT-PCR to be at cycle 36 for glucagon gene and 34 for HNF-3 beta and Pdx-1 genes (Table IX-D).

Collectively these data imply that effects of trichostatin A on gene expression are not sustained after its removal from culture. However, repeat applications of trichostatin A can restore it's effects on gene expression. The overall pattern of gene expression evoked
 25 by trichostatin A may depend in part on the dose concentration used, the duration of treatment, and the interval between treatment periods.

Example 13

Effects of Two Sequential High Dose Trichostatin A Treatments on Gene Expression in Amniotic Fluid-Cells and Pancreatic-Derived Stromal Cells.

Several cell lines obtained from different amniotic fluid specimens (see **Example 2**) and pancreas donors (see **Example 1**) were tested with similar results. Two lines at similar
 5 passage number but derived from different amniotic fluid specimens are shown in **Table X-A** and **Table X-B** for this example. One of these cell lines was also used in examples 2 and 4 above. In addition, this example also contains comparison data in **Table X-C** and **Table X-D** for a single pancreatic-derived stromal line grown to early and late passage number.

10 Amniotic fluid derived cells or pancreatic-derived stromal cells were seeded into 24-well tissue culture plates at a density of 5000/cm² and cultured in AMNIOMAX (Invitrogen) or DMEM with 10% FBS respectively under standard cell culture conditions until confluent. After the cells reached confluency, amniotic fluid derived cells were treated at
 15 time 0 hours with a dose of 1.25 μ M trichostatin A, and pancreatic-derived stromal cells were treated with a dose of 5.0 μ M trichostatin A solubilized in DMSO and medium. At time 24 hours, cell cultures underwent a complete medium change to remove all traces of trichostatin A. At time 96 hours, cell cultures were re-fed with fresh medium and received a second dose of trichostatin A at the same concentration as used previously. At
 20 time 120 hours, cell cultures again underwent a complete medium change and were cultured for an additional 24 hours or 148 hours total incubation time.

Samples were taken daily for RT-PCR at the times indicated in **Table X-A to D**. The culture media was removed, and samples were rinsed in PBS then collected in RLT with β -mercaptoethanol (Qiagen). RNA was purified using the RNeasy Mini Kit (Qiagen) and RNA quantity and quality were determined using a spectrophotometer. cDNA was made
 25 using the iScript cDNA synthesis kit (BioRad).

Samples of 20ng cDNA were used in each reaction to determine the expression levels of the following genes in amniotic fluid-derived cells: Gata1, HNF-3 beta, Pdx-1, insulin, and Sox17. Similarly, samples of 20ng cDNA were used in each reaction to determine

the expression level of the following genes in pancreatic-derived cells: glucagon, HNF-3 beta, insulin and Pdx-1. Real-Time PCR was performed on the Applied Biosystems 7500, and data was analyzed using the accompanying software according to the methods described in **Example 3**.

- 5 Prior to treatment with trichostatin A, the amniotic fluid-derived cell line used in **Examples 7 & 9** did not express Gata-1 or HNF-3 beta. Gene expression for insulin, Pdx-1, and Sox-17 was detected by RT-PCR at 36 cycles, 37 cycles, and 27 cycles, respectively. Treatment with 1.25 μ M trichostatin A caused HNF-3 beta expression, detected at 32 cycles; however, this expression was transient as HNF-3 beta gene
10 expression levels declined following the initial treatment with 1.25 μ M trichostatin A to undetectable levels. A second treatment with 1.25 μ M trichostatin A caused HNF-3 beta gene expression to be detected at 32 cycles as measured by RT-PCR (**Table X-A**). Similar results were observed for Pdx-1 gene expression. Treatment with 1.25 μ M trichostatin A caused an increase in Pdx-1 from 37 cycles to 32 cycles, as measured by
15 RT-PCR. This increase was transient, however, as Pdx-1 gene expression levels declined to undetectable levels following the initial treatment with 1.25 μ M trichostatin A. A second treatment with 1.25 μ M trichostatin A caused Pdx-1 gene expression to be detected at 34 cycles as measured by RT-PCR (**Table X-A**). Gata-1 expression was only detected at 37 cycles by RT-PCR following the first addition of trichostatin A. Sox-17
20 gene expression did not change with the addition of trichostatin A. Insulin gene expression was undetectable following 1.25 μ M trichostatin A treatment but was detected at 36 cycles as measured by RT-PCR following the media change (**Table X-A**).

- Prior to treatment with trichostatin A, the amniotic fluid-derived cell line used in **Example 11** did not express Gata-1, HNF-3 beta and Pdx-1. However, expression of
25 insulin and Sox-17 was detected by RT-PCR at 35 cycles and 27 cycles respectively. The initial 1.25 μ M trichostatin A treatment stimulated expression of HNF-3 beta and Pdx-1. HNF-3 beta expression was detected at 35 cycles as measured by RT-PCR but that level of expression decreased to 38 cycles prior to the second addition of trichostatin A. Following the second 1.25 μ M trichostatin A treatment HNF-3 beta gene expression

returned to detection at 32 cycles as measured by RT-PCR. Pdx-1 expression was
 detected by RT-PCR at 33 cycles after the initial 1.25 μ M trichostatin A treatment. This
 level of expression was not detectable after the trichostatin A was removed from the
 medium but returned to detectable levels at cycle 32 as measured by RT-PCR, following
 5 the second 1.25 μ M trichostatin A treatment (**Table X-B**). Gata-1 gene expression did
 not change throughout the course of the experiment. While insulin gene expression was
 detected prior to trichostatin A treatment at 35 cycles as measured by RT-PCR, it was not
 detectable immediately following treatment. After trichostatin A was washed away,
 detection of insulin gene expression returned and was detectable at 36 cycles as measured
 10 by RT-PCR. Following the second addition of trichostatin A, insulin gene expression
 was once again undetectable. Sox-17 gene expression was unchanged for the duration of
 the experiment (**Table X-B**). These data suggest that 1.25 μ M trichostatin A is a better
 concentration to use than 0.5 μ M trichostatin A for increasing HNF-3 β and Pdx-1 gene
 expression in this cell. The effects of 1.25 μ M trichostatin A seem have a prolonged
 15 effect after a change of medium, indicating that the effect on gene expression persists
 beyond the actual time the compound is present. It also appears that trichostatin A may
 have an inhibitory effect on insulin gene expression.

Expression of glucagon, HNF-3 beta and insulin genes was not detected in early passage
 (P5) pancreatic-derived stromal cells prior to treatment with 5.0 μ M trichostatin A
 20 although Pdx-1 expression was observed at 38 cycles as measured by RT-PCR (**Table X-
 C**). Following treatment with 5.0 μ M trichostatin A, HNF-3 beta and glucagon
 expression was detected at 34 cycles and 35 cycles respectively as measured by RT-PCR.
 HNF-3 beta gene expression was not detectable after trichostatin A was removed, but
 gene expression was restored and detectable at cycle 36 by RT-PCR following a second
 25 treatment with trichostatin A,. The level of expression of glucagon also decreased when
 trichostatin A was removed and was not detectable following the second addition of TSA
 until the end of the experiment when it was detected at 38 cycles by RT-PCR. Pdx-1
 gene expression was detected only after the second treatment of trichostatin A at cycle 32
 as measured by RT-PCR. Insulin gene expression did not change throughout the course
 30 of the experiment (**Table X-C**). These data suggest that 24 hours of treatment with 5.0

μ M trichostatin A was sufficient to increase gene expression of HNF-3 beta and Pdx-1 but was not sufficient to increase insulin gene expression in early passage (P5) pancreatic-derived stromal cells.

Results for late passage (P11) pancreatic-derived stromal cells were similar to those seen for early passage (P5) pancreatic-derived stromal cells. Prior to trichostatin A treatment, no genes of interest were detectable, but following treatment with 5.0 μ M trichostatin A, glucagon was detected at cycle 33, HNF-3 beta was detected at cycle 32 and Pdx-1 expression was detected at cycle 31 as measured by RT-PCR. Following the medium change, glucagon expression was still detectable by RT-PCR but the levels observed decreased to 38 cycles as measured by RT-PCR and did not increase with the second addition of trichostatin A. HNF-3 beta gene expression was detectable following the first trichostatin A treatment at 32 cycles but was undetectable following the change of medium; expression was not detectable again until after the second treatment of trichostatin A at 36 cycles as measured by RT-PCR. Pdx-1 was expressed at 31 cycles following the initial treatment with trichostatin A, but this level of expression was not detectable after the trichostatin A was removed. Pdx-1 gene expression was detected by RT-PCR at 34 cycles following the second addition of trichostatin A. There was no change in insulin gene expression following trichostatin A treatment or withdrawal (**Table X-D**). These data suggest that 24 hours of treatment with 5.0 μ M trichostatin A was not sufficient to increase insulin gene expression in late passage (P11) pancreatic-derived stromal cells, but that 5.0 μ M trichostatin A was sufficient to increase gene expression of HNF-3 beta and Pdx-1.

Example 14

Effects of Two High Dose Trichostatin A Treatments on Gene Expression in Amniotic Fluid-Cells and Pancreatic-Derived Stromal Cells.

Several cell lines obtained from different amniotic fluid specimens (see **Example 2**) and pancreas donors (see **Example 1**) were tested with similar results. Two lines at similar passage number but derived from different amniotic fluid specimens are shown in **Table**

VIII-A and Table VIII-B for this example. One of these cell lines was also used in **Examples 2 and 4** above. In addition, this example also contains comparison data in **Table X-C and Table X-D** for a single pancreatic-derived stromal line grown to early and late passage number.

- 5 Amniotic fluid derived cells or pancreatic-derived stromal cells were seeded into 24-well tissue culture plates at a density of 5000/cm² and cultured in AMNIOMAX (Invitrogen) or DMEM with 10% FBS respectively under standard cell culture conditions until confluent. After confluent, amniotic fluid derived cells were treated at time 0 hours with a dose of 1.25 μ M trichostatin A, and pancreatic-derived stromal cells were treated with a
10 dose of 5.0 μ M trichostatin A solubilized in DMSO and medium. At time 48 hours, cell cultures underwent a complete medium change to remove all traces of trichostatin A. At time 96 hours, cell cultures were re-fed with fresh medium and received a second dose of trichostatin A at the same concentration as used previously. At time 120 hours, cell cultures again underwent a complete medium change and were cultured for an additional
15 24 hours or 148 hours total incubation time.

Samples were taken for RT-PCR at the times indicated in **Table XI-A to D**. RNA samples were obtained daily from the start of the experiment. Culture medium was removed, and cells were washed with PBS then collected in RLT with β -mercaptoethanol (Qiagen). RNA was purified using the RNeasy Mini Kit (Qiagen) and RNA quantity and
20 quality was determined using a spectrophotometer. cDNA was made using the iScript cDNA synthesis kit (BioRad). Human pancreas cDNA was included as a control. Results were normalized against GAPDH expression levels.

Gene expression levels of Sox17, HNF-3 beta, Pdx-1, insulin, and glucagon were analyzed in amniotic-derived cells, while expression levels of glucagon, insulin, HNF-3
25 beta, and Pdx-1 were analyzed in pancreas-derived cells. Samples of 20ng cDNA was used in each Real-Time PCR reaction. RT-PCR was performed on the Applied Biosystems 7500, according to the methods described in **Example 3**. The data were analyzed using the accompanying software.

Prior to treatment with trichostatin A, the amniotic fluid-derived cell line used in **Examples 7 & 9** did not express Gata-1 and HNF-3 beta. Insulin and Pdx-1 were expressed at cycle 36 and cycle 37, respectively, as detected by RT-PCR, and Sox-17 expression was detected by RT-PCR at cycle 27. Following treatment with 1.25µM trichostatin A, Gata-1 gene expression was detected at cycle 37 by RT-PCR but was not detected for the remainder of the experiment. HNF-3 beta gene expression was detected by RT-PCR at cycle 31 following the addition of 1.25µM trichostatin A but this level of expression decreased to undetectable levels until the second addition of trichostatin A. Following the second treatment with trichostatin A, HNF-3 beta gene expression increased to 35 cycles as detected by RT-PCR. Insulin gene expression was not detectable by RT-PCR following the initial addition of 1.25µM trichostatin A. Pdx-1 gene expression was detected by RT-PCR at cycle 32 following the addition of 1.25µM trichostatin A, which decreased following the medium change but increased again after the second treatment with trichostatin A to 37 cycles as detected by RT-PCR. Sox-17 gene expression levels did not change throughout the course of the experiment (**Table XI-A**). These data provide further support that continued treatment with trichostatin A causes the increase of HNF-3 beta and Pdx-1 gene expression, that a more robust effect on gene expression can be measured with exposure to a higher concentration of trichostatin A for a longer time period, and that insulin gene expression may be inhibited in this cell type by the addition of trichostatin A.

Prior to treatment with trichostatin A, the amniotic fluid-derived cell line used in **Example 11** did not express Gata-1, HNF-3 beta and Pdx-1 prior to trichostatin A treatment. Sox-17 and insulin were expressed at cycles 27 and cycles 35, respectively, as detected by RT-PCR, prior to trichostatin A treatment. Following treatment with 1.25 µM trichostatin A, Gata-1 expression was detected at cycle 38 by RT-PCR, though this did not persist for more than 24 hours. Gata-1 expression was again detected at cycle 38 by RT-PCR following the second treatment with trichostatin A. HNF-3 beta expression was detected by RT-PCR at cycle 34 for the first 72 hours with a decrease to cycle 37 by 96 hours and an increase to cycle 33 following the second treatment with trichostatin A. Insulin expression was undetectable following treatment with 1.25 µM trichostatin A, and

expression did not change for the duration of the experiment. Pdx-1 expression was detected at cycle 35 by RT-PCR following the initial 48-hour treatment with 1.25 μ M trichostatin A. This level was undetectable once trichostatin A was removed but was detected by RT-PCR at cycle 34 following the second treatment of trichostatin A. Sox-
 5 17 gene expression levels did not change over the course of the experiment (**Table XI-B**). These data provide further support that continued treatment with trichostatin A causes an increase of HNF-3 beta and Pdx-1 gene expression, that a more robust effect on gene expression can be measured with exposure to a higher concentration of trichostatin A for a longer time period, and that insulin gene expression may be inhibited in this cell
 10 type by the addition of trichostatin A.

Early passage (P5) pancreatic-derived stromal cells expressed Pdx-1 at cycle 38 as detected by RT-PCR but do not express glucagon, HNF-3 beta and insulin prior to treatment with 5.0 μ M trichostatin A. Following treatment with trichostatin A, glucagon gene expression was detected by RT-PCR at cycle 35. This gene expression level
 15 increased to cycle 33 as detected by RT-PCR at 48 hours but decreased to 38 cycles after the trichostatin A was removed. Following the second addition of trichostatin A, glucagon gene expression increased to 37 cycles. HNF-3 beta gene expression was detectable at 34 cycles by RT-PCR following trichostatin A treatment, and this level of expression persisted until the removal of trichostatin A. When trichostatin A was added
 20 to the cells, expression was detected by RT-PCR at cycle 33. Pdx-1 gene expression was not detectable following the initial treatment with trichostatin A but was detected by RT-PCR at cycle 32 at 48 hours. Once trichostatin A was removed from the medium, gene expression was undetectable (**Table XI-C**). Pdx-1 gene expression was detected at 32 cycles following the second addition of trichostatin as measured by RT-PCR. Insulin
 25 gene expression was undetectable while trichostatin A remained in the medium but was detected at 33 cycles by RT-PCR following the medium change. After trichostatin A was added to the medium again, insulin gene expression was undetectable (**Table XI-C**). These data provide further support that continued treatment with trichostatin A causes an increase of HNF-3 beta and Pdx-1 gene expression that a more robust effect on gene
 30 expression can be measured with exposure to a higher concentration of trichostatin A for

a longer time period, and that insulin gene expression may be inhibited in this cell type by the addition of trichostatin A.

Results for late passage (P11) pancreatic-derived stromal were similar to those recorded for early passage (P5) pancreatic-derived stromal cells. No genes of interest were detectable prior to treatment with 5.0 μ M trichostatin A, but after addition of trichostatin A, glucagon was detected at cycle 33 by RT-PCR and HNF-3 beta was detected at 32 cycles by RT-PCR. Pdx-1 was detected by RT-PCR at cycle 31. Insulin gene expression did not change throughout the course of the experiment. Glucagon gene expression was detected at 33 cycles by RT-PCR for 48 hours following initial treatment with 5.0 μ M trichostatin A. This level of glucagon gene expression decreased to 37 cycles following the removal of trichostatin A and was undetectable prior to second treatment with trichostatin A, at which point it was detected at cycle 35 by RT-PCR. HNF-3 beta and Pdx-1 gene expression followed the same pattern. Expression was detected for 48 hours following addition of 5.0 μ M trichostatin A at cycles 33 and 32 respectively but was undetectable by RT-PCR after the medium was changed and trichostatin A was removed. Once trichostatin A was added again, HNF-3 beta gene expression increased to 34 cycles and Pdx-1 gene expression increased to 33 cycles as detected by RT-PCR (Table XI-D). These data provide further support that continued treatment with trichostatin A causes an increase of HNF-3 beta and Pdx-1 gene expression, that a more robust effect on gene expression can be measured with exposure to a higher concentration of trichostatin A for a longer time period, and that insulin gene expression may be inhibited in this cell type by the addition of trichostatin A.

Example 15

Effects of a 6 Hour Trichostatin A Treatment on Gene Expression in Amniotic Fluid-Cells and Pancreatic-Derived Stromal Cells.

Amniotic fluid derived cells or pancreas-derived cells were seeded into 24-well tissue culture plates at a density of 5000/cm² and cultured in AMNIOMAX (Invitrogen) or DMEM with 10% FBS respectively under standard cell culture conditions until

confluency was reached. Upon reaching confluency, amniotic fluid derived cells were treated with 1.25 μ M trichostatin A and pancreas-derived stromal cells were treated with 5.0 μ M trichostatin A. The media was changed 6 hours following the addition of trichostatin A and cultures were maintained for the remainder of the experiment. .

- 5 Several cell lines obtained from amniotic fluid (see **Example 2**) and pancreas (see **Example 1**) were tested. Samples were taken for RT-PCR at the times indicated in **Table XIA-D**.

RNA samples were obtained at the time the trichostatin A was removed and 24 hours from the start of the experiment. The culture media was removed and cells were washed
10 with PBS then collected in RLT Lysis Buffer with β -mercaptoethanol (Qiagen). RNA was purified using the RNeasy Mini Kit (Qiagen) and RNA quantity and quality was determined using a spectrophotometer. cDNA was made using the iScript cDNA synthesis kit (BioRad). Human pancreas cDNA was included as a control. Results were normalized against GAPDH expression levels.

- 15 The expression levels of Sox17, HNF-3 beta, Pdx-1, Insulin, and Gata-1 were analyzed in amniotic-derived cells while the expression levels of glucagon, insulin, pdx-1 and HNF-3 beta were analyzed in pancreas-derived cells. 20ng of cDNA was used in each RT-PCR reaction, which was performed on the Applied Biosystems 7500, according to the methods described in **Example 3**. Data was analyzed using the accompanying software.

- 20 Prior to treatment with trichostatin A, the amniotic fluid-derived cell line used in **Examples 7 & 9** did not express Gata-1 and HNF-3 beta. Following treatment with 1.25 μ M trichostatin A, HNF-3 beta expression was detected by RT-PCR cycle 32, but following the wash, increased to 35 cycles. Insulin gene expression decreased from 36 cycles to undetectable levels as determined by RT-PCR following the addition of
25 trichostatin A (**Table XII-A**). Pdx-1 expression was detected at cycle 37 by RT-PCR prior to treatment with trichostatin A. This level of expression decreased to 35 cycles after treatment with trichostatin A but was undetectable once trichostatin A was removed. Expression of Gata-1 and sox-17 remained unchanged with the addition of trichostatin A (**Table XII-A**).

Prior to treatment with trichostatin A, the amniotic fluid-derived cell line used in **Example 11** did not express Gata-1, HNF-3 beta or Pdx-1. Insulin and sox-17 were expressed at cycle 35 and cycle 27 respectively by RT-PCR. 6 hours of treatment with 1.25 μ M trichostatin A was sufficient to increase the expression of HNF-3 beta and Pdx-1 to cycles 31 and 35 respectively, as detected by RT-PCR. Following removal of trichostatin A, HNF-3 beta expression was detected at cycle 35 by RT-PCR and Pdx-1 was undetectable. Insulin gene expression was not detectable following addition of trichostatin A. Gata-1 and Sox-17 gene expression levels remained unchanged following treatment of 1.25 μ M trichostatin A (**Table XII-B**). These data provide support that insulin gene expression may be inhibited by trichostatin A treatment in these cells and that 6 hours of treatment was sufficient to see an increase in gene expression of HNF-3 beta and Pdx-1.

Early passage (P5) pancreatic-derived stomal cells did not express glucagon, HNF-3 beta or insulin prior to addition of 5.0 μ M trichostatin A. Following trichostatin A treatment glucagon gene expression was detected by RT-PCR at cycle 37, HNF-3 beta gene expression was detected by RT-PCR at cycle 35. Following trichostatin A removal, glucagon gene expression remained the same but HNF-3 beta was undetectable. Insulin gene expression remained undetectable until the trichostatin A was removed from the media, where it was then detected at cycle 32 by RT-PCR. Pdx-1 gene expression was detected at 38 cycles by RT-PCR prior to trichostatin A treatment, but following treatment that level of expression increased to 35 cycles (**Table XII-C**). These data suggest that treatment with 5.0 μ m trichostatin A for 6 hours was not sufficient for increasing expression of Pdx-1, but continues to suppress insulin gene expression as noted previously.

Late passage (P11) pancreatic-derived stromal cells did not express any of the genes of interest prior to treatment with 5.0 μ M trichostatin A. Following trichostatin A treatment, glucagon was detected at 37 cycles, HNF-3 beta was detected at 36 cycles and Pdx-1 was detected at 37 cycles by RT-PCR. There was no change in insulin gene expression following the addition of trichostatin A. Following the removal of trichostatin

A, glucagon gene expression was detected at 35 cycles by RT-PCR, while HNF-3 beta and Pdx-1 gene expression was undetectable (**Table XII-D**). These data suggests that trichostatin A is necessary to up-regulate HNF-3 beta and Pdx-1 gene expression.

Example 16

5 HDAC Inhibitor Screening for Cellular Differentiation

A library of small molecule inhibitors was made available for purposes of screening. The library was representative of a focused set of chemical structures designed for potential enzymatic inhibition. Compounds were solubilized in DMSO and diluted to 1mM stocks in 30% DMSO/50mM HEPES, plated in 96-well format, and frozen dessicated at –80°C
10 prior to use.

Amniotic fluid derived cells were seeded into flat bottom 96-well tissue culture plates at a density of 15,000 cells/well and cultured until confluent in completely supplemented AMNIOMAX (Invitrogen) under standard cell culture conditions. After confluent, cells were treated at time 0 hours with 5μM HDAC inhibitor diluted in culture medium (0.5%
15 DMSO final assay concentration). Negative control wells received diluent alone. Positive control wells received 5uM TSA. At time 24 hours, samples were taken for RT-PCR. Culture medium was removed, cells were washed with PBS, and a lysate was collected in RLT with β-mercaptoethanol (Qiagen). RNA was purified using the RNeasy Mini Kit (Qiagen), and RNA quantity and quality was determined using a
20 spectrophotometer. cDNA was made using the iScript cDNA synthesis kit (BioRad). Human pancreas cDNA was included as a control. Results were normalized against GAPDH expression levels.

Gene expression levels of Pdx-1 were analyzed using 20ng cDNA in each Real-Time PCR reaction. RT-PCR was performed on the Applied Biosystems 7500 according to the
25 methods described in **Example 15**. Data analysis was performed using the accompanying software. Results for all primary screening are presented in **Table XIII-A**.

Compounds that caused an increase in Pdx-1 gene expression to a level at least 80% of that induced by TSA were considered “hits” and were retested in the above protocol. Of 572 compounds tested, 56 were considered “hits” (9.8% hit rate). In the confirmation assays, all 56 hits were able to increase Pdx-1 gene expression to a level at least 80% of that caused by TSA (100% confirmation rate). Results for confirmation screening are presented in **Table XIII-B**.

Confirmed compounds were also screened in triplicate for cytotoxic effects using an MTS tetrazolium assay (Promega; Cell Titer 96 AQueous). Parallel cultures of amniotic fluid-derived cells in 96-well plates were exposed to 5µM compound for 24 or 72 hours under standard culture conditions. MTS reagent was added to each well per manufacturer’s instructions and cultured at 37°C for one hour then read at 490nm on a standard spectrophotometer. Numerical readings from treated wells were compared to untreated control wells and used to calculate a % viability index correlating with cellular metabolic activity. Summary results for all compounds are presented in **Figures 6 and 7** comparing viability measures for both exposure times.

The top ten most effective compounds were selected based on highest induction of Pdx-1 gene expression and least toxicity. These compounds were further tested in a two-fold dose titration assay using amniotic fluid derived cells (**Table XIII-C and Figure 8**) or pancreatic derived cells (**Table XIII-D and Figure 9**). Compound concentrations were tested over a range of 0.15 to 10µM for an exposure time of 24hrs prior to analysis of Pdx1 gene expression. An MTS cytotoxicity assay was also repeated in triplicate with a dose titration of each compound in both cell types. Summary results are presented in **Figures 10 and 11**. **Figure 12** compares the potency of enzyme inhibition for a dose titration of selected hits to TSA, a known HDAC inhibitor.

Example 17

Effects of a Combination of HDAC inhibitor and MG-132 Treatment on Gene Expression in an Adult Pancreatic-Derived Cell line.

Pancreatic derived cells were treated with trichostatin A (TSA), at varying concentrations either alone or in sequential combination with a cell permeable proteasome inhibitor, MG-132, also added at varying concentrations. Briefly, cells were plated and grown to a confluent monolayer in 6-well cluster plates in normal culture medium composed of DMEM high glucose with 10% FCS. At time 0 hrs, a sample of untreated cells was harvested for a basal control. MG-132 (EMD Biosciences) solubilized in DMSO was diluted to a final concentration of 1 μ M or 10 μ M in fresh medium and allowed to incubate with the cells for 24 hours under standard culture conditions. After 24 hours, the culture medium was removed, replaced with fresh medium containing a final dilution of 1.25 μ M or 2.5 μ M TSA, and allowed to incubate for an additional 24 hours. Negative control wells contained an equivalent volume of medium and DMSO diluent but without treatment compound.

RNA samples were obtained from the treated cultures 48 hours after initiating treatment. The culture medium was removed, the cells were washed with phosphate buffered saline (PBS), and RLT Lysis buffer containing β -mercaptoethanol (Qiagen) was added. The samples were homogenized using Qias shredder columns (Qiagen), and RNA was purified using the RNeasy Mini Kit (Qiagen). RNA quantity and quality was determined using a spectrophotometer, and cDNA was made using the iScript cDNA synthesis kit (BioRad).

The expression levels of Pdx-1, HNF-3 beta, insulin, and Nkx6.1 were determined by Real-Time PCR (RT-PCR) using 20ng cDNA per reaction, as described in **Example 3**. RT-PCR reactions were performed on the Applied Biosystems 7500 with data analysis using the accompanying software. Human pancreas cDNA was included as a positive control. Results were normalized against GAPDH expression levels.

Results in **Table XIV- Table XVI** demonstrate that TSA can induce a low level of gene expression for Pdx-1, HNF-3 beta, and Nkx6.1 in adult pancreatic-derived cells after 24 hours of treatment. Untreated cells consistently demonstrate no basal expression level of these genes. The proteasome inhibitor MG-132 was not able to induce gene expression when added alone to cultures (with the exception of 10 μ M MG-132 which induced a low level of Nkx6.1 expression) nor did pre-treatment with the MG-132 compound prior to

TSA addition enhance gene expression levels. Insulin gene expression was absent in adult pancreatic-derived cells and did not change relative to untreated controls in any of the samples tested.

The sequence of addition for MG-132 and TSA to cells in culture was reversed for results shown in **Table XV**. TSA alone was able to induce a low level of gene expression for Pdx-1, HNF-3 beta, and Nkx6.1 in adult pancreatic-derived cells, and this observed gene expression was not enhanced by pre- or post-treatment of cells with the MG-132 compound. In some cases, induced gene expression decreased if the TSA was removed in the final 24 hours of culture, suggesting that effects of an HDAC inhibitor on chromatin remodeling are reversible over time after washout and recovery.

The ability of TSA to induce gene expression was tested in different passages of adult pancreatic-derived cells, alone or in combination with MG-132, to determine if length of time in culture is a factor in their susceptibility to a differentiation stimulus. Results in **Table XVI** show gene expression levels for passage 10 and passage 19 cells after treatment with TSA, alone or in combination with MG-132. Overall, late passage (P19) cells demonstrate slightly better gene expression compared to early passage (P10) cells in this example, but results are not consistent or statistically significant for individual genes or treatments.

A range of dose concentrations and exposure times for treatment with the MG-132 compound followed by sequential addition of TSA (1.25 μ M or 2.5 μ M for 24 hours) was tested for improved induction of gene expression in adult pancreatic-derived cells. Results are shown in **Table XVII** and **Table XVII**. A slight additive effect was observed for combination treatment conditions, but there was no robust improvement in gene expression over TSA treatment alone for Pdx-1, HNF-3 beta, or Nkx6.1. Insulin gene expression was absent in adult pancreatic-derived cells and did not change relative to untreated controls in any of the samples tested.

Adult pancreatic-derived cells were also exposed to sequential treatments with MG-132 followed by TSA followed by a differentiation medium in an effort to enhance

- differentiation and lineage specific gene expression. Results for Pdx-1 gene expression in adult pancreatic-derived cells are shown in **Table XVIII** for a range of compound doses and exposure times in one exemplary differentiation medium. Differentiation medium #2 contained DMEM low glucose, 1% FCS, 20ng/ml activin A, 10ng/ml betacellulin, 20ng/ml bFGF, 10mM nicotinamide, and 50nM GLP-1 receptor agonist. As was observed previously (**Table XVII**), induced gene expression decreased after TSA was removed from culture, suggesting that effects of an HDAC inhibitor on chromatin remodeling are reversible over time after washout and recovery. Gene expression was not improved over TSA treatment alone for all treatment categories.
- Additional differentiation agents were tried in combination with TSA in an attempt to enhance differentiation and lineage specific gene expression. GSI-IX and GSI-X (EMD Biosciences) are two gamma secretase inhibitors that block Notch activation and signaling, thereby modulating cellular differentiation. **Table XIX** shows gene expression results for cells treated with various concentrations of each gamma secretase inhibitor, alone and in sequential combination with TSA. Neither GSI-IX or GSI-X were able to induce Pdx-1, HNF-3 beta, or Nkx6.1 gene expression when added alone to adult pancreatic-derived cell cultures nor did pre-treatment with the either GSI compound prior to TSA addition enhance gene expression levels. Insulin gene expression was absent in adult pancreatic-derived cells and did not change relative to untreated controls in any of the samples tested.

- A series of proprietary HDAC inhibitors was identified from a cell-based screen as having significant ability to induce gene expression relative to TSA (**Example 16**). These compounds were tested in adult pancreatic-derived cells, alone or in sequential addition with the proteasome inhibitor MG-132. Results are shown for the Pdx-1 gene in **Table XX** and the insulin gene in **Table XXI**. Untreated adult pancreatic-derived cells consistently demonstrated no basal expression level of Pdx-1. Each HDAC inhibitor induced a low level of Pdx-1 gene expression. However, pre-treatment with MG-132 did not significantly enhance Pdx-1 gene expression beyond what was observed with individual HDAC inhibitors alone. Insulin gene expression was absent in adult

pancreatic-derived cells and did not change relative to untreated controls in any of the samples tested.

Example 18

Dose Titration of Chromatin Remodeling or DNA Demethylating Agents at Various Times.

Amniotic fluid cells were plated in duplicate culture plates with multiple replicate sets. After reaching confluency (2-3 days), 5-azacytidine (5-Aza-2'-deoxycytidine; EMD Biosciences) was added to each replicate set at a range of 0.156 μ M to 2.5 μ M, final concentration. An equivalent amount of solvent was added to the no treatment control cultures. Cells were returned to standard culture conditions for 24 hr after which medium was removed, cells were washed with phosphate buffered saline (PBS), and RLT lysis buffer containing β -mercaptoethanol (Qiagen) was added to each well. Samples were homogenized using QiashredderTM columns (Qiagen) and RNA was purified using the RNeasy Mini Kit (Qiagen). RNA quantity and quality was determined using a spectrophotometer, and cDNA was made using the iScript cDNA synthesis kit (BioRad). Samples of 20ng cDNA were used in each reaction to determine expression levels of Pdx-1 or HNF-3 beta. Real-Time PCR was performed on an Applied Biosystems 7500 system, and data was analyzed using the accompanying software.

Table XXIII shows that untreated amniotic fluid cells have no basal expression level of Pdx-1 or HNF-3 beta. 5-Aza-2'-deoxycytidine (5-Aza) is a DNA methyltransferase inhibitor which can affect chromatin remodeling. Treatment of amniotic fluid cells with 5-Aza alone did not induce Pdx-1 or HNF-3 beta. In contrast, treatment with the HDAC inhibitor TSA was able to induce Pdx-1 and HNF-3 beta gene expression.

Example 19

Changes in Gene Expression by the Simultaneous Addition of a Histone Deacetylase Inhibitor and a DNA Demethylating Agent.

Amniotic fluid cells were plated and allowed to reach confluency (2-3 days). Both trichostatin A and 5-aza-2'-deoxycytidine were added to the culture at an optimal, nontoxic dose titration for 24 hours. At the conclusion of the treatment period, medium was removed, cells were washed with phosphate buffered saline (PBS), and RLT lysis
 5 buffer containing β -mercaptoethanol (Qiagen) was added to each well. Samples were homogenized using Qias shredder columns (Qiagen), and RNA was purified using the RNeasy Mini Kit (Qiagen). RNA quantity and quality were determined using a spectrophotometer, and cDNA was made using the iScript cDNA synthesis kit (BioRad). Samples of 20ng cDNA were used in each reaction to determine expression levels of
 10 Pdx-1 and HNF-3 beta. Real-Time PCR was performed on an Applied Biosystems 7500 system, and data was analyzed using the accompanying software.

Table XXIV shows that untreated amniotic fluid cells have no basal expression of Pdx-1 or HNF-3 beta, but gene expression can be induced after 24 hrs treatment with 1.25uM TSA. Treatment of amniotic fluid cells with 5-Aza alone did not induce Pdx-1 or HNF-3
 15 beta nor did it enhance gene expression when used in combination with the HDAC inhibitor TSA.

A sequential treatment with 5-Aza-2'-deoxycytidine followed by TSA was also used to induce gene expression in amniotic fluid cells. Confluent monolayers were pre-treated for 6 hours with 5-Aza after which TSA was added in combination for the final 18 hours
 20 of culture. Cell lysates, RNA extraction, cDNA synthesis and PCR were performed as described above. Results as shown in **Table XXV** also indicate that 5-Aza alone did not induce Pdx-1 or HNF-3 beta gene expression nor did it demonstrate an additive effect when used as a pre-treatment in combination with the HDAC inhibitor TSA.

Example 20

25 **The Effects of Trichostatin A Treatment and Inhibition of the Sonic Hedgehog Pathway on Gene Expression in Early Passage (P5) Pancreatic-Derived Stromal Cells and Amniotic Fluid-Derived Cells.**

Pancreatic-derived stromal cells are obtained according to the methods described in

Example 1. Cells are seeded into a 24-well tissue culture plate at a density of 5000/cm²/well and cultured in DMEM with 10% FBS under standard cell culture conditions until confluent. Amniotic fluid obtained from National Disease Research

Interchange (NDRI) is processed according to the methods described in **Example 2.** Cells are seeded into a 24-well tissue culture plate at a density of 5000/cm²/well and cultured in AMNIOMAXTM (Invitrogen) under standard cell culture conditions until confluent. After the cells reach confluency, sample wells are treated with 1.25 mM trichostatin A diluted in DMSO and medium; control wells receive DMSO at an equivalent concentration. At 24 hours, sample wells receive another dose of 1.25 μ M trichostatin A. A 10- μ M dose of CyclopamineTM (Sigma) and 10 mM Nicotinamide (Sigma) are added to the cell culture medium. The following day, medium is removed and cells are washed with PBS. New medium is added once every other day including similar doses of Nicotinamide and Cyclopamine. On day 7, Cells are collected for real time PCR analysis as described in

Example 3.

Example 21

The Effect of Trichostatin A on Gene Expression in Peripheral Blood Mononuclear Cells.

Peripheral blood mononuclear cells are isolated by density gradient sedimentation and plated in culture at a density of $0.5-2 \times 10^6$ per ml. An activation mitogen, such as for example PHA, is added at a final concentration of 10 μ g/ml. Controls omit the addition of PHA. Cells will be cultured for 3 days after which cells will be collected, washed, counted, resuspended and replated at a density of $1-2 \times 10^6$ per ml. Trichostatin A (or an alternative histone deacetylase inhibitor) and/or 5-azacytidine (or an alternative demethylating agent) is added to the culture at an optimal, nontoxic concentration and for a preferred time period to induce appropriate gene expression, as determined from **Examples 5-15** above. Untreated control wells receive a similar dilution of vehicle or diluent. At the conclusion of the culture time period (for example, 24 hours), medium will be removed, and cells are washed with phosphate buffered saline (PBS). RLT lysis

buffer containing β -mercaptoethanol (Qiagen) is added to each well. Samples are homogenized using Qiashredder columns (Qiagen) and RNA is purified using the RNeasy Mini Kit (Qiagen). RNA quantity and quality is determined using a spectrophotometer, and cDNA is made using the iScript cDNA synthesis kit (BioRad).

5 Samples of 20ng cDNA are used in each reaction to determine expression levels of PDX-1, insulin, glucagon, somatostatin, sox17, gata4, globin, beta-2-microglobulin. Real-Time PCR is performed on an Applied Biosystems 7500 system, and data is analyzed using the accompanying software.

Example 22

10 **Differentiation of Cells into Non-Pancreatic Cell types.**

Amniotic fluid or pancreatic progenitor cells or neonatal fibroblasts are plated and allowed to reach confluency (2-3 days). Alternatively, peripheral blood mononuclear cells are isolated by density gradient sedimentation and plated in culture at a density of $1-2 \times 10^6$ per ml. Trichostatin A (or an alternative histone deacetylase inhibitor) and/or 5-

15 azacytidine (or an alternative demethylating agent) is added to the culture at an optimal, nontoxic concentration and for a preferred time period to induce appropriate gene expression, as determined from **Examples 5-15 above**. At the conclusion of the time period (for example, 24 hours), medium is removed; cells are washed with phosphate buffered saline (PBS), resuspended and plated at a seeding density as above. A

20 differentiation protocol for adipocytes, known to those skilled in the art (Chemicon cat. #ECM950), is applied to cultured cells over a time period of 7 days or as appropriate. After culture is concluded, cells are stained with Oil Red O to detect lipid droplets in differentiated adipocytes. Alternatively, RLT lysis buffer containing β -mercaptoethanol (Qiagen) is added to each well. Samples are homogenized using Qiashredder columns

25 (Qiagen) and RNA is purified using the RNeasy Mini Kit (Qiagen). RNA quantity and quality is determined using a spectrophotometer, and cDNA is made using the iScript cDNA synthesis kit (BioRad). Samples of 20ng cDNA are used in each reaction to determine expression levels of PPAR γ . Real-Time PCR will be performed on an Applied Biosystems 7500 system, and data will be analyzed using the accompanying software.

TABLE I-A. ANTIBODIES TO SURFACE RECEPTORS

Antibody	Supplier	Isotype	Clone
Alkaline phosphatase	R&D systems (MN)	Mouse IgG1	B4-78
ATP binding cassette transporter (ABCG2)	BD Pharmingen (CA)	Mouse IgG2b, Kappa	5D3
CD10	BD Pharmingen (CA)	Mouse IgG1, Kappa	HI10a
CD29 (Beta 1 integrin)	BD Pharmingen (CA)	Mouse IgG1, Kappa	MAR4
CD44	BD Pharmingen (CA)	Mouse IgG2b, Kappa	G44-26
CD45	BD Pharmingen (CA)	Mouse IgG1, Kappa	Hi30
CD49f	BD Pharmingen (CA)	Rat IgG2A, Kappa	G0H3
CD49b (Alpha 2 integrin)	BD Pharmingen (CA)	Mouse IgG2a, Kappa	121-H6
CD56 (NCAM)	BD Pharmingen (CA)	Mouse IgG1, Kappa	B159
CD73	BD Pharmingen (CA)	Mouse IgG1, Kappa	AD2
CD90	BD Pharmingen (CA)	Mouse IgG1, kappa	5E10
CD95	BD Pharmingen (CA)	Mouse IgG1, Kappa	DX2
CD105 (endoglin)	Santa Cruz Biotechnology (CA)	Mouse IgG1	P3D1

CD117 (c-Kit)	BD Pharmingen (CA)	Mouse IgG1, kappa	YB5.B8
CD133	Miltenyi Biotec (CA)	Mouse IgG1	Ac133
Epithelial adhesion molecule (EpCAM)	BD Pharmingen (CA)	Mouse IgG1	EBA-1
Hepatocyte growth factor receptor (HGF or c-Met)	R&D systems (MN)	Mouse IgG2A	95309
Platelet/endothelial cell adhesion molecule-1 (PECAM-1)	Santa Cruz Biotechnology (CA)	Mouse IgG1	WM-59
CD49b (Alpha 2 integrin)	BD Pharmingen (CA)	Mouse IgG2a, Kappa	121-H6
Alpha 3 integrin	Santa Cruz (CA)	Mouse IgG1	P1B5
Alpha 5 intgerin	Santa Cruz (CA)	Mouse IgG3	P1D6
Beta 3 integrin	Santa Cruz (CA)	Mouse IgG1	Y2/51
Alpha V Beta 3 integrin (CD51/61)	BD Pharmingen (CA)	Mouse IgG1, Kappa	23C6
SSEA-3	Chemicon (CA)	Mouse IgG3	MC-631
SSEA-4	Chemicon (CA)	Rat IgM	MC-813-70
TRA 1-60	Chemicon (CA)	Mouse IgM	TRA 1-60
TRA 1-81	Chemicon (CA)	Mouse IgM	TRA 1-81
TRA 1-85	Chemicon (CA)	Mouse IgG1	TRA 1-85
TRA 2-54	Chemicon (CA)	Mouse IgG1	TRA 2-54
EGF r	BD Pharmingen (CA)	Mouse IgG2b, Kappa	EGFR1
HLA ABC	BD Pharmingen (CA)	Mouse IgG1, Kappa	G46-2.6

HLA DR	BD Pharmingen (CA)	Mouse IgG2b, Kappa	TU36
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TABLE I-B. LIST OF ANTIBODIES USED FOR IDENTIFICATION OF INTRACELLULAR MARKERS

Antibody	Supplier	Isotype	Clone
Nestin	R&D systems (MN)	Mouse IgG1	HSG02
Cytokeratin 5/8	Santa Cruz Biotechnology (CA)	Mouse IgG1	C50
Vimentin	Santa Cruz Biotechnology (CA)	Mouse IgG1	V9
Pan-Cytokeratin (4, 5, 6, 8, 10, 13, 18)	Santa Cruz Biotechnology (CA)	Mouse IgG1	C11
Peripherin	Santa Cruz Biotechnology (CA)	Goat Polyclonal	C19
Gilial fibrillary acidic protein (GFAP)	Santa Cruz Biotechnology (CA)	Goat polyclonal	N-18
Pan-Cytokeratin (14, 15, 16, and 19)	BD Pharmingen (CA)	Mouse IgG1, Kappa	KA4
Beta III tubulin	Chemicon International (CA)	Mouse IgG1	TU-20

TABLE II. LIST OF SECONDARY CONJUGATED ANTIBODIES USED FOR FACS AND IMMUNOSTAINING ANALYSIS.

Secondary conjugated antibody	Supplier	Dilution
Goat Anti-Mouse IgG APC conjugated	Jackson ImmunoResearch (PA)	1:200
Goat Anti-Mouse IgG PE conjugated	Jackson ImmunoResearch (PA)	1:200
Donkey anti-rabbit PE or – APC conjugated	Jackson ImmunoResearch (PA)	1:200
Donkey anti-goat PE or – APC conjugated	Jackson ImmunoResearch (PA)	1:200
Goat anti-mouse IgM PE	SouthernBiotech (AL)	1:200
Goat anti-Rat IgM PE	SouthernBiotech (AL)	1:200
Goat anti-mouse IgG3 PE	SouthernBiotech (AL)	1:200

TABLE III. THE EFFECTS OF HISTONE DEACETYLASE INHIBITOR TREATMENT ON GENE EXPRESSION IN PANC-1 CELLS AND NEONATAL FIBROBLASTS.

	GAPDH	glucagon	HNF-3beta	Insulin	pdx-1	Sox17
untreated fibroblasts	+++	nd	nd	nd	nd	nd
fibroblasts with 2.5μM trichostatin A after 48 hours	+++	+++	+++	nd	+	+++
Fibroblasts with 5.0μM trichostatin A after 48 hours	+++	+++	+++	nd	+	+++
untreated Panc-1	+++	nd	+++	nd	+++	+++
Panc-1 with 2.5μM trichostatin A after 48 hours	+++	+++	+++	+	+++	+++
panc-1 with 5.0μM trichostatin A after 48 hours	+++	+++	+++	+	+++	+++
human pancreas	+++	+++	+++	++	+++	+++
		nd	not detectable at >40 cycles by RT-PCR			
		+	detectable at greater than 35-40 cycles by RT-PCR			
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9			
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9			
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System						

TABLE IV-A. GENE EXPRESSION IN THE UNTREATED AMNIOTIC FLUID-DERIVED CELL LINE AFCA009-A.

	Untreated				
Time (hours)	glucagon	HNF-3beta	Insulin	pdx-1	Sox17
0	nd	nd	+	nd	+++
0.5	nd	+	+	nd	+++
1.5	nd	nd	+	nd	+++
3	nd	nd	+++	nd	+++
6	nd	+	+++	nd	+++
12	nd	nd	+++	nd	+++
24	nd	nd	+++	nd	+++
nd	not detectable at >40 cycles by RT-PCR				
+	detectable between 35 and 40 cycles by RT-PCR				
++	detectable at less than 35 cycles by RT-PCR with std error greater than 0.9				
+++	detectable at less than 35 cycles by RT-PCR with std error less than 0.9				
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE IV-B. GENE EXPRESSION IN THE AMNIOTIC FLUID-DERIVED CELL LINE AFCA009-A TREATED WITH TRICHOSTATIN A FOR 24 HOURS.

	Treated				
Time (hours)	glucagon	HNF-3beta	Insulin	pdx-1	Sox17
0.5	nd	+	+	nd	+++
1.5	nd	+	+	nd	+++
3	nd	+++	+	nd	+++
6	nd	+++	nd	+	+++
12	+	+++	+	+++	+++
24	+++	+++	+	+++	+++
nd	not detectable at >40 cycles by RT-PCR				
+	detectable between 35 and 40 cycles by RT-PCR				
++	detectable at less than 35 cycles by RT-PCR with std error greater than 0.9				
+++	detectable at less than 35 cycles by RT-PCR with std error less than 0.9				
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE V-A. GENE EXPRESSION IN LATE PASSAGE PANCREATIC-DERIVED STROMAL CELLS.

	untreated				
Time (hours)	glucagon	HNF-3beta	Insulin	pdx-1	Sox17
0	nd	nd	nd	nd	+
0.5	nd	nd	nd	nd	nd
1.5	nd	nd	nd	nd	nd
3	nd	nd	nd	nd	+
6	nd	nd	nd	nd	+
12	nd	nd	nd	nd	nd
24	nd	nd	nd	nd	+
nd	not detectable at >40 cycles by RT-PCR				
+	detectable between 35 and 40 cycles by RT-PCR				
++	detectable at less than 35 cycles by RT-PCR with std error greater than 0.9				
+++	detectable at less than 35 cycles by RT-PCR with std errorless than 0.9				
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE V-B. GENE EXPRESSION IN LATE PASSAGE PANCREATIC-DERIVED STROMAL CELLS TREATED WITH TRICHOSTATIN A FOR 24 HOURS.

	Treated				
Time (hours)	glucagon	HNF-3beta	Insulin	pdx-1	Sox17
0.5	nd	nd	nd	nd	+
1.5	nd	nd	nd	nd	nd
3	nd	nd	nd	nd	+
6	nd	+	nd	nd	+
12	nd	+	nd	+	+
24	+	+++	nd	+++	+++
nd	not detectable at >40 cycles by RT-PCR				
+	detectable between 35 and 40 cycles by RT-PCR				
++	detectable at less than 35 cycles by RT-PCR with std error greater than 0.9				
+++	detectable at less than 35 cycles by RT-PCR with std error less than 0.9				
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE VI. THE EFFECT OF CHRONIC TRICHOSTATIN A TRATMENT ON GENE EXPRESSION IN AMNIOTIC FLUID-DERIVED CELLS.

24 hours	glucagon	HNF-3beta	Insulin	pdx-1	Sox17	
untreated	nd	nd	+	nd	+++	
500 nM	+	+++	nd	+++	+++	
1 μM	+++	+++	nd	+++	+++	
48 hours	glucagon	HNF-3b	Insulin	PDX-1	Sox17	
untreated	nd	+	+++	nd	+++	
500 nM	+	+++	nd	+	+++	
1 μM	++	+++	nd	+++	+++	
72 hours	glucagon	HNF-3b	Insulin	PDX-1	Sox17	
untreated	nd	+	+++	nd	+++	
500 nM	+	+++	nd	+++	+++	
1 μM	+++	+++	nd	+++	+++	
nd	not detectable at >40 cycles by RT-PCR					
+	detectable between 35 and 40 cycles by RT-PCR					
++	detectable at less than 35 cycles by RT-PCR with std error greater than 0.9					
+++	detectable at less than 35 cycles by RT-PCR with std error less than 0.9					
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System						

TABLE VII. THE EFFECT OF CHRONIC TRICHOSTATIN A TRATMENT ON GENE EXPRESSION IN LATE PASSAGE PANCREATIC-DERIVED STROMAL CELLS.

24 hours	glucagon	HNF-3beta	Insulin	pdx-1	Sox17
untreated	nd	nd	nd	nd	nd
1.25 μM	+	+++	nd	+	+++
2.5 μM	nd	+	nd	+++	+++
48 hours	glucagon	HNF-3b	Insulin	PDX-1	Sox17
untreated	nd	nd	nd	nd	+
1.25 μM	+	++	nd	+++	+++
2.5 μM	+	+	nd	+++	+++
72 hours	glucagon	HNF-3b	Insulin	PDX-1	Sox17
untreated	nd	nd	nd	nd	+
1.25 μM	+	+++	nd	+++	+++
2.5 μM	nd	+++	nd	+	+++
nd	not detectable at >40 cycles by RT-PCR				
+	detectable between 35 and 40 cycles by RT-PCR				
++	detectable at less than 35 cycles by RT-PCR with std error greater than 0.9				
+++	detectable at less than 35 cycles by RT-PCR with std error less than 0.9				
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE VIII-A. THE EFFECT OF A SINGLE CHRONIC TRICHOSTATIN A DOSE ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF	insulin	Pdx-1	sox17
untreated	nd	nd	+	+	+++
24 hrs	nd	+++	nd	+	+++
48 hrs	nd	+++	nd	nd	+++
72 hrs	nd	+	+	nd	+++
96 hrs	nd	nd	+	nd	+++
120 hrs	nd	+	+	nd	+++
144 hrs	nd	nd	+	nd	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 cycles and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE VIII-B. THE EFFECT OF A SINGLE CHRONIC TRICHOSTATIN A DOSE ON GENE EXPRESSION IN A SECOND AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF	insulin	Pdx-1	sox17
untreated	nd	nd	+++	nd	+++
24 hrs	nd	+++	nd	+	+++
48 hrs	nd	+++	nd	nd	+++
72 hrs	nd	+	+	nd	+++
96 hrs	nd	+	++	nd	+++
120 hrs	nd	+	++	nd	+++
144 hrs	nd	+	++	nd	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE VIII-C. THE EFFECT OF A SINGLE CHRONIC TRICHOSTATIN A DOSE ON GENE EXPRESSION IN AN EARLY PASSAGE (P5) PANCREATIC-DERIVED STROMAL CELL LINE.

sample	glucagon	HNF	Insulin	Pdx-1
untreated	nd	nd	nd	+
24 hrs	+++	+++	nd	+++
48 hrs	+	nd	nd	nd
72 hrs	+	nd	nd	nd
96 hrs	+++	nd	nd	nd
120 hrs	nd	nd	nd	nd
144 hrs	nd	nd	nd	nd
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles by RT-PCR	
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE VIII-D. THE EFFECT OF A SINGLE CHRONIC TRICHOSTATIN A DOSE ON GENE EXPRESSION IN AN LATE PASSAGE (P14) PANCREATIC-DERIVED STROMAL CELL LINE.

sample	glucagon	HNF	Insulin	Pdx-1
untreated	nd	nd	nd	nd
24 hrs	+++	+	nd	+++
48 hrs	+	nd	nd	nd
72 hrs	nd	nd	nd	nd
96 hrs	nd	nd	nd	nd
120 hrs	nd	nd	nd	nd
144 hrs	nd	nd	nd	nd
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles RT-PCR	
		++	detectable at less than 35 cycles RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE IX-A. THE EFFECT OF TWO 500 nM TRICHOSTATIN A DOSES ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF	insulin	Pdx-1	sox17
untreated	nd	nd	+	+	+++
24 hrs	nd	+++	nd	+	+++
48 hrs	nd	+++	+	nd	+++
72 hrs	nd	+	+	nd	+++
96 hrs	nd	nd	+	nd	+++
120 hrs	nd	+	+	nd	+++
144 hrs	nd	+	+	nd	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE IX-B. THE EFFECT OF TWO 500 nM TRICHOSTATIN A DOSES ON GENE EXPRESSION IN A SECOND AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF	insulin	Pdx-1	sox17
untreated	nd	nd	+++	nd	+++
24 hrs	nd	+++	nd	+	+++
48 hrs	nd	+++	nd	nd	+++
72 hrs	nd	+++	+++	nd	+++
96 hrs	nd	+	+++	nd	+++
120 hrs	nd	+	+	nd	+++
144 hrs	nd	+	+++	nd	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles RT-PCR		
		++	detectable at less than 35 cycles RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE IX-C. THE EFFECT OF TWO 1.25 μ M TRICHOSTATIN A DOSES ON GENE EXPRESSION IN AN EARLY PASSAGE (P5) PANCREATIC-DERIVED STROMAL CELL LINE.

sample	glucagon	HNF	Insulin	Pdx-1
untreated	nd	nd	nd	+
24 hrs	+++	+++	nd	+++
48 hrs	+	nd	nd	nd
72 hrs	nd	nd	nd	nd
96 hrs	nd	nd	nd	nd
120 hrs	+	+++	nd	+++
144 hrs	+	nd	nd	nd
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles by RT-PCR	
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE IX-D. THE EFFECT OF TWO 1.25 μM TRICHOSTATIN A DOSES ON GENE EXPRESSION IN A LATE PASSAGE (P14) PANCREATIC-DERIVED STROMAL CELL LINE.

sample	glucagon	HNF	Insulin	Pdx-1
untreated	nd	nd	nd	nd
24 hrs	+++	+	nd	+++
48 hrs	+++	nd	+ -	nd
72 hrs	+	nd	nd	nd
96 hrs	nd	nd	nd	nd
120 hrs	=	+++	nd	++
144 hrs	+	nd	nd	nd
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles by RT-PCR	
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE X-A. THE EFFECT OF TWO 1.25 μM TRICHOSTATIN A DOSES ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF-3 beta	insulin	Pdx-1	sox17
untreated	nd	nd	+	+	+++
24 hrs	+	+++	nd	+++	+++
48 hrs	nd	+++	nd	nd	+++
72 hrs	nd	+	+	nd	+++
96 hrs	nd	+	+	nd	+++
120 hrs	nd	+++	nd	+++	+++
144 hrs	nd	+++	nd	nd	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE X-B. THE EFFECT OF TWO 1.25 μ M TRICHOSTATIN A DOSES ON GENE EXPRESSION IN A SECOND AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF-3 beta	insulin	Pdx-1	sox17
untreated	nd	nd	+++	nd	+++
24 hrs	+	+++	nd	+++	+++
48 hrs	nd	+++	nd	nd	+++
72 hrs	nd	+++	+	nd	+++
96 hrs	nd	+	+	nd	+++
120 hrs	+	+++	nd	+++	+++
144 hrs	nd	+++	nd	nd	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE X-C. THE EFFECT OF TWO 5 µM TRICHOSTATIN A DOSES ON GENE EXPRESSION IN AN EARLY PASSAGE (P5) PANCREATIC-DERIVED STROMAL CELL LINE.

sample	glucagon	HNF-3 beta	Insulin	Pdx-1
untreated	nd	nd	nd	+
24 hrs	+++	+++	nd	++
48 hrs	+	nd	nd	nd
72 hrs	+	nd	nd	nd
96 hrs	nd	nd	nd	nd
120 hrs	nd	+	nd	+++
144 hrs	+	nd	nd	nd
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles by RT-PCR	
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE X-D. THE EFFECT OF TWO 5 μ M TRICHOSTATIN A DOSES ON GENE EXPRESSION IN A LATE PASSAGE (P11) PANCREATIC-DERIVED STROMAL CELL LINE.

sample	glucagon	HNF-3 beta	Insulin	Pdx-1
untreated	nd	nd	nd	nd
24 hrs	+++	+++	nd	+
48 hrs	+	nd	+	nd
72 hrs	+	nd	nd	nd
96 hrs	+	nd	nd	nd
120 hrs	+	+	nd	+++
144 hrs	+	nd	nd	nd
		nd	not detectable	
		-	detectable at greater than 35 cycles	
		+	detectable at less than 35 cycles with SE greater than 0.9	
		++	detectable at less than 35 cycles with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE XI-A. THE EFFECT OF TWO 1.25 μ M TRICHOSTATIN A DOSES ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF-3 beta	insulin	Pdx-1	sox17
untreated	nd	nd	+	+	+++
24 hrs	+	+++	nd	+++	+++
48 hrs	nd	+++	nd	+++	+++
72 hrs	nd	+	nd	nd	+++
96 hrs	nd	nd	nd	nd	+++
120 hrs	nd	+	nd	+	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE XI-B. THE EFFECT OF TWO 1.25 μM TRICHOSTATIN A DOSES ON GENE EXPRESSION IN A SECOND AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF-3 beta	insulin	Pdx-1	sox17
untreated	nd	nd	+++	nd	+++
24 hrs	+	+++	nd	++	+++
48 hrs	nd	+++	nd	+	+++
72 hrs	nd	+++	nd	nd	+++
96 hrs	nd	+	nd	nd	+++
120 hrs	+	+++	nd	+++	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE XI-C. THE EFFECT OF TWO 5 μM TRICHOSTATIN A DOSES ON GENE EXPRESSION IN AN EARLY PASSAGE (P5) PACNREATIC-DERIVED STROMAL CELL LINE.

sample	glucagon	HNF-3 beta	Insulin	Pdx-1
untreated	nd	nd	nd	+
24 hrs	+++	+++	nd	+++
48 hrs	+++	+++	nd	+++
72 hrs	+	nd	+++	nd
96 hrs	+	nd	nd	nd
120 hrs	+	+++	nd	+++
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles by RT-PCR	
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE XI-D. THE EFFECT OF TWO 5 μM TRICHOSTATIN A DOSES ON GENE EXPRESSION IN A LATE PASSAGE (P11) PACNREATIC-DERIVED STROMAL CELL LINE.

sample	glucagon	HNF-3 beta	Insulin	Pdx-1
untreated	nd	nd	nd	Nd
24 hrs	+++	+++	nd	+
48 hrs	+++	+++	nd	+++
72 hrs	+	nd	nd	Nd
96 hrs	nd	nd	nd	Nd
120 hrs	+	+++	+	+++
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles by RT-PCR	
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE XII-A. THE EFFECT OF A 6 HOUR 1.25 μ M TRICHOSTATIN A TREATMENT ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF-3 beta	insulin	Pdx-1	sox17
untreated	nd	nd	+	+	+++
6 hrs	nd	+++	nd	+	+++
24 hrs	nd	+++	nd	nd	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE XII-B. THE EFFECT OF A 6 HOUR 1.25 μ M TRICHOSTATIN A TREATMENT ON GENE EXPRESSION IN A SECOND AMNIOTIC FLUID-DERIVED CELL LINE.

sample	Gata1	HNF-3 beta	insulin	Pdx-1	sox17
untreated	nd	nd	+++	nd	+++
6 hrs	nd	+++	nd	+++	+++
24 hrs	nd	+	nd	nd	+++
		nd	not detectable at >40 cycles by RT-PCR		
		+	detectable between 35 and 40 cycles by RT-PCR		
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9		
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9		
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System					

TABLE XII-C. THE EFFECT OF A 6 HOUR 5 μ M TRICHOSTATIN A TREATMENT ON GENE EXPRESSION IN AN EARLY PASSAGE (P5) PANCREATIC-DERIVED STOMAL CELL LINE.

sample	glucagon	HNF-3 beta	Insulin	Pdx-1
untreated	nd	nd	Nd	+
6 hrs	+	+++	Nd	+
24 hrs	+	nd	+++	nd
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles by RT-PCR	
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE XII-D. THE EFFECT OF A 6 HOUR 5 μ M TRICHOSTATIN A TREATMENT ON GENE EXPRESSION IN A LATE PASSAGE (P11) PANCREATIC-DERIVED STOMAL CELL LINE.

sample	glucagon	HNF-3 beta	Insulin	Pdx-1
untreated	nd	nd	Nd	nd
6 hrs	+	+	Nd	+
24 hrs	+	nd	Nd	nd
		nd	not detectable at >40 cycles by RT-PCR	
		+	detectable between 35 and 40 cycles by RT-PCR	
		++	detectable at less than 35 cycles by RT-PCR with SE greater than 0.9	
		+++	detectable at less than 35 cycles by RT-PCR with SE less than 0.9	
All RT-PCR was performed on the Applied Biosystems 7500 Real-Time PCR System				

TABLE XIII-A. THE EFFECT OF A 24 HOUR 5 μ M HDAC INHIBITOR TREATMENT ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
26996723	24.260	23.821	23.707	23.929	0.169	34.809	35.903	35.334	35.349	0.316	0.4
18042557	23.212	23.018	22.979	23.070	0.072	Undet.	Undet.	Undet.			
26979355	23.319	23.349	23.400	23.356	0.023	Undet.	Undet.	Undet.			
18042583	23.638	22.907	22.955	23.167	0.236	Undet.	Undet.	Undet.			
27019850	23.187	23.108	23.388	23.228	0.083	Undet.	Undet.	Undet.			0.1
27054313	23.844	23.374	23.754	23.657	0.144	Undet.	37.615	Undet.	37.615		
27129986	22.500	22.395	22.720	22.539	0.096	Undet.	Undet.	Undet.			
28635932	23.066	23.193	22.783	23.014	0.121	Undet.	Undet.	Undet.			
27140191	22.741	22.310	23.831	22.961	0.452	Undet.	Undet.	Undet.			1.0
28543944	23.396	23.309	24.072	23.592	0.241	33.558	33.199	34.116	33.624	0.267	
37271637	22.937	22.716	23.892	23.182	0.361	Undet.	Undet.	Undet.			
28596555	24.069	23.590	24.194	23.951	0.184	Undet.	Undet.	Undet.			
37271559	23.616	22.356	23.402	23.125	0.389	Undet.	Undet.	Undet.			
26972088	23.138	22.635	23.270	23.014	0.194	Undet.	Undet.	Undet.			
37271650	23.544	22.678	23.153	23.125	0.251	Undet.	Undet.	Undet.			
26977808	23.451	22.408	23.290	23.050	0.324	Undet.	Undet.	Undet.			
26142415	23.215	23.242	23.298	23.251	0.024	Undet.	Undet.	Undet.			
untreated	23.521	23.394	22.812	23.242	0.218	Undet.	Undet.	Undet.			
27422863	23.729	23.950	23.895	23.858	0.066	Undet.	Undet.	Undet.			
TSA	23.783	23.132	23.772	23.562	0.215	33.408	33.067	34.151	33.542	0.320	
27652677	23.799	23.698	24.276	23.924	0.178	33.890	33.157	34.960	34.002	0.524	1.0
28507193	23.845	23.847	23.292	23.661	0.185	34.271	35.198	34.328	34.599	0.300	0.9
37653265	23.047	23.007	23.298	23.118	0.091	Undet.	Undet.	Undet.			0.5
28571699	23.474	23.664	23.202	23.447	0.134	33.700	34.438	33.901	34.013	0.220	0.7
37791156	24.088	23.389	24.155	23.877	0.245	34.803	33.520	34.063	34.129	0.372	0.8

8584842	23.796	23.644	23.524	23.655	0.079	38.374	38.530	Undet.	38.452	0.078	0.0
37791104	23.669	23.319	23.563	23.517	0.104	34.057	34.571	34.617	34.415	0.180	0.5
28649465	24.300	23.501	23.729	23.844	0.238	37.693	36.510	37.504	37.236	0.367	0.1
27027026	23.856	24.250	23.063	23.723	0.349	34.025	34.238	33.121	33.795	0.342	0.9
29232073	23.800	23.643	23.260	23.568	0.160	33.011	32.785	33.056	32.951	0.084	1.5
27059331	23.980	23.479	23.577	23.679	0.153	34.639	35.004	35.340	34.994	0.202	0.4
32404580	23.398	23.067	23.213	23.226	0.096	Undet.	Undet.	Undet.			
Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
27628250	24.575	24.101	23.936	24.204	0.192	Undet.	Undet.	Undet.			0.6
27051895	23.535	Undet.	23.851	23.693	0.158	Undet.	Undet.	Undet.			
27075945	25.120	24.170	24.520	24.604	0.277	Undet.	Undet.	Undet.			
27070160	23.647	Undet.	23.682	23.665	0.018	Undet.	Undet.	Undet.			
27083537	23.952	23.591	23.511	23.685	0.136	Undet.	Undet.	Undet.			
27263366	23.251	Undet.	23.128	23.189	0.061	Undet.	Undet.	Undet.			0.3
27132391	24.200	23.126	22.964	23.430	0.388	Undet.	Undet.	Undet.			
28571530	22.535	Undet.	23.435	22.985	0.450	33.766	33.452	34.341	33.853	0.260	
27554553	23.624	22.718	24.634	23.659	0.553	Undet.	Undet.	Undet.			
28596503	22.792	Undet.	24.440	23.616	0.824	Undet.	Undet.	Undet.			
26900289	23.948	23.001	23.988	23.645	0.322	Undet.	Undet.	Undet.			0.4
28600650	22.837	Undet.	23.425	23.131	0.294	34.063	34.555	35.507	34.708	0.424	
26994461	23.777	23.129	23.634	23.514	0.197	34.337	34.593	35.308	34.746	0.291	1.0
37791065	23.222	Undet.	23.680	23.451	0.229	Undet.	Undet.	Undet.			
28549118	23.725	23.522	23.683	23.643	0.062	33.354	34.022	33.765	33.714	0.194	1.1
28427139	23.377	Undet.	23.768	23.572	0.195	Undet.	Undet.	Undet.			
33300943	26.317	25.666	25.677	25.887	0.215	35.984	34.695	36.702	35.794	0.587	1.6
untreated	25.963	24.642	24.596	25.067	0.448	Undet.	Undet.	Undet.			
33297888	25.322	24.894	25.139	25.118	0.124	34.115	34.145	35.206	34.489	0.359	1.0
TSA	25.224	24.046	25.952	25.074	0.555	34.884	33.285	37.095	35.088	1.104	
27617655	24.911	24.921	24.659	24.830	0.086	Undet.	Undet.	Undet.			

37653330	25.412	24.899	25.249	25.186	0.151	34.251	34.336	37.049	35.212	0.919	1.0
28427113	23.593	25.653	24.239	24.495	0.608	Undet.	Undet.	Undet.			
37804806	25.101	24.947	24.651	24.899	0.132	34.074	34.378	33.528	33.993	0.249	1.9
29784001	25.297	23.826	25.277	24.800	0.487	34.381	33.130	35.162	34.224	0.592	1.5
37786138	25.704	24.545	25.075	25.108	0.335	36.068	35.269	35.080	35.473	0.303	0.8
33300839	24.859	24.349	25.424	24.878	0.311	34.667	34.031	34.291	34.330	0.184	1.5
38117820	25.256	25.088	25.574	25.306	0.142	37.712	38.096	Undet.	37.904		0.2
26960167	25.043	24.157	26.281	25.160	0.616	Undet.	Undet.	Undet.			
38117859	25.102	24.401	24.947	24.816	0.213	34.452	33.525	34.524	34.167	0.322	1.6
27263158	25.050	25.327	26.236	25.538	0.358	Undet.	Undet.	Undet.			
38134395	26.227	24.421	24.750	25.133	0.555	35.286	34.709	34.664	34.886	0.200	1.2

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
27018576	25.059	26.422	26.338	25.939	0.441	Undet.	Undet.	Undet.			
26988312	Undet.	25.334	25.043	25.188	0.145	Undet.	Undet.	Undet.			
27019590	24.966	25.597	25.371	25.311	0.184	Undet.	Undet.	Undet.			
27121120	Undet.	25.838	24.550	25.194	0.644	Undet.	Undet.	Undet.			
37398855	25.106	25.585	25.667	25.453	0.175	34.258	35.682	36.410	35.450	0.632	1.1
27527305	Undet.	24.701	24.457	24.579	0.122	Undet.	Undet.	Undet.			
37398920	24.880	24.721	25.962	25.187	0.390	34.095	34.318	38.141	35.518	1.313	0.9
28540954	Undet.	24.599	25.218	24.909	0.309	Undet.	34.346	35.022	34.684	0.338	1.3
37398803	24.882	24.801	25.211	24.965	0.125	Undet.	Undet.	Undet.			
38153895	Undet.	24.610	25.201	24.906	0.296	Undet.	34.806	33.621	34.213	0.592	1.7
26989664	24.773	25.105	24.903	24.927	0.096	Undet.	Undet.	Undet.			
38153882	Undet.	26.274	25.062	25.668	0.606	Undet.	37.247	38.152	37.700	0.452	0.3
26981149	24.448	24.504	24.713	24.555	0.081	Undet.	Undet.	Undet.			
38151243	Undet.	24.350	24.916	24.633	0.283	Undet.	Undet.	Undet.			
26980174	24.031	24.519	24.410	24.320	0.148	Undet.	Undet.	Undet.			
27151813	Undet.	24.158	24.158	24.158	0.000	Undet.	Undet.	Undet.			
28557425	25.178	26.164	25.943	25.762	0.299	Undet.	Undet.	Undet.			

untreated	25.006	25.206	24.299	24.837	0.275	Undet.	Undet.	Undet.	Undet.	1.0
28427165	25.814	25.849	25.246	25.636	0.196	Undet.	Undet.	Undet.	Undet.	
TSA	24.505	24.926	25.230	24.887	0.210	34.728	35.053	35.205	0.141	
31046587	25.779	26.267	25.659	25.901	0.186	Undet.	Undet.	Undet.		
27147133	24.411	24.561	24.534	24.502	0.046	Undet.	Undet.	Undet.		
29776266	24.154	24.116	24.860	24.376	0.242	35.133	35.538	36.006	0.252	0.5
28296463	24.977	24.747	24.891	24.872	0.067	34.283	34.543	34.843	0.162	1.3
31051462	24.556	26.036	25.128	25.240	0.431	34.094	35.728	35.226	0.483	1.3
37804793	24.852	24.631	25.010	24.831	0.110	36.305	35.229	37.367	0.617	0.4
31046626	25.476	25.949	25.315	25.580	0.190	34.367	36.453	34.852	0.630	1.4
37786151	24.284	24.435	24.630	24.450	0.100	Undet.	Undet.	Undet.		
26913757	24.957	25.645	25.250	25.284	0.199	34.973	37.589	36.757	0.772	0.5
26949403	24.466	24.798	25.277	24.847	0.235	34.294	34.565	35.856	0.482	1.0
26949481	25.813	24.921	25.412	25.382	0.258	Undet.	36.352	37.228	0.438	0.4
26949312	24.320	24.803	24.744	24.622	0.152	35.021	34.216	34.846	0.245	1.0

Sample ID	GAPDH					PDX1				RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error
38134330	24.475	24.365	24.648	24.496	0.082	34.122	34.272	34.485	34.293	0.105
27054729	24.948	23.766	24.321	24.345	0.341	Undet.	Undet.	Undet.		
26949273	24.375	24.987	24.188	24.517	0.241	Undet.	Undet.	38.272	38.272	13.756
27032057	24.798	23.366	23.645	23.936	0.438	Undet.	Undet.	Undet.		
26949338	23.566	24.222	24.548	24.112	0.289	Undet.	Undet.	Undet.		
27137032	23.410	23.417	23.655	23.494	0.080	Undet.	Undet.	Undet.		
26949442	22.969	23.638	23.092	23.233	0.206	Undet.	Undet.	Undet.		
27136863	23.630	23.623	23.350	23.534	0.092	Undet.	Undet.	Undet.		
26949455	23.411	23.404	23.496	23.437	0.029	38.003	Undet.	Undet.	38.003	14.566
27136889	23.470	23.073	23.395	23.313	0.122	Undet.	Undet.	Undet.		
26949416	23.911	24.119	24.837	24.289	0.280	Undet.	Undet.	Undet.		
27136993	22.996	23.892	23.618	23.502	0.265	39.778	Undet.	Undet.		
26949390	24.275	24.257	24.422	24.318	0.052	Undet.	38.129	Undet.	38.129	13.811

27131546	23.753	23.765	23.305	23.608	0.151	Undet.	Undet.	Undet.	1.2
28571504	23.541	23.601	24.039	23.727	0.157	33.308	33.285	33.198	0.099
38222964	24.179	24.730	23.718	24.209	0.292	36.820	35.371	36.454	0.551
26909636	25.050	24.647	25.047	24.915	0.134	Undet.	Undet.	37.496	12.581
untreated	24.256	24.568	23.648	24.157	0.270	Undet.	Undet.		
27142674	24.391	24.247	24.322	24.320	0.042	33.969	34.450	33.854	0.382
TSA	23.984	24.219	24.240	24.148	0.082	34.305	33.714	33.923	0.191
27142401	24.025	23.977	24.376	24.126	0.126	33.905	33.382	33.682	0.156
26951249	24.389	24.749	24.816	24.651	0.133	Undet.	Undet.	38.406	13.755
26910897	23.739	23.279	23.606	23.541	0.137	Undet.	Undet.		
28584777	23.515	24.366	23.736	23.872	0.255	Undet.	Undet.		
27122225	23.209	23.726	24.422	23.786	0.351	Undet.	Undet.		
27147081	23.214	24.310	23.750	23.758	0.317	Undet.	Undet.		
29232541	24.254	24.722	23.970	24.315	0.219	35.196	35.380	35.622	0.338
27142323	23.457	24.960	23.902	24.106	0.446	Undet.	Undet.		
29381378	24.546	24.326	23.773	24.215	0.230	Undet.	Undet.		
27621126	23.510	24.315	23.849	23.892	0.233	34.405	35.120	35.322	0.597
35807343	24.368	24.136	24.203	24.236	0.069	Undet.	Undet.		
28577068	24.063	24.943	23.943	24.316	0.315	Undet.	Undet.		

Sample ID	GAPDH					PDX1				RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error
27580670	23.352	23.782	23.059	23.398	0.210	Undet.	Undet.	Undet.		
27018225	23.053	22.978	23.054	23.028	0.025	Undet.	Undet.	Undet.		
36278853	22.947	23.720	23.930	23.532	0.299	34.557	35.220	35.618	35.132	0.310
27018199	23.661	23.099	23.405	23.388	0.162	36.020	Undet.	35.971	35.995	0.024
27274468	22.037	23.412	23.484	22.978	0.471	33.015	34.377	34.210	33.868	0.429
27017159	22.920	23.738	23.472	23.377	0.241	Undet.	Undet.	Undet.		
27267279	22.643	22.592	22.679	22.638	0.025	Undet.	Undet.	Undet.		
27017198	23.103	23.130	22.990	23.074	0.043	Undet.	Undet.	Undet.		
27266343	23.106	23.736	23.830	23.558	0.227	Undet.	Undet.	Undet.		

27019291	24.182	24.023	23.403	23.869	0.238	Undet.	Undet.	Undet.	0.5
27385098	23.383	23.388	23.347	23.372	0.013	Undet.	Undet.	Undet.	
28313220	22.945	23.484	23.016	23.148	0.169	Undet.	Undet.	Undet.	
26633763	22.814	23.950	23.333	23.366	0.328	34.310	34.330	34.681	0.120
27059357	23.035	23.341	23.262	23.213	0.092	Undet.	Undet.	Undet.	
27018212	23.303	23.834	23.869	23.669	0.183	35.327	36.291	36.004	0.286
29380936	24.078	23.260	23.143	23.494	0.294	Undet.	Undet.	Undet.	
26933374	22.736	23.306	22.857	22.967	0.173	38.795	37.135	Undet.	0.830
untreated	22.489	23.195	22.871	22.852	0.204	37.202	Undet.	Undet.	0.1
26933296	23.747	23.482	23.207	23.479	0.156	38.026	36.423	38.190	0.564
TSA	23.044	23.134	22.950	23.043	0.053	33.199	32.871	33.190	0.108
26984152	24.221	23.739	23.754	23.905	0.158	36.175	35.407	Undet.	0.384
28658149	23.203	23.604	23.657	23.488	0.143	Undet.	Undet.	Undet.	
27418183	23.324	24.440	23.318	23.694	0.373	36.060	Undet.	35.063	0.499
27136811	23.266	23.336	23.615	23.406	0.106	37.985	Undet.	Undet.	0.0
27557478	23.593	23.572	23.836	23.667	0.085	34.039	35.024	33.497	0.447
38171757	23.458	23.471	23.592	23.507	0.042	33.467	33.686	33.451	0.076
27587807	23.431	24.064	23.991	23.829	0.200	33.198	34.015	34.464	0.371
38176073	23.276	23.870	24.020	23.722	0.227	34.055	34.403	34.346	0.107
37851398	23.690	23.464	23.981	23.712	0.150	Undet.	Undet.	Undet.	
27136668	23.367	23.216	23.431	23.338	0.064	Undet.	Undet.	Undet.	
27447654	23.027	23.724	23.329	23.360	0.202	Undet.	Undet.	Undet.	

Sample ID	GAPDH					PDX1				RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	
26956163	25.497	25.072	24.804	25.124	0.201	Undet.	Undet.	Undet.		0.3
28309411	24.832	24.120	25.468	24.807	0.389	37.671	Undet.	Undet.	37.671	
27570972	25.572	37.680	25.164	29.472	4.106	Undet.	Undet.	Undet.		
28576860	25.598	26.164	24.807	25.523	0.393	Undet.	Undet.	Undet.		
28313272	24.416	35.980	25.458	28.618	3.693	Undet.	Undet.	Undet.		
28571868	24.355	24.539	25.931	24.941	0.498	Undet.	Undet.	Undet.		

28315326	23.921	35.649	24.443	28.004	3.825	Undet.	Undet.	Undet.	0.1
28587208	23.747	24.105	24.690	24.181	0.275	Undet.	39.157	Undet.	
28314000	24.075	24.004	24.521	24.200	0.162	Undet.	Undet.	Undet.	
28536118	24.526	24.904	25.315	24.915	0.228	Undet.	Undet.	Undet.	
26949299	23.771	24.068	24.483	24.107	0.206	38.670	38.670	Undet.	0.1
28536157	24.000	23.824	24.423	24.082	0.178	Undet.	Undet.	Undet.	
27669330	24.327	24.087	24.542	24.319	0.131	Undet.	Undet.	Undet.	
27347892	24.539	24.615	23.645	24.266	0.311	Undet.	Undet.	Undet.	
28536092	23.794	24.954	25.249	24.666	0.444	Undet.	Undet.	Undet.	
27520155	24.100	23.580	24.579	24.087	0.288	35.568	35.563	36.791	0.7
27522482	24.761	24.913	25.147	24.940	0.112	Undet.	Undet.	Undet.	
untreated	25.264	24.183	24.749	24.732	0.312	Undet.	Undet.	Undet.	
27522703	25.332	25.431	24.898	25.220	0.164	Undet.	Undet.	Undet.	
TSA	25.183	24.692	25.296	25.057	0.185	35.293	35.984	36.306	1.0
27522378	25.032	24.780	24.553	24.788	0.138	38.019	37.171	37.004	0.4
27527383	25.080	24.931	25.157	25.056	0.066	Undet.	38.764	38.764	0.1
27522716	24.724	24.145	24.981	24.616	0.247	Undet.	38.139	Undet.	0.2
28557555	25.237	24.088	24.799	24.708	0.335	Undet.	39.126	38.095	0.1
27522612	25.272	23.862	25.055	24.729	0.438	Undet.	Undet.	Undet.	
29232515	25.033	24.774	24.774	24.860	0.086	37.030	36.270	35.802	0.7
26909584	24.014	24.215	25.134	24.454	0.345	35.777	36.732	37.375	0.4
28978209	25.070	24.805	25.000	24.958	0.079	36.014	36.136	36.036	0.8
28427152	25.599	25.110	24.974	25.228	0.190	36.227	36.608	36.245	0.7
28297919	24.506	23.866	24.850	24.407	0.288	Undet.	Undet.	Undet.	
28831777	25.136	25.295	25.699	25.377	0.168	37.044	37.297	38.013	0.5
26980395	24.611	24.138	25.222	24.657	0.314	39.393	38.698	Undet.	0.1

Sample ID	GAPDH				PDX1				RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	
27625156	25.349	25.726	25.303	25.459	0.134	Undet.	Undet.	Undet.	
untreated	25.801	25.810	24.698	25.436	0.369	Undet.	Undet.	Undet.	

[illegible]

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
37125335	25.400	25.753	25.171	25.441	0.169	36.379	37.855	36.226	36.820	0.519	0.7
28606643	25.577	25.336	25.026	25.313	0.159	36.854	Undet.	37.622	37.238	0.384	0.5
26975390	24.244	24.642	24.569	24.485	0.122	Undet.	Undet.	Undet.			
27039857	24.096	25.170	24.919	24.728	0.324	Undet.	Undet.	Undet.			
27136772	23.531	24.142	24.691	24.121	0.335	Undet.	Undet.	Undet.			
28315300	25.210	24.255	24.285	24.583	0.313	37.049	35.189	35.295	35.844	0.603	0.8
27580501	22.909	24.055	23.447	23.470	0.331	36.408	37.492	38.392	37.431	0.574	0.1
28338089	24.651	23.823	24.375	24.283	0.243	36.158	34.465	35.045	35.223	0.497	1.0
27580566	24.085	23.855	25.288	24.409	0.444	Undet.	Undet.	Undet.			
28345213	24.095	24.166	25.308	24.523	0.393	36.572	38.152	39.734	38.153	0.913	0.2
26906997	23.873	24.037	25.062	24.324	0.372	36.113	36.913	36.674	36.567	0.237	0.4
28376686	23.841	24.449	24.781	24.357	0.275	34.588	37.510	37.156	36.418	0.921	0.5
27017406	24.003	24.700	24.430	24.377	0.203	Undet.	Undet.	Undet.			
28407275	25.100	24.919	25.010	25.010	0.052	38.940	38.991	38.011	38.648	0.319	0.2
27025583	24.295	24.049	24.476	24.273	0.124	Undet.	Undet.	Undet.			
28427087	25.151	24.365	24.577	24.698	0.235	Undet.	Undet.	Undet.			
28518919	25.348	26.388	25.303	25.680	0.354	37.862	37.800	37.565	37.742	0.090	0.5
untreated	25.642	25.490	24.786	25.306	0.264	Undet.	Undet.	Undet.			
27122147	25.551	25.801	25.514	25.622	0.090	Undet.	Undet.	Undet.			
TSA	25.742	24.269	25.113	25.041	0.427	36.363	35.589	35.919	35.957	0.224	1.0
28616289	24.986	25.793	25.125	25.301	0.249	Undet.	Undet.	39.841	39.841		0.1
27191021	24.613	24.822	24.770	24.735	0.063	Undet.	Undet.	Undet.			
28296424	24.516	24.286	24.612	24.471	0.097	38.876	Undet.	Undet.	38.876		0.1
31040217	25.833	25.010	24.614	25.152	0.359	36.613	36.255	35.410	36.093	0.357	1.0
31035940	24.718	25.087	24.753	24.853	0.118	Undet.	Undet.	Undet.			
26960674	25.234	24.897	25.346	25.159	0.135	Undet.	Undet.	Undet.			
31040776	25.467	25.545	25.078	25.363	0.144	38.215	Undet.	38.619	38.417	0.202	0.2
27639677	24.960	24.639	24.662	24.754	0.103	Undet.	Undet.	Undet.			
31040763	24.456	25.210	25.013	24.893	0.226	34.445	37.223	36.715	36.128	0.854	0.8

26930943	25.188	25.187	24.711	25.029	0.159	Undet.	39.275	Undet.	39.275	0.1
31040074	24.736	24.986	25.398	25.040	0.193	35.196	35.623	35.911	35.577	1.3
27589328	25.622	25.004	24.638	25.088	0.287	Undet.	Undet.	Undet.		

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
27136980	24.727	24.850	24.967	24.848	0.069	Undet.	Undet.	Undet.			1.0
untreated	24.474	25.112	23.651	24.412	0.423	Undet.	Undet.	Undet.			
27136967	24.620	25.024	24.796	24.813	0.117	Undet.	Undet.	Undet.			
TSA	25.524	24.816	24.525	24.955	0.297	34.079	34.137	34.838	34.351	0.244	1.0
27136941	24.103	24.558	24.049	24.237	0.162	Undet.	Undet.	Undet.			
27552421	24.033	24.462	23.705	24.066	0.219	Undet.	Undet.	Undet.			
27136915	23.741	24.085	24.156	23.994	0.128	Undet.	Undet.	Undet.			0.7
28549144	23.835	24.102	23.953	23.964	0.077	Undet.	Undet.	Undet.			
27137045	24.891	24.158	24.374	24.474	0.218	Undet.	Undet.	Undet.			
31002439	24.376	24.549	24.140	24.355	0.118	34.143	34.913	33.826	34.294	0.323	0.7
27136759	25.201	24.229	24.374	24.602	0.303	Undet.	Undet.	Undet.			
28338102	25.329	25.197	24.361	24.962	0.303	34.412	35.402	34.838	34.884	0.287	
27263379	24.560	24.145	24.388	24.364	0.120	Undet.	Undet.	Undet.			0.4
28427100	24.269	24.822	24.783	24.625	0.178	34.893	34.936	36.372	35.400	0.486	
27263392	24.642	24.421	24.629	24.564	0.071	Undet.	Undet.	Undet.			
28549079	24.907	24.903	25.208	25.006	0.101	34.961	35.212	36.292	35.488	0.409	0.5
37827634	25.598	24.690	25.369	25.219	0.273	Undet.	39.182	Undet.	39.182		
26996710	25.215	25.482	25.429	25.375	0.082	35.942	35.427	35.921	35.763	0.168	
37844664	24.908	25.119	25.158	25.062	0.078	Undet.	39.783	39.602	39.693	0.091	0.1
26996736	25.125	25.864	25.606	25.532	0.217	38.536	37.573	38.540	38.216	0.322	
26996645	24.567	25.174	25.949	25.230	0.400	34.780	35.082	37.356	35.739	0.813	
26996749	24.563	24.917	25.081	24.854	0.153	37.187	36.188	38.134	37.170	0.562	0.1
26996866	24.168	24.633	25.345	24.716	0.342	36.779	37.676	37.350	37.268	0.262	
28651012	24.177	25.858	25.082	25.039	0.486	Undet.	Undet.	Undet.			
26996892	24.733	25.659	25.230	25.207	0.268	Undet.	38.929	Undet.	38.929		0.1

28663973	25.447	24.777	25.495	25.240	0.232	36.413	35.620	37.239	36.424	0.468	0.3
26996905	24.717	24.767	26.120	25.201	0.460	37.053	38.627	Undet.	37.840		0.1
28324036	24.445	25.078	24.774	24.765	0.183	Undet.	Undet.	Undet.			
26996671	25.088	24.652	25.361	25.034	0.206	34.953	34.577	35.472	35.001	0.259	0.7
31046600	25.059	25.378	25.243	25.227	0.092	35.053	34.542	35.433	35.009	0.258	0.8
26996918	24.998	24.642	25.391	25.010	0.216	36.120	39.263	37.122	37.501	0.927	0.1
26977847	25.343	25.159	25.020	25.174	0.093	36.414	35.872	36.448	36.245	0.187	0.3

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
27632917	25.292	25.074	24.977	25.114	0.093	Undet.	Undet.	Undet.			
untreated	24.567	24.317	24.320	24.401	0.083	Undet.	Undet.	Undet.			
36721698	24.869	24.496	25.066	24.810	0.167	Undet.	Undet.	Undet.			
TSA	25.242	24.688	24.362	24.764	0.257	34.017	33.986	34.600	34.201	0.200	1.0
26909688	24.749	24.470	24.655	24.624	0.082	Undet.	Undet.	Undet.			
27190124	24.170	24.162	24.112	24.148	0.018	Undet.	Undet.	Undet.			
27628198	23.994	23.750	23.435	23.726	0.162	Undet.	Undet.	Undet.			
27213719	23.657	24.136	24.006	23.933	0.143	Undet.	Undet.	Undet.			
27625182	25.294	24.715	24.419	24.809	0.257	Undet.	Undet.	Undet.			
27633073	24.361	24.411	24.020	24.264	0.123	Undet.	Undet.	Undet.			
27632670	24.416	23.905	24.541	24.287	0.194	Undet.	Undet.	Undet.			
26909727	23.951	24.121	23.907	23.993	0.065	Undet.	Undet.	Undet.			
27625260	25.338	24.521	25.385	25.081	0.280	Undet.	Undet.	Undet.			
26909753	24.241	24.759	24.811	24.604	0.182	Undet.	Undet.	Undet.			
33297914	24.778	24.863	25.238	24.960	0.141	Undet.	Undet.	Undet.			
26909766	24.152	24.337	24.474	24.321	0.093	Undet.	Undet.	Undet.			
31069415	26.046	25.168	25.487	25.567	0.257	Undet.	Undet.	Undet.			
28518568	25.205	25.745	24.773	25.241	0.281	Undet.	Undet.	Undet.			
37804546	25.980	25.100	25.904	25.661	0.282	Undet.	37.203	37.663	37.433	0.230	0.2
31064072	24.451	25.196	24.636	24.761	0.224	38.184	Undet.	Undet.	38.184		0.1
27477788	24.889	25.131	25.142	25.054	0.083	34.645	33.999	35.341	34.662	0.387	0.9

28309385	24.313	23.666	23.861	23.947	0.192	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	0.6	
28557464	24.010	24.051	24.259	24.107	0.077	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
28309320	23.977	24.768	24.233	24.326	0.233	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
31053828	25.368	24.710	25.074	25.050	0.190	35.482	34.909	35.035	35.142	0.174	35.482	34.909	35.035	35.142	0.174		
28309242	24.936	24.196	25.256	24.796	0.314	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	1.1	
31056792	25.531	24.944	25.251	25.242	0.170	34.006	34.183	35.584	34.591	0.499	34.006	34.183	35.584	34.591	0.499		
27635556	23.806	24.328	24.648	24.261	0.246	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
28531516	24.913	25.111	24.518	24.847	0.174	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
26963105	24.191	25.137	24.288	24.539	0.300	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	1.0	
28309255	24.481	24.642	24.879	24.667	0.116	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
26986076	24.344	25.435	25.115	24.965	0.324	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
Sample ID	GAPDH										PDX1					RQ	
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error							
35772568	25.492	24.814	25.236	25.181	0.198	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	1.2	
33155811	Undet.	25.223	24.620	24.922	0.301	Undet.	34.716	34.473	34.594	0.122	Undet.	34.716	34.473	34.594	0.122		
28404844	25.613	25.084	24.326	25.007	0.373	33.790	34.994	33.859	34.214	0.390	33.790	34.994	33.859	34.214	0.390	1.6	
27016223	24.120	24.419	24.296	24.278	0.087	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
27137006	24.342	24.182	23.564	24.029	0.237	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	1.0	
27022307	23.655	23.699	23.532	23.629	0.050	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
28507271	23.898	24.106	23.715	23.906	0.113	34.305	34.073	33.170	33.849	0.346	34.305	34.073	33.170	33.849	0.346		
27534455	23.609	24.152	23.101	23.621	0.303	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
27136733	23.810	24.356	24.478	24.214	0.205	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	1.0	
27422889	23.609	23.523	24.619	23.917	0.352	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
27136850	23.687	24.632	24.870	24.396	0.361	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
28532946	24.465	24.924	25.496	24.962	0.298	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
27136824	23.913	24.738	23.786	24.146	0.299	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	1.0	
27482286	24.941	25.019	24.783	24.914	0.069	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
27136785	23.789	24.405	24.810	24.335	0.297	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
27513252	23.440	25.004	24.486	24.310	0.460	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.		
27519635	24.468	24.346	24.049	24.288	0.124	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	Undet.	1.0	

untreated	23.479	23.294	23.072	23.282	0.118	Undet.	Undet.	Undet.	
27522430	23.737	23.949	23.230	23.639	0.213	Undet.	Undet.	Undet.	
TSA	23.835	23.793	23.384	23.671	0.144	33.732	33.241	33.697	0.158
26933257	23.760	23.735	23.861	23.785	0.038	Undet.	37.205	37.103	0.051
31068076	24.106	24.254	23.746	24.035	0.151	37.364	38.629	35.568	0.1
26996658	23.554	23.762	22.976	23.430	0.235	36.922	35.836	34.445	0.1
31068089	23.590	23.490	23.666	23.582	0.051	34.655	33.945	34.262	0.2
26996801	23.598	23.983	24.168	23.916	0.168	38.190	Undet.	Undet.	0.6
27304524	24.085	23.302	23.052	23.480	0.311	Undet.	Undet.	Undet.	0.0
26996814	25.098	24.623	23.624	24.448	0.435	36.098	36.951	Undet.	
38163801	23.343	23.563	23.365	23.423	0.070	Undet.	Undet.	Undet.	0.2
26996827	25.276	25.322	24.838	25.145	0.154	38.720	38.282	Undet.	
38171744	23.197	23.518	23.372	23.363	0.093	Undet.	Undet.	Undet.	0.1
27022437	24.216	25.137	25.084	24.812	0.299	Undet.	Undet.	Undet.	
36074545	23.727	23.429	23.556	23.571	0.086	Undet.	Undet.	Undet.	

Sample ID	GAPDH					PDX1			RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	
27016236	24.552	24.527	24.409	24.496	0.044	Undet.	Undet.	Undet.	
untreated	23.644	24.704	23.909	24.085	0.319	Undet.	Undet.	Undet.	0.1
27570933	25.399	25.309	25.590	25.433	0.083	Undet.	39.987	Undet.	
TSA	23.550	24.827	25.394	24.590	0.545	33.973	35.214	36.156	1.0
38113595	25.447	25.194	25.985	25.542	0.233	Undet.	Undet.	Undet.	
28547103	23.600	24.933	24.122	24.218	0.388	Undet.	Undet.	Undet.	
38107862	24.508	24.397	25.429	24.778	0.327	35.763	34.588	35.360	1.0
27572441	24.503	24.497	24.826	24.609	0.108	37.178	36.165	Undet.	0.3
37125426	24.243	26.276	25.208	25.242	0.587	Undet.	Undet.	Undet.	
27587781	23.711	24.806	24.422	24.313	0.321	34.627	35.384	35.423	0.8
37827803	24.882	26.378	25.923	25.728	0.443	Undet.	Undet.	Undet.	
27580449	24.246	24.694	24.624	24.522	0.139	39.133	39.534	Undet.	0.1
27151787	24.130	24.315	24.967	24.471	0.254	Undet.	Undet.	Undet.	

27643356	23.498	23.871	24.253	23.874	0.218	Undet.	Undet.	Undet.	0.2
27151696	24.762	26.717	26.051	25.843	0.574	Undet.	Undet.	Undet.	
28577055	24.660	25.028	25.290	24.993	0.183	36.317	38.243	37.522	0.606
27039935	25.747	25.241	25.546	25.511	0.147	Undet.	Undet.	Undet.	
5526079	24.378	24.744	24.253	24.458	0.147	38.468	Undet.	38.468	0.1
27054586	25.661	24.876	26.091	25.543	0.356	Undet.	36.810	36.175	0.635
28663986	25.660	25.063	24.651	25.125	0.293	35.763	37.168	36.490	0.6
27643317	24.596	24.477	25.159	24.744	0.210	Undet.	Undet.	Undet.	
27122173	25.897	24.232	24.055	24.728	0.587	Undet.	Undet.	Undet.	
26962962	24.519	25.148	25.253	24.973	0.229	35.172	35.870	35.847	0.8
28846740	24.635	24.978	24.362	24.658	0.178	Undet.	Undet.	Undet.	
27054547	24.505	25.174	25.158	24.946	0.220	Undet.	Undet.	Undet.	
28846870	25.841	25.207	24.813	25.287	0.299	38.785	38.368	38.577	0.1
27075750	25.220	26.054	24.696	25.324	0.395	Undet.	Undet.	Undet.	
28847052	25.234	25.158	25.346	25.246	0.054	37.174	37.205	37.836	0.2
26981201	25.062	26.784	25.954	25.933	0.497	34.594	37.627	37.213	0.6
26996684	25.765	25.868	25.291	25.641	0.178	36.277	Undet.	37.523	0.4
26163605	24.085	26.517	24.262	24.955	0.783	Undet.	Undet.	Undet.	
26996840	24.788	24.936	24.829	24.851	0.044	37.526	38.023	37.774	0.2

Sample ID	GAPDH					PDX1			RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	
28625207	26.500	26.148	25.262	25.970	0.368	Undet.	Undet.	Undet.	
26996762	26.116	25.977	25.417	25.837	0.214	Undet.	Undet.	Undet.	
26962923	25.212	24.611	24.295	24.706	0.269	Undet.	Undet.	Undet.	
28543983	24.136	24.752	25.596	24.828	0.423	34.584	35.008	36.088	0.6
27117259	23.577	24.012	24.643	24.078	0.309	Undet.	Undet.	Undet.	
26996775	24.312	24.521	25.027	24.620	0.212	Undet.	Undet.	Undet.	
27062698	24.055	23.029	24.546	23.877	0.447	Undet.	Undet.	Undet.	
28540863	24.266	24.013	24.682	24.320	0.195	Undet.	Undet.	Undet.	
27558414	25.079	24.977	25.312	25.123	0.099	Undet.	Undet.	Undet.	

28543996	24.371	24.567	25.262	24.733	0.270	35.957	35.930	38.742	36.876	0.933	0.2
27620710	25.632	25.183	24.982	25.265	0.192	36.320	35.495	37.583	36.466	0.607	0.3
31013086	23.843	24.466	24.015	24.108	0.186	Undet.	Undet.	Undet.			
27639287	26.097	25.083	24.981	25.387	0.356	37.354	35.099	36.341	36.265	0.652	0.4
27570946	25.740	25.036	24.087	24.954	0.479	Undet.	Undet.	Undet.			
31012904	26.105	25.203	26.042	25.783	0.291	Undet.	36.764	39.046	37.905	1.141	0.2
27580657	25.303	25.266	24.355	24.975	0.310	Undet.	Undet.	Undet.			
26996853	25.404	26.458	26.147	26.003	0.313	37.940	Undet.	36.666	37.303	0.637	0.3
untreated	25.027	25.201	24.805	25.011	0.115	Undet.	Undet.	Undet.			
27014377	25.373	26.058	25.358	25.596	0.231	36.538	Undet.	Undet.	36.538		0.4
TSA	25.625	24.740	25.526	25.297	0.280	34.243	34.713	35.604	34.853	0.399	1.0
27422746	24.376	25.133	24.956	24.822	0.229	Undet.	Undet.	38.571	38.571		0.1
27580592	24.154	24.132	24.715	24.333	0.191	Undet.	Undet.	Undet.			
27572428	23.983	23.999	23.941	23.974	0.017	Undet.	Undet.	Undet.			
30999683	23.961	23.904	24.853	24.239	0.307	Undet.	Undet.	Undet.			
31005871	25.092	25.266	24.433	24.930	0.253	Undet.	Undet.	Undet.			
30997824	24.736	25.301	25.304	25.114	0.189	38.106	Undet.	Undet.	38.106		0.1
26909714	25.747	25.089	24.654	25.163	0.318	Undet.	Undet.	Undet.			
30997915	24.016	23.826	25.500	24.447	0.529	35.120	34.484	38.055	35.886	1.100	0.3
26933283	24.967	25.399	25.611	25.326	0.189	Undet.	Undet.	Undet.			
38222951	24.001	24.253	24.267	24.174	0.086	34.263	35.078	35.148	34.829	0.284	0.5
31053854	24.259	24.657	25.685	24.867	0.425	34.290	34.889	34.671	34.617	0.175	0.9
31068778	24.068	23.556	25.024	24.216	0.430	Undet.	Undet.	Undet.			

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
28315365	24.320	24.653	24.780	24.584	0.137	Undet.	Undet.	Undet.			
untreated	23.910	23.797	24.101	23.936	0.089	Undet.	Undet.	Undet.			
28313207	24.002	23.687	24.403	24.031	0.207	Undet.	Undet.	Undet.			
TSA	23.623	23.860	24.215	23.899	0.172	33.638	33.531	34.048	33.739	0.158	1.0
28323906	23.687	24.909	24.801	24.466	0.391	34.367	35.284	35.552	35.068	0.359	0.6

31069428	23.493	24.477	24.423	24.131	0.319	34.340	35.238	34.369	34.649	0.294	0.6
33300969	23.168	23.676	23.517	23.454	0.150	Undet.	Undet.	Undet.			
27387373	23.898	24.070	24.399	24.122	0.147	Undet.	Undet.	Undet.			
38163957	25.357	26.004	25.081	25.481	0.273	35.864	36.126	35.613	35.868	0.148	0.7
31064020	24.732	24.652	24.144	24.509	0.184	Undet.	Undet.	Undet.			
38168078	27.754	27.511	27.049	27.438	0.207	39.974	36.909	Undet.	38.442		0.4
26988858	25.779	26.112	24.955	25.615	0.344	Undet.	Undet.	Undet.			
28631590	27.344	26.515	26.052	26.637	0.378	35.928	35.746	35.839	35.838	0.053	1.6
26988884	26.272	26.550	26.196	26.339	0.107	Undet.	Undet.	Undet.			
28848469	27.748	27.488	26.734	27.323	0.304	38.450	37.563	36.819	37.610	0.471	0.7
28323945	27.625	27.522	26.844	27.330	0.245	Undet.	Undet.	Undet.			
27117480	25.467	Undet.	25.406	25.436	0.030	Undet.	Undet.	Undet.			
28502240	23.784	Undet.	24.697	24.241	0.457	34.980	Undet.	34.441	34.710	0.269	0.6
27217333	24.447	25.299	25.554	25.100	0.335	Undet.	Undet.	Undet.			
38107849	24.724	23.958	24.695	24.459	0.251	36.717	34.464	35.626	35.602	0.650	0.4
27217541	24.459	24.017	25.843	24.773	0.550	Undet.	Undet.	Undet.			
38107992	26.261	25.144	23.985	25.130	0.657	35.134	34.835	34.154	34.707	0.290	1.2
26986453	24.457	24.750	24.861	24.689	0.120	34.993	35.054	34.562	34.870	0.155	0.8
28540902	24.714	23.666	24.235	24.205	0.303	Undet.	Undet.	Undet.			
27132352	25.096	24.767	25.817	25.227	0.310	Undet.	Undet.	Undet.			
28600871	25.439	25.562	25.282	25.427	0.081	Undet.	Undet.	Undet.			
28532933	26.627	26.705	27.149	26.827	0.163	Undet.	Undet.	Undet.			
27599728	25.695	26.209	25.925	25.943	0.149	Undet.	Undet.	Undet.			
37852763	30.123	29.119	29.119	29.119	0.000	Undet.	Undet.	Undet.			
31064111	28.294	27.951	26.350	27.532	0.599	Undet.	Undet.	39.010	39.010		0.3
28502435	28.975	28.291	26.821	28.029	0.635	Undet.	39.597	38.139	38.868	0.729	0.5
27635465	26.206	26.620	26.167	26.331	0.145	38.682	Undet.	38.220	38.451	0.231	0.2

Sample ID	GAPDH				PDX1				RQ	
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error
27589315	25.450	24.672	24.901	25.008	0.231	Undet.	Undet.	36.379	36.379	0.2

untreated	24.029	24.992	23.594	24.205	0.413	Undet.	Undet.	Undet.	Undet.	0.7
28323984	24.654	26.129	25.638	25.474	0.434	34.091	36.059	35.084	0.568	
TSA	24.014	24.850	24.240	24.368	0.250	33.284	33.710	33.332	0.135	1.0
28414061	23.654	24.116	24.593	24.121	0.271	35.522	33.277	33.701	0.689	0.5
38163983	24.587	24.897	24.382	24.622	0.150	Undet.	Undet.	Undet.		
28482285	23.943	23.882	24.218	24.014	0.104	Undet.	Undet.	Undet.		
38163970	24.030	24.092	24.096	24.073	0.021	Undet.	Undet.	Undet.		
27147406	24.134	24.401	25.040	24.525	0.269	35.747	36.206	36.608	0.249	0.2
30999670	24.431	24.134	23.965	24.177	0.136	Undet.	Undet.	Undet.		
27521052	24.472	24.650	25.097	24.740	0.186	Undet.	Undet.	Undet.		
27075607	24.055	24.648	23.970	24.224	0.213	Undet.	Undet.	Undet.		
27521533	24.063	23.796	24.721	24.193	0.275	33.516	33.076	33.208	0.130	1.0
27274260	24.185	23.504	23.583	23.757	0.215	Undet.	Undet.	Undet.		
27580709	24.897	24.378	25.523	24.933	0.331	35.794	33.983	39.014	1.471	0.2
27267292	23.461	23.517	24.181	23.720	0.231	Undet.	Undet.	Undet.		
28324010	25.433	25.572	25.040	25.348	0.159	Undet.	Undet.	Undet.		
27142765	25.437	24.838	24.863	25.046	0.196	Undet.	Undet.	Undet.		
28606656	25.074	24.740	24.497	24.770	0.167	Undet.	Undet.	Undet.		
27143272	24.408	23.986	24.879	24.424	0.258	35.276	33.385	37.026	1.051	0.3
27482559	23.841	24.003	23.997	23.947	0.053	Undet.	Undet.	Undet.		
27143246	25.112	24.525	24.891	24.843	0.171	Undet.	Undet.	Undet.		
27557374	23.926	23.923	24.054	23.968	0.043	Undet.	Undet.	37.020		0.1
28635919	24.710	24.515	24.508	24.578	0.066	33.726	33.326	33.992	0.193	1.0
28439905	24.137	24.009	24.235	24.127	0.065	Undet.	Undet.	Undet.		
36722621	23.753	24.563	24.280	24.199	0.237	Undet.	Undet.	Undet.		
26142428	24.903	24.792	24.548	24.748	0.105	Undet.	Undet.	Undet.		
26933387	25.084	24.556	24.950	24.863	0.159	Undet.	Undet.	Undet.		
27131169	24.427	25.309	24.194	24.643	0.339	Undet.	Undet.	Undet.		
38168052	24.136	24.915	25.218	24.756	0.322	Undet.	Undet.	Undet.		
27143441	25.343	25.314	24.262	25.329	0.014	Undet.	Undet.	Undet.		
28553720	24.815	24.094	24.503	24.471	0.209	Undet.	Undet.	Undet.		

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
28658071	25.281	25.598	24.812	25.230	0.228	37.497	37.936	Undet.	37.716		0.1
untreated	24.387	24.309	24.265	24.320	0.036	Undet.	Undet.	Undet.			
27244529	24.884	25.074	24.298	24.752	0.233	Undet.	Undet.	Undet.			
TSA											
28571751	24.628	24.966	24.373	24.656	0.172	33.969	34.009	33.683	33.887	0.103	1.0
26909662	25.372	24.185	24.093	24.550	0.412	Undet.	Undet.	Undet.			
28407340	25.180	24.673	24.269	24.707	0.264	Undet.	36.055	35.932	35.993	0.061	
26909675	25.068	25.649	25.037	25.251	0.199	Undet.	Undet.	Undet.			0.2
28407054	26.118	24.533	24.626	25.092	0.513	37.641	34.960	33.868	35.489	1.121	
27576770	23.938	24.905	25.185	24.676	0.378	Undet.	Undet.	Undet.			
26949429	24.828	25.195	24.257	24.760	0.273	Undet.	Undet.	38.592	38.592		0.0
37853842	25.408	25.469	25.470	25.449	0.020	Undet.	Undet.	38.613	38.613		
27120171	24.449	24.559	24.622	24.543	0.050	35.513	35.069	35.341	35.308	0.129	
27136902	25.299	23.545	23.554	24.133	0.583	Undet.	Undet.	Undet.			0.3
27632683	24.747	23.931	23.997	24.225	0.262	Undet.	Undet.	Undet.			
27136681	24.762	25.095	23.968	24.608	0.334	Undet.	Undet.	Undet.			
27265004	25.169	24.614	24.131	24.638	0.300	Undet.	Undet.	Undet.			
26905008	Undet.	25.264	25.439	25.352	0.087	Undet.	Undet.	Undet.			
27418144	24.664	25.278	25.048	24.997	0.179	Undet.	Undet.	Undet.			
27527552	Undet.	24.947	26.084	25.516	0.569	Undet.	Undet.	Undet.			
27413854	24.880	25.556	23.546	24.661	0.590	Undet.	Undet.	Undet.			
27556971	Undet.	24.643	25.382	25.013	0.370	Undet.	Undet.	Undet.			
27418612	25.449	24.362	24.318	24.710	0.370	Undet.	Undet.	Undet.			
27632722	23.997	24.979	25.410	24.795	0.418	Undet.	Undet.	Undet.			
34661913	24.629	23.710	24.122	24.154	0.266	Undet.	Undet.	Undet.			
27392703	25.498	24.633	25.360	25.164	0.268	Undet.	Undet.	Undet.			
34661848	25.526	25.245	25.312	25.361	0.085	Undet.	Undet.	Undet.			
28841982	26.227	24.864	25.535	25.542	0.393	Undet.	Undet.	Undet.			
	25.344	26.234	25.035	25.538	0.359	Undet.	Undet.	Undet.			

27478867	25.568	25.563	25.118	25.416	0.149	36.495	33.605	34.360	34.820	0.865	0.9
27392612	24.422	25.385	24.544	24.783	0.303	Undet.	Undet.	Undet.			
27059409	25.222	25.057	25.501	25.260	0.129	34.569	33.627	36.027	34.741	0.698	0.8
27418404	23.728	24.229	24.549	24.169	0.239	Undet.	Undet.	Undet.			

TABLE XIII-B. CONFIRMATION OF THE EFFECT OF A 24 HOUR 5 μM HDAC INHIBITOR TREATMENT ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
37398920	25.420	25.256	25.038	25.238	0.111	34.787	35.062	35.895	35.248	0.333	1.0
27142401	24.445	24.541	23.877	24.288	0.207	33.966	34.259	33.941	34.055	0.102	1.2
28540954	24.890	25.342	25.265	25.166	0.139	35.228	36.267	36.141	35.879	0.327	0.6
38171757	24.268	24.387	24.016	24.224	0.109	34.805	35.029	35.087	34.974	0.086	0.6
38153895	24.200	24.280	25.079	24.520	0.281	34.173	34.383	35.762	34.773	0.498	0.9
27587807	23.876	24.208	23.798	23.961	0.126	33.965	34.302	33.760	34.009	0.158	1.0
28641171	23.773	24.227	24.073	24.024	0.133	34.095	34.477	34.528	34.367	0.136	0.8
27418378	24.342	24.198	24.202	24.247	0.047	33.631	34.547	34.349	34.176	0.278	1.1
38134356	24.419	24.312	24.273	24.335	0.044	34.489	34.059	33.708	34.085	0.226	1.2
31017090	24.113	23.911	23.722	23.916	0.113	34.240	34.105	33.911	34.085	0.096	0.9
38134330	24.507	23.751	24.189	24.149	0.219	34.412	34.092	34.241	34.248	0.093	1.0
31034679	24.344	24.604	23.901	24.283	0.205	34.516	35.932	33.805	34.751	0.625	0.7
28571504	24.909	24.076	24.204	24.397	0.259	35.080	34.224	34.253	34.519	0.281	0.9
untreated	23.912	24.202	22.841	23.652	0.414	Undet.	Undet.	Undet.			
27142674	25.358	24.614	24.272	24.748	0.321	36.420	37.104	35.083	36.202	0.594	0.4
TSA	24.046	24.166	23.900	24.037	0.077	33.642	34.068	34.487	34.066	0.244	1.0
28543944	25.532	24.894	24.619	25.015	0.270	34.071	35.442	33.854	34.456	0.497	1.5
33297888	25.068	25.317	24.260	24.882	0.319	35.468	35.794	34.191	35.151	0.489	0.8
27652677	25.472	26.026	25.114	25.537	0.265	35.421	35.305	35.791	35.506	0.147	1.0
29784001	24.145	25.498	24.319	24.654	0.425	34.405	35.296	34.552	34.751	0.276	1.0
37791156	24.846	24.772	24.478	24.699	0.112	34.664	34.717	35.086	34.822	0.132	0.9
33300839	23.936	24.567	23.526	24.009	0.303	34.030	35.349	33.397	34.259	0.575	0.9
27027026	24.178	24.228	24.189	24.198	0.015	35.047	34.665	35.347	35.020	0.198	0.6
37653330	24.026	23.846	24.328	24.067	0.141	35.112	34.216	34.437	34.588	0.269	0.7
28296463	24.339	25.009	24.222	24.524	0.245	34.855	35.179	33.676	34.570	0.457	1.0

37804806	23.630	24.794	24.507	24.311	0.350	33.884	34.958	34.779	34.540	0.332	0.9
29232073	25.770	24.392	24.032	24.732	0.530	35.296	34.031	33.856	34.394	0.454	1.3
38117859	24.117	24.224	23.792	24.044	0.130	34.275	35.254	33.985	34.505	0.384	0.7
28549118	24.647	25.288	24.014	24.649	0.368	34.570	34.475	33.335	34.127	0.397	1.5
38134395	24.930	25.053	24.326	24.770	0.225	34.916	35.775	34.018	34.903	0.507	0.9
33300943	24.701	24.984	24.613	24.766	0.112	35.194	34.126	34.677	34.666	0.308	1.1
37398855	24.503	24.532	24.188	24.408	0.110	34.466	35.210	34.656	34.777	0.223	0.8

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
27477788	25.097	24.453	24.659	24.736	0.190	36.412	37.169	36.231	36.604	0.287	0.5
28978209	24.641	24.285	25.099	24.675	0.236	35.163	35.268	35.246	35.225	0.032	1.2
31056792	24.766	24.163	24.492	24.474	0.174	34.953	35.210	35.550	35.238	0.173	1.1
28338089	23.759	23.832	24.232	23.941	0.147	34.426	34.325	34.700	34.484	0.112	1.2
28404844	24.027	24.018	24.158	24.067	0.045	34.651	34.934	34.500	34.695	0.127	1.2
31040763	23.801	23.296	24.169	23.755	0.253	35.347	34.971	35.942	35.420	0.283	0.6
28507271	23.848	24.535	24.390	24.258	0.209	35.328	36.253	34.710	35.430	0.449	0.8
31040074	23.907	23.793	24.333	24.011	0.164	34.423	34.814	34.717	34.651	0.118	1.2
33155811	24.514	25.189	24.240	24.648	0.282	35.983	36.844	35.316	36.048	0.442	0.7
31040217	24.483	24.161	24.379	24.341	0.095	34.058	34.871	34.429	34.453	0.235	1.7
27054586	24.200	24.213	24.435	24.282	0.076	Undet.	Undet.	Undet.			
31053854	24.687	24.435	24.507	24.543	0.075	34.671	35.019	35.391	35.027	0.208	1.3
28107862	23.983	24.083	24.026	24.031	0.029	34.815	35.037	34.681	34.845	0.104	1.0
31056337	24.907	24.663	25.257	24.942	0.172	35.522	35.357	36.013	35.631	0.197	1.1
27587781	24.414	24.986	24.470	24.624	0.182	34.447	35.884	36.096	35.476	0.518	1.0
38107992	25.900	25.217	24.554	25.224	0.388	35.976	34.946	34.299	35.074	0.488	2.0
26949403	24.692	24.477	24.991	24.720	0.149	35.564	35.065	36.181	35.603	0.323	1.0
28631590	25.519	24.738	24.625	24.961	0.281	34.742	35.168	33.926	34.612	0.364	2.3
26949312	24.462	24.011	24.190	24.221	0.131	34.766	33.913	34.742	34.474	0.281	1.5
28635919	24.171	24.660	24.178	24.336	0.162	35.110	35.232	35.146	35.163	0.036	1.0
TSA	23.668	24.182	23.885	24.344	0.215	33.964	35.167	34.574	35.192	0.373	1.0

TSA	24.663	25.070	24.598	24.344	0.215	35.878	36.531	35.037	35.192	0.373	1.0
27521533	24.213	24.021	23.758	23.997	0.132	34.621	35.278	34.899	34.932	0.190	0.9
untreated	23.283	23.648	23.254	23.486	0.108	Undet.	Undet.				
untreated	23.196	23.043	23.402	23.486	0.108	Undet.	Undet.	Undet.			
untreated	Undet.	24.249	23.703	23.486	0.108	Undet.	Undet.	Undet.			
untreated	Undet.	23.587	23.500	23.486	0.108	Undet.	Undet.	Undet.			
27478867	24.584	23.830	23.759	24.058	0.264	34.884	34.307	34.502	34.565	0.169	1.3
27059409	23.999	24.195	23.663	23.952	0.155	35.017	35.188	34.433	34.879	0.229	0.9
31051462	24.029	24.067	23.494	23.864	0.185	35.571	34.159	34.044	34.591	0.491	1.1
31046626	24.487	24.610	24.356	24.484	0.073	35.723	35.028	34.713	35.155	0.298	1.1

TABLE XIII-C. EFFECTS OF A RANGE OF HDAC INHIBITOR CONCENTRATIONS ON PDX-1 GENE EXPRESSION IN AN ADULT PANCREATIC-DERIVED CELL LINE.

Sample ID - [μM]	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
38107992 - 10	25.854	26.295	25.885	26.012	0.142	34.811	35.401	35.570	35.261	0.230	29.7
38107992 - 5	26.793	26.371	25.049	26.071	0.525	35.651	35.655	35.354	35.553	0.100	25.3
38107992 - 2.5	25.028	24.963	25.887	25.293	0.298	34.518	34.498	35.615	34.877	0.369	23.6
38107992 - 1.25	24.753	24.509	24.937	24.733	0.124	35.203	34.412	35.291	34.969	0.279	15.0
38107992 - 0.625	26.371	24.940	24.678	25.330	0.526	35.141	34.417	34.300	34.620	0.263	28.9
38107992 - 0.3	26.148	26.441	26.342	26.311	0.086	35.099	36.077	37.448	36.208	0.681	19.0
38107992 - 0.15	25.871	26.539	26.269	26.227	0.194	36.197	38.658	37.448	37.434	0.710	
TSA - 10	26.572	27.068	26.209	26.616	0.249	35.124	35.572	36.134	35.610	0.292	35.5
TSA - 5	25.742	26.506	25.545	25.931	0.293	35.266	35.363	35.224	35.284	0.041	27.7
TSA - 2.5	26.200	25.952	25.560	25.904	0.186	35.384	34.902	35.579	35.288	0.201	27.1
TSA - 1.25	25.632	25.667	25.592	25.630	0.022	36.420	34.667	36.585	35.890	0.613	14.8
TSA - 0.625	26.069	26.049	26.170	26.096	0.037	Undet.	Undet.	Undet.			
TSA - 0.3	25.510	25.856	25.253	25.539	0.175	39.154	Undet.	Undet.	39.154		1.4
TSA - 0.15	26.035	26.138	25.728	25.967	0.123	Undet.	Undet.	Undet.		7.650	
0	26.049	26.028	25.849	25.618	0.205	Undet.	38.657	Undet.	38.657		1.0
0	25.784	25.167	24.829	25.618	0.205	Undet.	Undet.	Undet.	38.657		1.0
0	24.407	24.186	24.294	24.099	0.104	Undet.	Undet.	Undet.			
0	24.016	23.998	23.691	24.099	0.104	Undet.	Undet.	Undet.			
0	24.124	23.928	23.801	23.939	0.061	Undet.	Undet.	Undet.			
0	24.116	23.866	23.798	23.939	0.061	Undet.	Undet.	Undet.			
0	24.242	24.373	Undet.	23.772		Undet.	Undet.	Undet.			
0	23.378	23.623	23.243	23.772	0.228	37.590	39.153	Undet.	38.417	0.489	1.0
0	24.586	25.147	24.440	24.422	0.278	39.369	Undet.	37.556	38.417	0.489	1.0
0	23.601	23.640	25.115	24.422	0.278	38.967	Undet.	Undet.	38.967		1.0
31040217 - 10	25.132	24.790	25.542	25.155	0.217	Undet.	Undet.	Undet.	38.967		1.0
						36.209	36.919	37.671	36.933	0.422	5.2

31040217 - 5	24.547	24.930	24.847	24.775	0.117	35.345	36.324	36.883	36.184	0.449	6.7
31040217 - 2.5	23.785	24.335	25.267	24.462	0.433	35.688	35.971	36.523	36.061	0.245	5.8
31040217 - 1.25	23.522	23.924	24.384	23.944	0.249	35.989	36.590	35.831	36.137	0.231	3.9
31040217 - 0.625	24.268	24.709	24.875	24.618	0.181	35.589	37.628	36.186	36.468	0.605	4.9
31040217 - 0.3	24.443	24.789	24.625	24.619	0.100	37.833	Undet.	39.120	38.476	0.644	1.2
31040217 - 0.15	25.150	25.011	25.313	25.158	0.087	Undet.	38.691	38.734	38.712	0.022	1.5
31053854 - 10	24.777	24.193	24.641	24.537	0.176	Undet.	Undet.	Undet.			
31053854 - 5	24.637	24.385	24.691	24.571	0.094	Undet.	Undet.	Undet.			
31053854 - 2.5	24.051	24.396	24.033	24.160	0.118	Undet.	Undet.	Undet.			
31053854 - 1.25	23.994	23.713	24.133	23.947	0.123	Undet.	Undet.	Undet.			
31053854 - 0.625	24.437	24.220	23.870	24.175	0.165	Undet.	Undet.	Undet.			
31053854 - 0.3	31.550	24.336	24.094	26.660	2.446	Undet.	Undet.	Undet.			
31053854 - 0.15	23.928	24.158	23.990	24.025	0.069	Undet.	Undet.	Undet.			
27652677 - 10	25.250	24.378	25.188	24.939	0.281	34.816	34.818	35.259	34.964	0.148	17.4
27652677 - 5	24.566	25.182	25.147	24.965	0.200	36.169	36.202	35.943	36.105	0.082	8.0
27652677 - 2.5	23.947	24.313	24.718	24.326	0.223	Undet.	37.575	38.262	37.918	0.343	1.5
27652677 - 1.25	23.626	23.432	24.218	23.759	0.237	Undet.	Undet.	Undet.			
27652677 - 0.625	24.175	24.157	24.390	24.241	0.075	Undet.	Undet.	Undet.			
27652677 - 0.3	24.168	24.024	24.093	24.095	0.041	38.126	Undet.	Undet.	38.126		1.1
27652677 - 0.15	24.083	24.150	24.209	24.148	0.036	Undet.	Undet.	Undet.			
28404844 - 10	24.871	24.460	24.391	24.574	0.150	36.439	35.815	35.287	35.847	0.333	7.3
28404844 - 5	24.313	24.845	24.575	24.578	0.154	35.147	35.902	35.578	35.542	0.219	9.1
28404844 - 2.5	24.669	24.641	24.502	24.604	0.052	34.490	35.225	35.445	35.053	0.289	12.9
28404844 - 1.25	25.192	24.764	24.583	24.846	0.181	35.589	35.070	34.908	35.189	0.205	13.9
28404844 - 0.625	23.716	24.349	23.709	23.925	0.212	34.875	34.681	35.078	34.878	0.114	9.1
28404844 - 0.3	24.314	24.294	23.777	24.128	0.176	36.174	35.414	35.560	35.716	0.233	5.9
28404844 - 0.15	23.887	24.220	24.537	24.215	0.188	37.444	36.090	Undet.	36.767		3.0
26949312 - 10	24.120	24.568	23.828	24.172	0.215	35.274	35.372	39.769	36.805	1.483	2.8
26949312 - 5	25.533	24.509	23.791	24.611	0.506	35.363	35.306	35.734	35.467	0.134	9.8
26949312 - 2.5	24.709	25.296	23.902	24.636	0.404	35.370	35.367	36.890	35.876	0.507	7.5
26949312 - 1.25	23.660	23.190	24.193	23.681	0.290	35.789	34.936	36.215	35.647	0.376	4.5

26949312 - 0.625	24.276	23.284	24.147	23.902	0.311	38.198	36.099	37.896	37.398	0.655	1.6
26949312 - 0.3	23.439	24.406	23.351	23.732	0.338	37.138	39.249	38.950	38.446	0.659	0.7
26949312 - 0.15	24.174	24.056	23.536	23.922	0.196	38.356	Undet.	38.433	38.394	0.039	0.8
28543944 - 10	25.306	26.435	24.692	25.477	0.510	35.410	37.512	35.734	36.219	0.653	10.6
28543944 - 5	24.657	24.080	25.402	24.713	0.383	34.878	35.863	36.609	35.783	0.501	8.4
28543944 - 2.5	23.736	24.072	25.806	24.538	0.642	34.559	35.559	37.287	35.802	0.797	7.4
28543944 - 1.25	23.897	23.331	24.122	23.783	0.235	35.466	35.389	36.261	35.705	0.279	4.7
28543944 - 0.625	24.217	24.081	24.581	24.293	0.149	36.082	38.200	37.353	37.212	0.615	2.3
28543944 - 0.3	24.994	24.387	26.001	25.127	0.471	38.644	38.248	Undet.	38.446		1.8
28543944 - 0.15	25.266	24.555	24.912	24.911	0.205	Undet.	Undet.	39.187	39.187		0.9
28631590 - 10	24.737	24.142	24.856	24.578	0.221	35.810	35.755	36.284	35.950	0.168	6.8
28631590 - 5	24.973	24.748	24.992	24.904	0.078	36.229	36.065	36.230	36.174	0.055	7.3
28631590 - 2.5	25.338	24.195	24.584	24.705	0.336	35.048	34.434	37.759	35.747	1.022	8.6
28631590 - 1.25	24.314	24.110	23.892	24.106	0.122	34.385	34.392	34.731	34.503	0.114	13.4
28631590 - 0.625	24.319	24.150	23.813	24.094	0.149	35.683	35.838	36.587	36.036	0.279	4.6
28631590 - 0.3	24.518	24.526	25.279	24.774	0.252	38.616	Undet.	Undet.	38.616		1.2
28631590 - 0.15	25.046	25.180	24.530	24.919	0.198	Undet.	Undet.	38.393	38.393		1.6

TABLE XIII-D. EFFECTS OF A RANGE OF HDAC INHIBITOR CONCENTRATIONS ON PDX-1 GENE EXPRESSION
IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

Sample ID	GAPDH					PDX1					RQ
	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	replicate 1	replicate 2	replicate 3	Avg Ct	Ct std error	
26949312-10	26.448	25.057	26.003	25.836	0.41	34.880	34.463	34.407	34.583	0.149	1.5
26949312-5	26.255	26.023	25.642	25.973	0.179	34.994	35.507	35.068	35.190	0.160	1.7
26949312-2.5	25.467	25.567	25.04	25.358	0.162	34.855	34.585	34.175	34.538	0.198	2.5
26949312-1.25	25.255	25.919	25.182	25.452	0.235	35.501	35.418	36.239	35.719	0.261	1.5
26949312-0.6	25.894	24.872	25.982	25.582	0.356	36.874	37.669	37.358	37.301	0.231	3.5
26949312-0.3	25.766	26.482	26.42	26.223	0.229	Undet.	Undet.	Undet.			
26949312-0.15	26.148	25.651	26.007	25.935	0.148	39.610	Undet.	Undet.	39.610		
untreated	25.155	25.282	24.491	25.012	0.177	Undet.	Undet.	Undet.			
untreated	24.518	25.032	25.591	25.012	0.177	Undet.	Undet.	Undet.			
untreated	23.971	23.902	23.626	23.713	0.13	Undet.	Undet.	Undet.			
untreated	23.343	24.079	23.356	23.713	0.13	Undet.	Undet.	Undet.			
untreated	23.665	23.605	23.351	23.54	0.096	Undet.	Undet.	Undet.			
untreated	22.711	24.132	23.102	23.157	0.228	Undet.	Undet.	Undet.			
untreated	22.619	23.429	22.946	23.157	0.228	Undet.	Undet.	Undet.			
untreated	25.115	24.958	24.442	24.948	0.142	Undet.	Undet.	Undet.			
untreated	24.642	25.386	25.145	24.948	0.142	Undet.	Undet.	Undet.			
untreated	24.434	23.244	24.613	24.293	0.211	Undet.	Undet.	Undet.			
untreated	24.494	24.471	24.5	24.293	0.211	Undet.	Undet.	Undet.			
28543944-10	24.996	25.183	25.384	25.187	0.112	34.373	34.171	34.239	34.261	0.059	1.2
28543944-5	25.587	25.215	24.7	25.167	0.257	34.541	34.324	33.963	34.276	0.169	1.8
28543944-2.5	24.629	25.097	24.898	24.874	0.136	34.987	34.578	34.544	34.703	0.142	1.6
28543944-1.25	24.503	24.213	24.673	24.463	0.134	34.645	34.463	35.010	34.706	0.161	1.6
28543944-0.6	24.818	25.068	25.269	25.052	0.13	35.881	36.647	37.432	36.654	0.448	3.8
28543944-0.3	25.534	24.953	25.368	25.285	0.173	37.046	Undet.	37.161	37.104	0.058	10.8
28543944-0.15	24.912	25.273	24.778	24.988	0.148	Undet.	Undet.	39.134	39.134		

28631590-10	25.828	25.244	24.508	25.193	0.382	35.365	34.330	34.445	34.713	0.328	0.9
28631590-5	24.97	25.007	24.542	24.84	0.149	33.904	33.720	34.243	33.956	0.153	1.8
28631590-2.5	24.636	24.346	24.129	24.37	0.147	34.082	34.456	34.056	34.198	0.129	1.6
28631590-1.25	24.807	24.817	24.211	24.612	0.2	34.608	34.245	34.213	34.355	0.127	2.5
28631590-0.6	24.806	24.792	25.032	24.877	0.078	34.402	35.116	35.208	34.909	0.255	11.4
28631590-0.3	25.014	24.86	24.97	24.948	0.046	37.170	37.587	38.313	37.690	0.334	5.7
28631590-0.15	24.975	24.384	24.603	24.654	0.172	Undet.	38.059	38.341	38.200	0.141	4.8
TSA 10	24.088	24.18	23.943	24.07	0.069	33.220	33.509	33.418	33.383	0.085	
TSA 5	24.181	23.869	23.934	23.995	0.095	34.219	33.503	34.193	33.972	0.234	
TSA 2.5	23.809	23.453	23.244	23.502	0.165	34.160	34.073	33.853	34.029	0.091	
TSA 1.25	23.38	23.538	22.972	23.297	0.169	33.428	34.285	34.823	34.179	0.406	
TSA 0.6	23.708	23.509	23.369	23.529	0.098	35.218	37.464	38.525	37.069	0.975	
TSA 0.3	23.243	23.353	23.162	23.252	0.055	38.481	37.619	39.413	38.504	0.518	
TSA 0.15	23.757	23.344	23.329	23.476	0.14	39.691	38.881	Undet.	39.286		
31053854-10	23.95	24.213	24.164	24.109	0.081	34.456	34.060	35.137	34.551	0.315	0.5
31053854-5	24.213	23.982	23.683	23.959	0.153	33.752	34.593	35.331	34.559	0.456	0.6
31053854-2.5	23.458	23.25	23.656	23.455	0.117	35.529	37.419	37.660	36.869	0.674	0.1
31053854-1.25	23.12	23.307	23.179	23.202	0.055	38.802	Undet.	Undet.	38.802		
31053854-0.6	23.538	23.383	23.064	23.328	0.14	38.685	Undet.	Undet.	38.685		
31053854-0.3	23.615	23.955	23.548	23.706	0.126	Undet.	Undet.	Undet.			
31053854-0.15	23.692	23.374	23.677	23.581	0.104	Undet.	Undet.	38.037	38.037		
38107992-10	23.412	23.343	23.425	23.393	0.025	34.350	34.777	34.222	34.450	0.168	0.3
38107992-5	23.572	23.435	23.575	23.527	0.046	34.937	35.065	35.059	35.020	0.042	0.3
38107992-2.5	24.128	23.576	23.108	23.604	0.295	34.948	34.541	34.008	34.499	0.272	0.8
38107992-1.25	23.583	23.279	23.341	23.401	0.093	34.621	34.064	33.672	34.119	0.275	1.1
38107992-0.6	23.62	23.347	23.752	23.573	0.119	35.001	33.830	34.246	34.359	0.343	6.7
38107992-0.3	23.552	23.329	23.828	23.569	0.144	34.862	34.486	35.081	34.810	0.174	16.1
38107992-0.15	24.006	23.779	23.658	23.814	0.102	35.970	36.013	36.826	36.270	0.278	10.2
31040074-6.25	26.192	25.514	25.223	25.643	0.287	34.777	34.683	34.357	34.605	0.127	1.3
31040074-3.1	25.313	25.833	25.942	25.696	0.194	33.880	34.662	34.821	34.454	0.291	2.3
31040074-1.56	24.947	25.173	25.52	25.213	0.166	34.942	34.885	35.638	35.155	0.242	1.5

31040074-0.78	24.609	24.91	25.24	24.919	0.182	34.957	34.464	35.647	35.023	0.343	1.7
31040074-0.39	25.807	25.252	25.518	25.526	0.16	35.811	36.152	38.097	36.687	0.712	5.2
31040074-0.2	25.462	25.424	25.405	25.43	0.017	38.438	Undet.	Undet.	38.438		
31040074-0.1	25.444	25.12	25.157	25.24	0.102	Undet.	Undet.	Undet.			
31040217-10	25.645	26.643	25.023	25.771	0.472	34.905	36.254	34.118	35.092	0.624	1.0
31040217-5	24.899	25.387	25.103	25.129	0.141	34.277	34.507	35.221	34.669	0.284	1.4
31040217-2.5	24.928	25.136	25.108	25.057	0.065	34.061	34.010	33.576	33.882	0.154	3.3
31040217-1.25	25.737	25.45	25.269	25.485	0.136	35.123	34.764	35.203	35.030	0.135	2.5
31040217-0.6	25.143	25.711	25.642	25.499	0.179	35.127	35.967	35.948	35.681	0.277	8.5
31040217-0.3	25.342	25.486	25.586	25.471	0.071	37.404	38.012	37.484	37.633	0.191	8.5
31040217-0.15	25.374	25.842	24.962	25.393	0.254	38.193	Undet.	38.627	38.410	0.217	6.9
27652677-10	25.094	25.655	24.988	25.246	0.207	34.189	34.889	34.775	34.618	0.217	1.0
27652677-5	25.306	25.138	24.962	25.135	0.099	34.722	34.870	35.005	34.866	0.082	1.2
27652677-2.5	24.583	24.722	24.091	24.465	0.192	36.261	36.455	35.189	35.969	0.394	0.5
27652677-1.25	25.446	24.477	24.751	24.891	0.288	Undet.	36.790	39.614	38.202	1.412	0.2
27652677-0.6	25.024	25.316	24.827	25.056	0.142	Undet.	Undet.	Undet.			
27652677-0.3	24.997	25.472	24.259	24.909	0.353	Undet.	Undet.	Undet.			
27652677-0.15	25.428	24.982	24.833	25.081	0.179	Undet.	Undet.	Undet.			
28404844-10	24.37	24.307	25.196	24.624	0.287	34.508	33.938	34.491	34.313	0.187	0.8
28404844-5	25.704	24.338	24.919	24.987	0.396	35.323	34.233	34.390	34.649	0.340	1.2
28404844-2.5	24.817	25.298	24.498	24.871	0.232	35.107	34.032	35.117	34.752	0.360	1.2
28404844-1.25	24.805	25.06	24.541	24.802	0.15	35.403	37.184	34.947	35.845	0.682	0.9
28404844-0.6	24.478	25.252	25.057	24.929	0.233	36.445	36.404	35.967	36.272	0.153	4.6
28404844-0.3	25.166	24.565	24.399	24.71	0.233	Undet.	38.756	38.892	38.824	0.068	2.2
28404844-0.15	24.838	25.498	25.135	25.157	0.191	38.107	Undet.	Undet.	38.107		

TABLE XIV. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P19 Cell Treatment	Pdx1		Pancreas		Sample		Pancreas		$\Delta\Delta Ct$		$2^{-(\Delta\Delta Ct)}=RQ$		% RQ		Std err	
	Sample Ct	Pdx1 Ct	Pdx1 Ct	Pdx1 Ct	GAPDH Ct	GAPDH Ct	GAPDH Ct	GAPDH Ct	$\Delta\Delta Ct$	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	% RQ	Std err	Std err
untreated cells	-	-	29.144	29.144	22.091	22.091	27.162	27.162	-	-	-	-	-	-	-	-
medium treated control cells	-	-	28.628	28.628	20.249	20.249	25.471	25.471	-	-	-	-	-	-	-	-
1uM MG132 for 24 hrs	-	-	29.144	29.144	21.634	21.634	27.162	27.162	-	-	-	-	-	-	-	-
10uM MG132 for 24 hrs	-	-	29.144	29.144	22.384	22.384	27.162	27.162	-	-	-	-	-	-	-	-
1.25uM TSA for 24 hrs	34.557	34.557	28.628	28.628	21.045	21.045	25.471	25.471	10.355	10.355	0.001	0.001	0.076	0.076	0.108	0.108
2.5uM TSA for 24 hrs	32.624	32.624	28.628	28.628	20.438	20.438	25.471	25.471	9.029	9.029	0.002	0.002	0.191	0.191	0.162	0.162
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	32.744	32.744	28.628	28.628	20.788	20.788	25.471	25.471	8.799	8.799	0.002	0.002	0.225	0.225	0.258	0.258
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	32.316	32.316	28.628	28.628	20.784	20.784	25.471	25.471	8.375	8.375	0.003	0.003	0.301	0.301	0.143	0.143
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	32.019	32.019	28.628	28.628	22.355	22.355	25.471	25.471	6.507	6.507	0.011	0.011	1.100	1.100	0.034	0.034
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	31.582	31.582	28.628	28.628	22.272	22.272	25.471	25.471	6.153	6.153	0.014	0.014	1.405	1.405	0.077	0.077
H5F3P19 Cell Treatment	HNF3- β		Pancreas		Sample		Pancreas		$\Delta\Delta Ct$		$2^{-(\Delta\Delta Ct)}=RQ$		% RQ		Std err	
	Sample Ct	HNF3- β Ct	HNF3- β Ct	HNF3- β Ct	GAPDH Ct	GAPDH Ct	GAPDH Ct	GAPDH Ct	$\Delta\Delta Ct$	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	% RQ	Std err	Std err
untreated cells	-	-	27.251	27.251	22.091	22.091	27.162	27.162	-	-	-	-	-	-	-	-
medium treated control cells	-	-	27.622	27.622	20.249	20.249	25.471	25.471	-	-	-	-	-	-	-	-
1uM MG132 for 24 hrs	-	-	27.251	27.251	21.634	21.634	27.162	27.162	-	-	-	-	-	-	-	-
10uM MG132 for 24 hrs	-	-	27.251	27.251	22.384	22.384	27.162	27.162	-	-	-	-	-	-	-	-
1.25uM TSA for 24 hrs	34.069	34.069	27.622	27.622	21.045	21.045	25.471	25.471	10.873	10.873	0.001	0.001	0.053	0.053	0.111	0.111
2.5uM TSA for 24 hrs	32.883	32.883	27.622	27.622	20.438	20.438	25.471	25.471	10.294	10.294	0.001	0.001	0.080	0.080	0.170	0.170
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	33.778	33.778	27.622	27.622	20.788	20.788	25.471	25.471	10.839	10.839	0.001	0.001	0.055	0.055	0.219	0.219
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	33.429	33.429	27.622	27.622	20.784	20.784	25.471	25.471	10.494	10.494	0.001	0.001	0.069	0.069	0.213	0.213
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	31.678	31.678	27.622	27.622	22.355	22.355	25.471	25.471	7.172	7.172	0.007	0.007	0.693	0.693	0.078	0.078
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	31.183	31.183	27.622	27.622	22.272	22.272	25.471	25.471	6.760	6.760	0.009	0.009	0.923	0.923	0.136	0.136
H5F3P19 Cell Treatment	Insulin		Pancreas		Sample		Pancreas		$\Delta\Delta Ct$		$2^{-(\Delta\Delta Ct)}=RQ$		% RQ		Std err	
	Sample Ct	Insulin Ct	Insulin Ct	Insulin Ct	GAPDH Ct	GAPDH Ct	GAPDH Ct	GAPDH Ct	$\Delta\Delta Ct$	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	% RQ	Std err	Std err
untreated cells	-	-	18.282	18.282	22.091	22.091	27.162	27.162	-	-	-	-	-	-	-	-
medium treated control cells	-	-	18.011	18.011	20.249	20.249	25.471	25.471	-	-	-	-	-	-	-	-
1uM MG132 for 24 hrs	-	-	18.282	18.282	21.634	21.634	27.162	27.162	-	-	-	-	-	-	-	-

10uM MG132 for 24 hrs	-	18.282	22.384	27.162	-	-	-	-
1.25uM TSA for 24 hrs	-	18.011	21.045	25.471	-	-	-	-
2.5uM TSA for 24 hrs	-	18.011	20.438	25.471	-	-	-	-
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	-	18.011	20.788	25.471	-	-	-	-
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	-	18.011	20.784	25.471	-	-	-	-
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	-	18.011	22.355	25.471	-	-	-	-
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	-	18.011	22.272	25.471	-	-	-	-
H5F3P19 Cell Treatment								
untreated cells	NKX6.1 Sample Ct	Pancreas NKX6.1 Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
medium treated control cells	-	29.679	22.091	27.162	-	-	-	-
1uM MG132 for 24 hrs	-	30.161	20.249	25.471	-	-	-	-
10uM MG132 for 24 hrs	-	29.679	21.634	27.162	-	-	-	-
1.25uM TSA for 24 hrs	36.281	29.679	22.384	27.162	11.380	0.000	0.038	0.211
2.5uM TSA for 24 hrs	30.621	30.161	21.045	25.471	4.886	0.034	3.382	0.110
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	29.323	30.161	20.438	25.471	4.195	0.055	5.460	0.113
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.718	30.161	20.788	25.471	4.240	0.053	5.292	0.080
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	29.122	30.161	20.784	25.471	3.648	0.080	7.977	0.191
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.704	30.161	22.355	25.471	2.659	0.158	15.833	0.017
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.410	30.161	22.272	25.471	2.448	0.183	18.326	0.019

TABLE XV. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P9 Cell Treatment: MG132 followed by TSA	Pdx1 Sample Ct	Pdx1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control	-	28.660	24.340	28.950	-	-	-	-
1uM MG132 for 24 hrs	-	28.660	23.680	28.950	-	-	-	-
10uM MG132 for 24 hrs	-	28.660	23.680	28.950	-	-	-	-
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	35.010	28.660	23.690	28.950	11.610	0.000	0.032	0.100
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	34.060	28.660	23.780	28.950	10.570	0.001	0.066	0.200
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	31.770	28.660	24.040	28.950	8.020	0.004	0.385	0.130
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	33.240	28.660	23.800	28.950	9.730	0.001	0.118	0.170
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	32.120	28.660	25.880	28.950	6.530	0.011	1.082	0.400
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	32.100	28.660	24.370	28.950	8.020	0.004	0.385	0.110
H5F3P9 Cell Treatment: TSA followed by MG132	Pdx1 Sample Ct	Pdx1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control	-	28.660	22.680	28.950	-	-	-	-
1.25uM TSA for 24 hr	34.940	28.660	22.900	28.950	12.330	0.000	0.019	0.260
2.5uM TSA for 24 hr	34.940	28.660	24.310	28.950	10.920	0.001	0.052	0.060
2%DMEM for 24 hrs followed by 1uM MG132 for 24 hrs	-	28.660	25.400	28.950	-	-	-	-
2%DMEM for 24 hrs followed by 10uM MG132 for 24 hrs	-	28.660	24.070	28.950	-	-	-	-
1.25uM TSA for 24 hrs followed by 1uM MG132 for 24 hrs	-	28.660	24.120	28.950	-	-	-	-
1.25uM TSA for 24 hrs followed by 10uM MG132 for 24 hrs	-	28.660	24.250	28.950	-	-	-	-
2.5uM TSA for 24 hrs followed by 1uM MG132 for 24 hrs	-	28.660	24.290	28.950	-	-	-	-
2.5uM TSA for 24 hrs followed by 10uM MG132 for 24 hrs	-	28.660	26.670	28.950	-	-	-	-
H5F3P9 Cell Treatment: MG132 followed by TSA	HNF3- β Sample Ct	HNF3- β Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control	-	26.720	24.340	28.950	-	-	-	-
1uM MG132 for 24 hrs	34.030	26.720	23.680	28.950	12.580	0.000	0.016	0.190
10uM MG132 for 24 hrs	34.550	26.720	23.680	28.950	13.100	0.000	0.011	0.090
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	35.140	26.720	23.690	28.950	13.680	0.000	0.008	0.090

2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	33.290	26.720	23.780	28.950	11.740	0.000	0.029	0.370
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	31.900	26.720	24.040	28.950	10.090	0.001	0.092	0.220
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	34.030	26.720	23.800	28.950	12.460	0.000	0.018	0.350
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	29.770	26.720	25.880	28.950	6.120	0.014	1.438	0.150
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	30.290	26.720	24.370	28.950	8.150	0.004	0.352	0.040
H5F3P9 Cell Treatment: TSA followed by MG132	HNF3-β Sample Ct	HNF3-β Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2^(-ΔΔCt)=RQ	% RQ	Std err
untreated control	-	26.720	22.680	28.950	-	-	-	-
1.25uM TSA for 24 hr	34.120	26.720	22.900	28.950	13.450	0.000	0.009	0.180
2.5uM TSA for 24 hr	34.180	26.720	24.310	28.950	12.100	0.000	0.023	0.450
2%DMEM for 24 hrs followed by 1uM MG132 for 24 hrs	32.830	26.720	25.400	28.950	9.660	0.001	0.124	0.250
2%DMEM for 24 hrs followed by 10uM MG132 for 24 hrs	32.520	26.720	24.070	28.950	10.680	0.001	0.061	0.050
1.25uM TSA for 24 hrs followed by 1uM MG132 for 24 hrs	34.870	26.720	24.120	28.950	12.980	0.000	0.012	0.380
1.25uM TSA for 24 hrs followed by 10uM MG132 for 24 hrs	35.070	26.720	24.250	28.950	13.050	0.000	0.012	0.230
2.5uM TSA for 24 hrs followed by 1uM MG132 for 24 hrs	34.940	26.720	24.290	28.950	12.880	0.000	0.013	0.450
2.5uM TSA for 24 hrs followed by 10uM MG132 for 24 hrs	35.670	26.720	26.670	28.950	11.230	0.000	0.042	0.400
H5F3P9 Cell Treatment: MG132 followed by TSA	Insulin Sample Ct	Insulin Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2^(-ΔΔCt)=RQ	% RQ	Std err
untreated control	-	17.940	24.340	28.950	-	-	-	-
1uM MG132 for 24 hrs	-	17.940	23.680	28.950	-	-	-	-
10uM MG132 for 24 hrs	-	17.940	23.680	28.950	-	-	-	-
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	-	17.940	23.690	28.950	-	-	-	-
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	-	17.940	23.780	28.950	-	-	-	-
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	-	17.940	24.040	28.950	-	-	-	-
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	-	17.940	23.800	28.950	-	-	-	-
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	37.060	17.940	25.880	28.950	22.190	0.000	0.000	0.360
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	-	17.940	24.370	28.950	-	-	-	-
H5F3P9 Cell Treatment: TSA followed by MG132	Insulin Sample Ct	Insulin Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2^(-ΔΔCt)=RQ	% RQ	Std err
untreated control	-	17.940	22.680	28.950	-	-	-	-
1.25uM TSA for 24 hr	-	17.940	22.900	28.950	-	-	-	-
2.5uM TSA for 24 hr	-	17.940	24.310	28.950	-	-	-	-
2%DMEM for 24 hrs followed by 1uM MG132 for 24 hrs	-	17.940	25.400	28.950	-	-	-	-

2%DMEM for 24 hrs followed by 10uM MG132 for 24 hrs	-	17.940	24.070	28.950	-	-	-	-
1.25uM TSA for 24 hrs followed by 1uM MG132 for 24 hrs	-	17.940	24.120	28.950	-	-	-	-
1.25uM TSA for 24 hrs followed by 10uM MG132 for 24 hrs	-	17.940	24.250	28.950	-	-	-	-
2.5uM TSA for 24 hrs followed by 1uM MG132 for 24 hrs	-	17.940	24.290	28.950	-	-	-	-
2.5uM TSA for 24 hrs followed by 10uM MG132 for 24 hrs	-	17.940	26.670	28.950	-	-	-	-
H5F3P9 Cell Treatment: MG132 followed by TSA	NKX6.1	NKX6.1	Sample	Pancreas	ΔΔCt	2^{Δ(-ΔΔCt)}=RQ	% RQ	Std err
untreated control	-	29.120	24.340	28.950	-	-	-	-
1uM MG132 for 24 hrs	33.820	29.120	23.680	28.950	9.970	0.001	0.100	0.000
10uM MG132 for 24 hrs	32.850	29.120	23.680	28.950	9.970	0.001	0.100	0.420
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	30.590	29.120	23.690	28.950	6.730	0.009	0.942	0.060
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	29.830	29.120	23.780	28.950	5.880	0.017	1.698	0.060
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	27.970	29.120	24.040	28.950	3.760	0.074	7.381	0.070
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.310	29.120	23.800	28.950	5.340	0.025	2.469	0.200
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	29.000	29.120	25.880	28.950	2.950	0.129	12.941	0.050
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	28.860	29.120	24.370	28.950	4.320	0.050	5.007	0.100
H5F3P9 Cell Treatment: TSA followed by MG132	NKX6.1	NKX6.1	Sample	Pancreas	ΔΔCt	2^{Δ(-ΔΔCt)}=RQ	% RQ	Std err
untreated control	-	29.120	22.680	28.950	-	-	-	-
1.25uM TSA for 24 hr	29.920	29.120	22.900	28.950	6.850	0.009	0.867	0.000
2.5uM TSA for 24 hr	30.130	29.120	24.310	28.950	5.650	0.020	1.992	0.130
2%DMEM for 24 hrs followed by 1uM MG132 for 24 hrs	32.830	29.120	25.400	28.950	7.260	0.007	0.652	0.250
2%DMEM for 24 hrs followed by 10uM MG132 for 24 hrs	33.200	29.120	24.070	28.950	8.960	0.002	0.201	0.610
1.25uM TSA for 24 hrs followed by 1uM MG132 for 24 hrs	35.950	29.120	24.120	28.950	11.660	0.000	0.031	0.110
1.25uM TSA for 24 hrs followed by 10uM MG132 for 24 hrs	34.700	29.120	24.250	28.950	10.280	0.001	0.080	0.160
2.5uM TSA for 24 hrs followed by 1uM MG132 for 24 hrs	34.820	29.120	24.290	28.950	10.360	0.001	0.076	0.480
2.5uM TSA for 24 hrs followed by 10uM MG132 for 24 hrs	35.400	29.120	26.670	28.950	8.560	0.003	0.265	0.060

TABLE XVI. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P10 Cell Treatment: MG132 followed by TSA	Pdx1 Sample Ct	Pdx1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control	-	28.660	24.010	28.950	-	-	-	-
1uM MG132 for 24 hrs	-	30.110	25.460	33.450	-	-	-	-
10uM MG132 for 24 hrs	-	30.110	25.620	33.450	-	-	-	-
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	36.490	28.660	22.190	28.950	14.590	0.000	0.004	0.850
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	33.270	28.660	21.920	28.950	11.640	0.000	0.031	0.110
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	33.810	30.110	26.470	33.450	10.680	0.001	0.061	0.120
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	33.590	30.110	32.740	33.450	4.190	0.055	5.479	0.200
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	31.530	30.110	25.950	33.450	8.920	0.002	0.206	0.010
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	32.160	28.660	22.570	28.950	9.880	0.001	0.106	0.180
H5F3P19 Cell Treatment: MG132 followed by TSA	Pdx1 Sample Ct	Pdx1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control	-	30.110	26.740	33.450	-	-	-	-
1uM MG132 for 24 hrs	-	28.660	23.870	28.950	-	-	-	-
10uM MG132 for 24 hrs	-	28.660	24.790	28.950	-	-	-	-
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	32.790	28.660	24.650	28.950	8.430	0.003	0.290	0.160
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	30.510	28.660	23.340	28.950	7.460	0.006	0.568	0.100
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	32.120	28.660	24.280	28.950	8.130	0.004	0.357	0.260
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	32.740	28.660	24.710	28.950	8.320	0.003	0.313	0.060
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	32.470	28.660	25.290	28.950	7.470	0.006	0.564	0.160
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	32.310	28.660	25.100	28.950	7.500	0.006	0.552	0.040
H5F3P10 Cell Treatment: MG132 followed by TSA	HNF3- β Sample Ct	HNF3- β Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control	-	26.720	24.010	28.950	-	-	-	-
1uM MG132 for 24 hrs	-	27.920	25.460	33.450	-	-	-	-
10uM MG132 for 24 hrs	37.510	27.920	25.620	33.450	17.420	0.000	0.001	0.730
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	36.000	26.720	22.190	28.950	16.040	0.000	0.001	1.200

2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	33.500	26.720	21.920	28.950	13.810	0.000	0.007	0.300
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	31.690	27.920	26.470	33.450	10.750	0.001	0.058	0.230
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	31.840	27.920	32.740	33.450	4.630	0.040	4.039	0.300
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	28.950	27.920	25.950	33.450	8.530	0.003	0.271	0.040
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	30.410	26.720	22.570	28.950	10.070	0.001	0.093	0.100
H5F3P19 Cell Treatment: MG132 followed by TSA								
untreated control	-	HNF3-β Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2^(-ΔΔCt)=RQ	% RQ	Std err
1uM MG132 for 24 hrs	33.270	27.920	26.740	33.450	-	-	-	-
10uM MG132 for 24 hrs	34.110	26.720	23.870	28.950	11.630	0.000	0.032	0.170
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	32.190	26.720	24.790	28.950	11.550	0.000	0.033	0.280
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	31.720	26.720	24.650	28.950	9.770	0.001	0.115	0.160
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	29.370	26.720	23.340	28.950	10.610	0.001	0.064	0.080
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.940	26.720	24.280	28.950	7.320	0.006	0.626	0.260
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	29.310	26.720	24.710	28.950	7.460	0.006	0.568	0.010
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.840	26.720	25.290	28.950	6.250	0.013	1.314	0.210
H5F3P10 Cell Treatment: MG132 followed by TSA								
untreated control	-	Insulin Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2^(-ΔΔCt)=RQ	% RQ	Std err
1uM MG132 for 24 hrs	-	17.940	24.010	28.950	-	-	-	-
10uM MG132 for 24 hrs	-	19.080	25.460	33.450	-	-	-	-
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	-	19.080	25.620	33.450	-	-	-	-
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	-	17.940	22.190	28.950	-	-	-	-
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	-	17.940	21.920	28.950	-	-	-	-
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	-	19.080	26.470	33.450	-	-	-	-
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	-	19.080	32.740	33.450	-	-	-	-
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	36.000	17.940	25.950	33.450	-	-	-	-
H5F3P19 Cell Treatment: MG132 followed by TSA								
untreated control	-	Insulin Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2^(-ΔΔCt)=RQ	% RQ	Std err
1uM MG132 for 24 hrs	-	19.080	26.740	33.450	-	-	-	-
10uM MG132 for 24 hrs	-	17.940	23.870	28.950	-	-	-	-
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	-	17.940	24.790	28.950	-	-	-	-

2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	-	17.940	23.340	28.950	-	-	-	-
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	36.580	17.940	24.280	28.950	23.310	0.000	0.000	0.760
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	36.430	17.940	24.710	28.950	22.730	0.000	0.000	0.320
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	36.060	17.940	25.290	28.950	21.780	0.000	0.000	1.100
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	-	17.940	25.100	28.950	-	-	-	-
H5F3P10 Cell Treatment: MG132 followed by TSA	NKX6.1	NKX6.1	Sample GAPDH Ct	Pancreas GAPDH Ct	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err	
untreated control	-	29.120	24.010	28.950	-	-	-	-
1uM MG132 for 24 hrs	-	30.240	25.460	33.450	-	-	-	-
10uM MG132 for 24 hrs	34.550	30.240	25.620	33.450	12.140	0.000	0.022	0.380
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	30.640	29.120	22.190	28.950	8.280	0.003	0.322	0.060
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	29.380	29.120	21.920	28.950	7.290	0.006	0.639	0.040
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	30.690	30.240	26.470	33.450	7.430	0.006	0.580	0.070
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	30.740	30.240	32.740	33.450	1.210	0.432	43.227	0.210
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	28.930	30.240	25.950	33.450	6.190	0.014	1.370	0.200
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.290	29.120	22.570	28.950	6.550	0.011	1.067	0.070
H5F3P19 Cell Treatment: MG132 followed by TSA	NKX6.1	NKX6.1	Sample GAPDH Ct	Pancreas GAPDH Ct	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err	
untreated control	-	30.240	26.740	33.450	-	-	-	-
1uM MG132 for 24 hrs	31.930	29.120	23.870	28.950	7.890	0.004	0.422	0.090
10uM MG132 for 24 hrs	32.660	29.120	24.790	28.950	7.700	0.005	0.481	0.350
2% DMEM for 24 hrs followed by 1.25uM TSA for 24 hrs	29.070	29.120	24.650	28.950	4.250	0.053	5.256	0.210
2% DMEM for 24 hrs followed by 2.5uM TSA for 24 hrs	28.690	29.120	23.340	28.950	5.180	0.028	2.758	0.300
1uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	28.290	29.120	24.280	28.950	3.840	0.070	6.983	0.210
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.430	29.120	24.710	28.950	4.550	0.043	4.269	0.230
10uM MG132 for 24 hrs followed by 1.25uM TSA for 24 hrs	29.040	29.120	25.290	28.950	3.580	0.084	8.362	0.400
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24 hrs	29.240	29.120	25.100	28.950	3.970	0.064	6.381	0.020

TABLE XVII. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P10 Cell Treatment: MG132 followed by TSA	Pdx1 Sample Ct	Pdx1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control 3 hrs	-	30.812	21.985	28.330	-	-	-	-
1uM MG132 for 3 hrs	-	30.812	22.223	28.330	-	-	-	-
5uM MG132 for 3 hrs	-	30.812	22.358	28.330	-	-	-	-
10uM MG132 for 3 hrs	-	30.812	23.215	28.330	-	-	-	-
untreated control 6 hrs	-	30.812	22.845	28.330	-	-	-	-
1uM MG132 for 6 hrs	-	30.812	22.134	28.330	-	-	-	-
5uM MG132 for 6 hrs	-	30.812	22.601	28.330	-	-	-	-
10uM MG132 for 6 hrs	-	30.812	23.078	28.330	-	-	-	-
1uM MG132 for 9 hrs	-	30.812	21.710	28.330	-	-	-	-
5uM MG132 for 9 hrs	-	30.812	22.376	28.330	-	-	-	-
10uM MG132 for 9 hrs	-	30.812	22.948	28.330	-	-	-	-
untreated control 12 hrs	-	30.812	22.332	28.330	-	-	-	-
1uM MG132 for 12 hrs	39.852	30.812	22.163	28.330	15.207	0.000	0.003	-
5uM MG132 for 12 hrs	38.040	30.812	22.247	28.330	13.311	0.000	0.010	-
10uM MG132 for 12 hrs	-	30.812	22.265	28.330	-	-	-	-
untreated control 24 hrs	-	30.812	22.426	28.330	-	-	-	-
1uM MG132 for 24 hrs	-	29.282	20.963	27.787	-	-	-	-
5uM MG132 for 24 hrs	-	29.282	21.825	27.787	-	-	-	-
10uM MG132 for 24 hrs	-	29.282	22.143	27.787	-	-	-	-
2.5uM TSA for 24 hrs	35.425	29.282	22.023	27.787	11.907	0.000	0.026	0.978
1uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	37.429	30.812	23.465	28.330	11.482	0.000	0.035	0.173
5uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	35.465	30.812	23.507	28.330	9.476	0.001	0.140	0.346
10uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	33.821	30.812	23.684	28.330	7.655	0.005	0.496	0.159
1uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	36.660	30.812	22.604	28.330	11.574	0.000	0.033	0.491
5uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	32.950	30.812	22.716	28.330	7.752	0.005	0.464	0.021
10uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	32.293	30.812	23.269	28.330	6.542	0.011	1.073	0.168
1uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	35.004	29.282	21.479	27.787	12.030	0.000	0.024	0.003

5uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	33.868	29.282	21.698	27.787	10.675	0.001	0.061	0.050
10uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	32.776	29.282	22.310	27.787	8.971	0.002	0.199	0.175
1uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	35.127	29.282	22.395	27.787	11.237	0.000	0.041	0.969
5uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	33.794	29.282	22.898	27.787	9.401	0.001	0.148	0.342
10uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	33.325	29.282	23.707	27.787	8.123	0.004	0.359	0.112
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	-	29.282	20.116	27.787	-	-	-	-
5uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	34.520	29.282	19.742	27.787	13.283	0.000	0.010	0.235
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	33.216	29.282	20.421	27.787	11.300	0.000	0.040	0.029
H5F3P10 Cell Treatment: MG132 followed by TSA								
untreated control 3 hrs	-	28.3680	21.9850	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{(-\Delta\Delta Ct)}=RQ$	% RQ	Std err
1uM MG132 for 3 hrs	-	28.3680	22.2230	28.3300	-	-	-	-
5uM MG132 for 3 hrs	-	28.3680	22.3580	28.3300	-	-	-	-
10uM MG132 for 3 hrs	-	28.3680	23.2150	28.3300	-	-	-	-
untreated control 6 hrs	-	28.3680	22.8450	28.3300	-	-	-	-
1uM MG132 for 6 hrs	-	28.3680	22.1340	28.3300	-	-	-	-
5uM MG132 for 6 hrs	-	28.3680	22.6010	28.3300	-	-	-	-
10uM MG132 for 6 hrs	37.2890	28.3680	23.0780	28.3300	14.1730	0.0001	0.0054	-
1uM MG132 for 9 hrs	-	28.3680	21.7100	28.3300	-	-	-	-
5uM MG132 for 9 hrs	-	28.3680	22.3760	28.3300	-	-	-	-
10uM MG132 for 9 hrs	-	28.3680	22.9480	28.3300	-	-	-	-
untreated control 12 hrs	-	28.3680	22.3320	28.3300	-	-	-	-
1uM MG132 for 12 hrs	-	28.3680	22.1630	28.3300	-	-	-	-
5uM MG132 for 12 hrs	36.9740	28.3680	22.2470	28.3300	14.6890	0.0000	0.0038	-
10uM MG132 for 12 hrs	37.3820	28.3680	22.2650	28.3300	15.0790	0.0000	0.0029	0.1310
untreated control 24 hrs	-	28.3680	22.4260	28.3300	-	-	-	-
1uM MG132 for 24 hrs	-	28.5450	20.9630	27.7870	-	-	-	-
5uM MG132 for 24 hrs	35.8470	28.5450	21.8250	27.7870	13.2640	0.0001	0.0102	0.3366
10uM MG132 for 24 hrs	33.3790	28.5450	22.1430	27.7870	10.4780	0.0007	0.0701	0.6053
2.5uM TSA for 24 hrs	36.1230	28.5450	22.0230	27.7870	13.3420	0.0001	0.0096	0.5317
1uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	37.1680	28.3680	23.4650	28.3300	13.6650	0.0001	0.0077	-
5uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	37.6040	28.3680	23.5070	28.3300	14.0590	0.0001	0.0059	1.0580
10uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	34.5960	28.3680	23.6840	28.3300	10.8740	0.0005	0.0533	0.0290

	Insulin Sample Ct	Insulin Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
1uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	35.6510	28.3680	22.6040	28.3300	13.0090	0.0001	0.0121	0.4200
5uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	33.7310	28.3680	22.7160	28.3300	10.9770	0.0005	0.0496	0.0870
10uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	32.5800	28.3680	23.2690	28.3300	9.2730	0.0016	0.1616	0.2290
1uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	35.3600	28.5450	21.4790	27.7870	13.1230	0.0001	0.0112	1.4927
5uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	34.3150	28.5450	21.6980	27.7870	11.8590	0.0003	0.0269	0.0007
10uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	34.0920	28.5450	22.3100	27.7870	11.0240	0.0005	0.0480	0.1626
1uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	36.3570	28.5450	22.3950	27.7870	13.2040	0.0001	0.0106	1.0557
5uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	34.4540	28.5450	22.8980	27.7870	10.7980	0.0006	0.0562	0.6336
10uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	32.9030	28.5450	23.7070	27.7870	8.4380	0.0029	0.2883	0.1704
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	36.5240	28.5450	20.1160	27.7870	15.6500	0.0000	0.0019	0.6215
5uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	34.5550	28.5450	19.7420	27.7870	14.0550	0.0001	0.0059	0.8330
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	30.7860	28.5450	20.4210	27.7870	9.6070	0.0013	0.1282	0.6081
H5F3P10 Cell Treatment: MG132 followed by TSA								
untreated control 3 hrs	-	19.823	21.985	28.330	-	-	-	-
1uM MG132 for 3 hrs	-	19.823	22.223	28.330	-	-	-	-
5uM MG132 for 3 hrs	-	19.823	22.358	28.330	-	-	-	-
10uM MG132 for 3 hrs	-	19.823	23.215	28.330	-	-	-	-
untreated control 6 hrs	-	19.823	22.845	28.330	-	-	-	-
1uM MG132 for 6 hrs	-	19.823	22.134	28.330	-	-	-	-
5uM MG132 for 6 hrs	-	19.823	22.601	28.330	-	-	-	-
10uM MG132 for 6 hrs	-	19.823	23.078	28.330	-	-	-	-
1uM MG132 for 9 hrs	-	19.823	21.710	28.330	-	-	-	-
5uM MG132 for 9 hrs	-	19.823	22.376	28.330	-	-	-	-
10uM MG132 for 9 hrs	-	19.823	22.948	28.330	-	-	-	-
untreated control 12 hrs	-	19.823	22.332	28.330	-	-	-	-
1uM MG132 for 12 hrs	-	19.823	22.163	28.330	-	-	-	-
5uM MG132 for 12 hrs	-	19.823	22.247	28.330	-	-	-	-
10uM MG132 for 12 hrs	-	19.823	22.265	28.330	-	-	-	-
untreated control 24 hrs	-	19.823	22.426	28.330	-	-	-	-
1uM MG132 for 24 hrs	-	19.135	20.963	27.787	-	-	-	-
5uM MG132 for 24 hrs	-	19.135	21.825	27.787	-	-	-	-
10uM MG132 for 24 hrs	-	19.135	22.143	27.787	-	-	-	-

2.5uM TSA for 24 hrs	-	19.823	22.124	28.330	-	-	-	-
1uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	-	19.823	23.465	28.330	-	-	-	-
5uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	-	19.823	23.507	28.330	-	-	-	-
10uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	-	19.823	23.684	28.330	-	-	-	-
1uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	-	19.823	22.604	28.330	-	-	-	-
5uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	-	19.823	22.716	28.330	-	-	-	-
10uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	-	19.823	23.269	28.330	-	-	-	-
1uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	-	19.135	21.479	27.787	-	-	-	-
5uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	-	19.135	21.698	27.787	-	-	-	-
10uM MG132 for 9 hrs followed by 2.5uM TSA for 24hrs	-	19.135	22.310	27.787	-	-	-	-
1uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	-	19.135	22.395	27.787	-	-	-	-
5uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	-	19.135	22.898	27.787	-	-	-	-
10uM MG132 for 12 hrs followed by 2.5uM TSA for 24hrs	-	19.135	23.707	27.787	-	-	-	-
1uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	-	19.135	20.116	27.787	-	-	-	-
5uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	-	19.135	19.742	27.787	-	-	-	-
10uM MG132 for 24 hrs followed by 2.5uM TSA for 24hrs	-	19.135	20.421	27.787	-	-	-	-
H5F3P10 Cell Treatment: MG132 followed by TSA	NKX6.1 Sample Ct	NKX6.1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control 3 hrs	-	29.877	21.985	28.330	-	-	-	-
1uM MG132 for 3 hrs	-	29.877	22.223	28.330	-	-	-	-
5uM MG132 for 3 hrs	37.817	29.877	22.358	28.330	13.912	0.000	0.006	0.455
10uM MG132 for 3 hrs	35.781	29.877	23.215	28.330	11.019	0.000	0.048	-
untreated control 6 hrs	-	29.877	22.845	28.330	-	-	-	-
1uM MG132 for 6 hrs	-	29.877	22.134	28.330	-	-	-	-
5uM MG132 for 6 hrs	36.014	29.877	22.601	28.330	-	-	-	-
10uM MG132 for 6 hrs	36.808	29.877	23.078	28.330	12.183	0.000	0.022	0.725
untreated control 24 hrs	-	29.877	22.426	28.330	-	-	-	-
2.5uM TSA for 24 hrs	32.336	29.877	22.124	28.330	8.665	0.002	0.246	0.026
1uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	31.999	29.877	23.465	28.330	6.987	0.008	0.788	0.060
5uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	31.784	29.877	23.507	28.330	6.730	0.009	0.942	0.050
10uM MG132 for 3 hrs followed by 2.5uM TSA for 24hrs	30.182	29.877	23.684	28.330	4.951	0.032	3.233	0.037
1uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	31.042	29.877	22.604	28.330	6.891	0.008	0.843	0.056
5uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	29.876	29.877	22.716	28.330	5.613	0.020	2.043	0.111

10uM MG132 for 6 hrs followed by 2.5uM TSA for 24hrs	29.460	29.877	23.269	28.330	4.644	0.040	4.000	0.022
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TABLE XVIII. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P19 Cell Treatment: MG132 followed by TSA	Pdx1 Sample Ct	Pdx1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2 ^{Δ(-ΔΔCt)} =RQ	% RQ	Std err
untreated control	-	27.909	19.927	25.975	-	-	-	-
1uM MG132 for 6 hrs	-	27.909	19.311	25.975	-	-	-	-
5uM MG132 for 6 hrs	-	27.909	19.494	25.975	-	-	-	-
10uM MG132 for 6 hrs	-	27.909	19.657	25.975	-	-	-	-
1uM MG132 for 24 hrs	-	27.909	19.446	25.975	-	-	-	-
10uM MG132 for 24 hrs	-	27.909	19.417	25.975	-	-	-	-
1.25uM TSA for 24 hrs	33.243	27.909	19.373	25.975	11.936	0.000	0.03	0.357
2.5uM TSA for 24 hrs	32.933	27.909	21.176	25.975	9.823	0.001	0.11	0.095
1uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	-	27.909	22.139	25.975	-	-	-	-
5uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	32.011	27.909	21.967	25.975	8.11	0.004	0.36	-
10uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	31.636	27.909	22.111	25.975	7.591	0.005	0.52	-
1uM MG132 for 24 hrs followed by 1.25 TSA for 24hrs	31.097	27.909	20.151	25.975	9.012	0.002	0.19	0.123
10uM MG132 for 24 hrs followed by 1.25 TSA for 24hrs	31.191	27.909	20.096	25.975	9.161	0.002	0.17	0.125
1uM MG132 for 24 hrs followed by 2.5 TSA for 24hrs	30.257	27.909	19.387	25.975	8.936	0.002	0.20	0.153
10uM MG132 for 24 hrs followed by 2.5 TSA for 24hrs	30.81	27.909	20.03	25.975	8.846	0.002	0.22	0.165
H5F3P19 Cell Treatment: MG132 followed by TSA	HNF3-β Sample Ct	HNF3-β Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2 ^{Δ(-ΔΔCt)} =RQ	% RQ	Std err
untreated control	-	26.893	19.927	25.975	-	-	-	-
1uM MG132 for 6 hrs	-	26.893	19.311	25.975	-	-	-	-
5uM MG132 for 6 hrs	-	26.893	19.494	25.975	-	-	-	-
10uM MG132 for 6 hrs	-	26.893	19.657	25.975	-	-	-	-
1uM MG132 for 24 hrs	33.47	26.893	19.446	25.975	13.106	0.000	0.01	0.9
10uM MG132 for 24 hrs	35.725	26.893	19.417	25.975	15.39	0.000	0.00	-
1.25uM TSA for 24 hrs	32.75	26.893	19.373	25.975	12.459	0.000	0.02	0.598
2.5uM TSA for 24 hrs	-	26.893	21.176	25.975	-	-	-	-
1uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	-	26.893	22.139	25.975	-	-	-	-
5uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	32.191	26.893	21.967	25.975	9.306	0.002	0.16	0.066

10uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	32.385	26.893	22.111	25.975	9.356	0.002	0.15	0.384
1uM MG132 for 24 hrs followed by 1.25 TSA for 24hrs	31.771	26.893	20.151	25.975	10.702	0.001	0.06	0.384
10uM MG132 for 24 hrs followed by 1.25 TSA for 24hrs	28.537	26.893	20.096	25.975	7.523	0.005	0.54	0.091
1uM MG132 for 24 hrs followed by 2.5 TSA for 24hrs	31.196	26.893	19.387	25.975	10.891	0.001	0.05	0.459
10uM MG132 for 24 hrs followed by 2.5 TSA for 24hrs	28.39	26.893	20.03	25.975	7.442	0.006	0.58	0.088
H5F3P19 Cell Treatment: MG132 followed by TSA								
untreated control	-	15.946	19.927	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
1uM MG132 for 6 hrs	-	15.946	19.311	25.975	-	-	-	-
5uM MG132 for 6 hrs	-	15.946	19.494	25.975	-	-	-	-
10uM MG132 for 6 hrs	-	15.946	19.657	25.975	-	-	-	-
1uM MG132 for 24 hrs	-	15.946	19.446	25.975	-	0.000	0.00	-
10uM MG132 for 24 hrs	-	15.946	19.417	25.975	-	-	-	-
1.25uM TSA for 24 hrs	-	15.946	19.373	25.975	-	-	-	-
2.5uM TSA for 24 hrs	-	15.946	21.176	25.975	-	-	-	-
1uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	-	15.946	22.139	25.975	-	-	-	-
5uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	-	15.946	21.967	25.975	-	-	-	-
10uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	-	15.946	22.111	25.975	-	-	-	-
1uM MG132 for 24 hrs followed by 1.25 TSA for 24hrs	-	15.946	20.151	25.975	-	-	-	-
10uM MG132 for 24 hrs followed by 1.25 TSA for 24hrs	-	15.946	20.096	25.975	-	-	-	-
1uM MG132 for 24 hrs followed by 2.5 TSA for 24hrs	-	15.946	19.387	25.975	-	-	-	-
10uM MG132 for 24 hrs followed by 2.5 TSA for 24hrs	-	15.946	20.03	25.975	-	-	-	-
H5F3P19 Cell Treatment: MG132 followed by TSA								
untreated control	NKX6.1 Sample Ct	NKX6.1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
1uM MG132 for 6 hrs	-	28.463	19.927	25.975	-	-	-	-
5uM MG132 for 6 hrs	-	28.463	19.311	25.975	-	-	-	-
10uM MG132 for 6 hrs	-	28.463	19.494	25.975	-	-	-	-
1uM MG132 for 24 hrs	35.307	28.463	19.657	25.975	14.732	0.000	0.00	0.092
10uM MG132 for 24 hrs	33.673	28.463	19.446	25.975	24.256	0.000	5E-06	0.187
1.25uM TSA for 24 hrs	-	28.463	19.417	25.975	-	-	-	-
2.5uM TSA for 24 hrs	29.345	28.463	19.373	25.975	9.054	0.002	0.19	0.169
1uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	29.898	28.463	21.176	25.975	7.804	0.004	0.45	0.217
	-	28.463	22.139	25.975	-	-	-	-

5uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	28.976	28.463	21.967	25.975	6.091	0.015	1.47	0.06
10uM MG132 for 6 hrs followed by 2.5uM TSA for 24 hrs	28.874	28.463	22.111	25.975	5.845	0.017	1.74	0.108
1uM MG132 for 24 hrs followed by 1.25 TSA for 24hrs	28.299	28.463	20.151	25.975	7.23	0.007	0.67	0.159
10uM MG132 for 24 hrs followed by 1.25 TSA for 24hrs	27.869	28.463	20.096	25.975	6.855	0.009	0.86	0.092
1uM MG132 for 24 hrs followed by 2.5 TSA for 24hrs	27.306	28.463	19.387	25.975	7.001	0.008	0.78	0.158
10uM MG132 for 24 hrs followed by 2.5 TSA for 24hrs	27.516	28.463	20.03	25.975	6.568	0.011	1.05	0.093

TABLE XIX. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P13 Cell Treatment	Pdx1 Sample Ct	Pdx1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct
untreated in 2% DMEM for 24 hrs	38.337	31.818	25.543	31.010
untreated in 2% DMEM for 24 hrs followed by 2% DMEM for 3 days	37.797	31.818	25.765	31.010
untreated in 2% DMEM for 24 hrs followed by 2% DMEM for 3 days followed by Diff Med #2 for 3 days	37.892	31.818	24.877	31.010
untreated in 2% DMEM for 24 hrs followed by 2% DMEM for 7 days	37.045	31.818	24.869	31.010
1uM MG132 for 6hr in 2% DMEM	-	31.818	24.532	31.010
1uM MG132 for 24hr in 2% DMEM	39.237	31.818	25.014	31.010
2.5 uM TSA for 6hr in 2% DMEM	38.426	31.818	24.333	31.010
2.5 uM TSA for 24hr in 2% DMEM	34.854	31.818	24.767	31.010
2.5uM TSA for 6hr followed by 2% DMEM for 7days	37.983	31.818	24.967	31.010
2.5uM TSA for 24hr followed by 2% DMEM for 7days	-	31.818	25.206	31.010
2.5uM TSA for 24hr followed by Diff Med #2 for 7days	37.075	31.818	24.013	31.010
2.5uM TSA for 6hr followed by Diff Med #2 for 7days	39.025	31.818	24.479	31.010
1uM MG132 for 6hr followed by 2% DMEM for 3 days	37.269	31.818	24.908	31.010
1uM MG132 for 24hr followed by 2% DMEM for 3 days	-	31.818	24.506	31.010
1uM MG132 for 6hr followed by 2% DMEM for 7 days	38.911	31.818	24.958	31.010
1uM MG132 for 24hr followed by 2% DMEM for 7 days	38.234	31.818	25.276	31.010
2.5uM MG132 for 6hr followed by 2% DMEM for 3 days	38.007	31.818	24.936	31.010
2.5uM MG132 for 24hr followed by 2% DMEM for 3 days	37.901	31.818	25.516	31.010
1uM MG132 for 6hr followed by Diff Med #2 for 3 days	39.010	31.818	24.845	31.010
1uM MG132 for 24hr followed by Diff Med #2 for 3 days	-	31.818	24.995	31.010
1uM MG132 for 6hr followed by Diff Med #2 for 7 days	38.046	31.818	24.548	31.010
1uM MG132 for 24hr followed by Diff Med #2 for 7 days	38.621	31.818	24.656	31.010
2.5uM MG132 for 6hr followed by Diff Med #2 for 3 days	37.935	31.818	25.791	31.010
2.5uM MG132 for 24hr followed by Diff Med #2 for 3 days	38.796	31.818	25.194	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 6hr	36.120	31.818	23.972	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 24hr	34.479	31.818	24.611	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 6hr	35.070	31.818	24.518	31.010

1uM MG132 for 24hr followed by 2.5uM TSA for 24hr	34.241	31.818	24.438	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 6hr followed by 2% DMEM for 3 days	38.802	31.818	24.801	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 24hr followed by 2% DMEM for 3 days	38.746	31.818	24.676	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 6hr followed by 2% DMEM for 3 days	38.425	31.818	24.705	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 24hr followed by 2% DMEM for 3 days	37.637	31.818	23.958	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 6hr followed by 2% DMEM for 7 days	-	31.818	23.831	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 6hr followed by 2% DMEM for 7 days	38.685	31.818	24.571	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 24hr followed by 2% DMEM for 7 days	-	31.818	24.951	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 6hr followed by Diff Med #2 for 3 days	38.550	31.818	25.409	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 24hr followed by Diff Med #2 for 3 days	37.667	31.818	24.563	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 6hr followed by Diff Med #2 for 7 days	38.933	31.818	24.777	31.010
1uM MG132 for 6hr followed by 2.5uM TSA for 24hr followed by Diff Med #2 for 7 days	37.276	31.818	24.170	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 6hr followed by Diff Med #2 for 3 days	38.992	31.818	25.133	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 24hr followed by Diff Med #2 for 3 days	38.771	31.818	26.999	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 6hr followed by Diff Med #2 for 7 days	37.788	31.818	24.970	31.010
1uM MG132 for 24hr followed by 2.5uM TSA for 24hr followed by Diff Med #2 for 7 days	38.805	31.818	24.862	31.010

TABLE XX. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P15 Cell Treatment: GSI followed by TSA	Pdx1 Sample Ct	Pdx1 Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control	-	27.909	19.788	25.975	-	-	-	-
1uM GSI-IX for 24hrs	-	27.909	20.2	25.975	-	-	-	-
10uM GSI-IX for 24hrs	-	27.909	21.3	25.975	-	-	-	-
1uM GSI-X for 24hrs	-	27.909	20.645	25.975	-	-	-	-
10uM GSI-X for 24hrs	-	27.909	20.151	25.975	-	-	-	-
1.25uM TSA for 24hrs	-	27.179	21.658	25.937	-	-	-	-
2.5uM TSA for 24hrs	31.020	27.179	20.985	25.937	8.79	0.002	0.23	0.197
1uM GSI-IX for 24hrs followed by 1.25uM TSA for 24hrs	33.679	27.179	21.849	25.937	10.6	0.001	0.06	0.217
10uM GSI-IX for 24hrs followed by 1.25uM TSA for 24hrs	37.125	27.179	22.004	25.937	13.9	0.000	0.01	1.372
1uM GSI-IX for 24hrs followed by 2.5uM TSA for 24hrs	31.457	27.179	21.573	25.937	8.64	0.003	0.25	0.094
10uM GSI-IX for 24hrs followed by 2.5uM TSA for 24hrs	31.156	27.179	20.99	25.937	8.92	0.002	0.21	0.175
1uM GSI-X for 24hrs followed by 1.25uM TSA for 24hrs	36.200	27.179	21.388	25.937	13.6	0.000	0.01	1.84
10uM GSI-X for 24hrs followed by 1.25uM TSA for 24hrs	31.579	27.179	19.682	25.937	10.7	0.001	0.06	0.182
1uM GSI-X for 24hrs followed by 2.5uM TSA for 24hrs	30.473	27.179	20.308	25.937	8.92	0.002	0.21	0.252
10uM GSI-X for 24hrs followed by 2.5uM TSA for 24hrs	31.243	27.179	20.775	25.937	9.23	0.002	0.17	0.047
H5F3P15 Cell Treatment: GSI followed by TSA	HNF3- β Sample Ct	HNF3- β Pancreas Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
untreated control	-	26.893	19.788	25.975	-	-	-	-
1uM GSI-IX for 24hrs	-	26.893	20.2	25.975	-	-	-	-
10uM GSI-IX for 24hrs	-	26.893	21.3	25.975	-	-	-	-
1uM GSI-X for 24hrs	-	26.893	20.645	25.975	-	-	-	-
10uM GSI-X for 24hrs	-	26.893	20.151	25.975	-	-	-	-
1.25uM TSA for 24hrs	34.563	27.109	21.658	25.937	11.7	0.000	0.03	0.533
2.5uM TSA for 24hrs	32.406	27.109	20.985	25.937	10.2	0.001	0.08	0.314
1uM GSI-IX for 24hrs followed by 1.25uM TSA for 24hrs	34.082	27.109	21.849	25.937	11.1	0.000	0.05	0.949
10uM GSI-IX for 24hrs followed by 1.25uM TSA for 24hrs	34.849	27.109	22.004	25.937	11.7	0.000	0.03	0.428
1uM GSI-IX for 24hrs followed by 2.5uM TSA for 24hrs	32.355	27.109	21.573	25.937	9.61	0.001	0.13	0.086

10uM GSI-IX for 24hrs followed by 2.5uM TSA for 24hrs	32.290	27.109	20.99	25.937	10.1	0.001	0.09	0.25
1uM GSI-X for 24hrs followed by 1.25uM TSA for 24hrs	35.057	27.109	21.388	25.937	12.5	0.000	0.02	
10uM GSI-X for 24hrs followed by 1.25uM TSA for 24hrs	31.610	27.109	19.682	25.937	10.8	0.001	0.06	0.05
1uM GSI-X for 24hrs followed by 2.5uM TSA for 24hrs	31.889	27.109	20.308	25.937	10.4	0.001	0.07	0.35
10uM GSI-X for 24hrs followed by 2.5uM TSA for 24hrs	31.866	27.109	20.775	25.937	9.92	0.001	0.10	0.032
H5F3P15 Cell Treatment: GSI followed by TSA								
untreated control	-	15.946	19.788	25.975	-	-	-	-
1uM GSI-IX for 24hrs	-	15.946	20.2	25.975	-	-	-	-
10uM GSI-IX for 24hrs	-	15.946	21.3	25.975	-	-	-	-
1uM GSI-X for 24hrs	-	15.946	20.645	25.975	-	-	-	-
10uM GSI-X for 24hrs	-	15.946	20.151	25.975	-	-	-	-
1.25uM TSA for 24hrs	-	15.946	21.074	25.975	-	-	-	-
2.5uM TSA for 24hrs	-	15.692	21.375	25.975	-	-	-	-
1uM GSI-IX for 24hrs followed by 1.25uM TSA for 24hrs	-	15.692	21.849	25.937	-	-	-	-
10uM GSI-IX for 24hrs followed by 1.25uM TSA for 24hrs	-	15.692	22.004	25.937	-	-	-	-
1uM GSI-IX for 24hrs followed by 2.5uM TSA for 24hrs	-	15.692	21.573	25.937	-	-	-	-
10uM GSI-IX for 24hrs followed by 2.5uM TSA for 24hrs	-	15.692	20.99	25.937	-	-	-	-
1uM GSI-X for 24hrs followed by 1.25uM TSA for 24hrs	-	15.692	21.388	25.937	-	-	-	-
10uM GSI-X for 24hrs followed by 1.25uM TSA for 24hrs	-	15.692	19.682	25.937	-	-	-	-
1uM GSI-X for 24hrs followed by 2.5uM TSA for 24hrs	-	15.692	20.308	25.937	-	-	-	-
10uM GSI-X for 24hrs followed by 2.5uM TSA for 24hrs	-	15.692	20.775	25.937	-	-	-	-
H5F3P15 Cell Treatment: GSI followed by TSA								
untreated control	-	28.463	19.788	25.975	-	-	-	-
1uM GSI-IX for 24hrs	-	28.463	20.2	25.975	-	-	-	-
10uM GSI-IX for 24hrs	-	28.463	21.3	25.975	-	-	-	-
1uM GSI-X for 24hrs	-	28.463	20.645	25.975	-	-	-	-
10uM GSI-X for 24hrs	-	28.463	20.151	25.975	-	-	-	-
1.25uM TSA for 24hrs	30.915	29.081	21.658	25.937	6.11	0.014	1.44	0.128
2.5uM TSA for 24hrs	31.398	29.081	20.985	25.937	7.27	0.006	0.65	2.977
1uM GSI-IX for 24hrs followed by 1.25uM TSA for 24hrs	30.351	29.081	21.849	25.937	5.36	0.024	2.44	0.212
10uM GSI-IX for 24hrs followed by 1.25uM TSA for 24hrs	31.283	29.081	22.004	25.937	6.14	0.014	1.42	0.144

1uM GSI-IX for 24hrs followed by 2.5uM TSA for 24hrs	29.346	29.081	21.573	25.937	4.63	0.040	4.04	0.108
10uM GSI-IX for 24hrs followed by 2.5uM TSA for 24hrs	28.702	29.081	20.99	25.937	4.57	0.042	4.22	0.431
1uM GSI-X for 24hrs followed by 1.25uM TSA for 24hrs	31.849	29.081	21.388	25.937	7.32	0.006	0.63	0.321
10uM GSI-X for 24hrs followed by 1.25uM TSA for 24hrs	28.281	29.081	19.682	25.937	5.46	0.023	2.28	0.08
1uM GSI-X for 24hrs followed by 2.5uM TSA for 24hrs	28.241	29.081	20.308	25.937	4.79	0.036	3.62	0.132
10uM GSI-X for 24hrs followed by 2.5uM TSA for 24hrs	28.456	29.081	20.775	25.937	4.54	0.043	4.31	0.1

TABLE XXI. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P16 Cell Treatment	Pdx1 Sample Ct	Pancreas Pdx1 Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	$\Delta\Delta Ct$	$2^{-(\Delta\Delta Ct)}=RQ$	% RQ	Std err
Untreated 1 day control	-	27.825	20.774	24.365	-	-	-	-
1uM MG132 x 1 day	-	27.825	20.564	24.365	-	-	-	-
5uM MG132 x 1 day	-	27.825	20.693	24.365	-	-	-	-
10uM MG132 x 1 day	-	27.825	20.783	24.365	-	-	-	-
Untreated 2 day control	-	27.825	21.227	24.365	-	-	-	-
5uM JNJ 27652677 x 1 day	35.239	27.825	22.388	24.365	9.392	1.49E-03	0.149	0.105
1uM MG132 x 1 day + 1.25uM JNJ 27652677 x 1 day	33.611	27.825	20.536	24.365	9.615	1.28E-03	0.128	0.245
1uM MG132 x 1 day + 2.5uM JNJ 27652677 x 1 day	34.801	27.825	21.766	24.365	9.576	1.31E-03	0.131	0.012
1uM MG132 x 1 day + 5uM JNJ 27652677 x 1 day	33.995	27.825	21.092	24.365	9.443	1.44E-03	0.144	0.015
5uM MG132 x 1 day + 1.25uM JNJ 27652677 x 1 day	35.160	27.825	24.274	24.365	7.426	5.81E-03	0.581	0.063
5uM MG132 x 1 day + 2.5uM JNJ 27652677 x 1 day	33.393	27.825	21.658	24.365	8.275	3.23E-03	0.323	0.185
5uM MG132 x 1 day + 5uM JNJ 27652677 x 1 day	34.363	27.825	22.892	24.365	8.011	3.88E-03	0.388	0.387
10uM MG132 x 1 day + 1.25uM JNJ 27652677 x 1 day	34.767	27.825	24.048	24.365	7.259	6.53E-03	0.653	0.023
10uM MG132 x 1 day + 2.5uM JNJ 27652677 x 1 day	36.324	27.825	25.043	24.365	7.822	4.42E-03	0.442	0.346
10uM MG132 x 1 day + 5uM JNJ 27652677 x 1 day	35.542	27.825	24.012	24.365	8.070	3.72E-03	0.372	0.070
5uM JNJ 28404844 x 1 day	35.378	27.825	22.218	24.365	9.700	1.20E-03	0.120	0.175
1uM MG132 x 1 day + 1.25uM JNJ 28404844 x 1 day	33.580	27.825	20.354	24.365	9.766	1.15E-03	0.115	0.083
1uM MG132 x 1 day + 2.5uM JNJ 28404844 x 1 day	33.186	27.825	20.163	24.365	9.563	1.32E-03	0.132	0.005
1uM MG132 x 1 day + 5uM JNJ 28404844 x 1 day	34.044	27.825	21.446	24.365	9.139	1.77E-03	0.177	0.073
5uM MG132 x 1 day + 1.25uM JNJ 28404844 x 1 day	35.210	27.825	23.279	24.365	8.470	2.82E-03	0.282	0.406
5uM MG132 x 1 day + 2.5uM JNJ 28404844 x 1 day	34.830	27.825	23.586	24.365	7.784	4.54E-03	0.454	0.032
5uM MG132 x 1 day + 5uM JNJ 28404844 x 1 day	34.499	27.825	23.079	24.365	7.959	4.02E-03	0.402	0.222
10uM MG132 x 1 day + 1.25uM JNJ 28404844 x 1 day	35.002	27.825	23.845	24.365	7.697	4.82E-03	0.482	0.254
10uM MG132 x 1 day + 2.5uM JNJ 28404844 x 1 day	34.394	27.825	23.502	24.365	7.432	5.79E-03	0.579	0.258
10uM MG132 x 1 day + 5uM JNJ 28404844 x 1 day	35.563	27.825	23.604	24.365	8.499	2.76E-03	0.276	0.128
5uM JNJ 28543944 x 1 day	34.746	27.825	21.387	24.365	9.899	1.05E-03	0.105	0.394

1uM MG132 x 1 day + 1.25uM JNJ 28543944 x 1 day	35.545	27.825	23.158	24.365	8.927	2.06E-03	0.206	0.048
1uM MG132 x 1 day + 2.5uM JNJ 28543944 x 1 day	35.677	27.825	23.075	24.365	9.142	1.77E-03	0.177	0.315
1uM MG132 x 1 day + 5uM JNJ 28543944 x 1 day	36.178	27.825	23.144	24.365	9.574	1.31E-03	0.131	0.379
5uM MG132 x 1 day + 1.25uM JNJ 28543944 x 1 day	36.310	27.825	24.379	24.365	8.471	2.82E-03	0.282	0.375
5uM MG132 x 1 day + 2.5uM JNJ 28543944 x 1 day	36.023	27.825	23.992	24.365	8.571	2.63E-03	0.263	0.421
5uM MG132 x 1 day + 5uM JNJ 28543944 x 1 day	36.257	27.825	24.519	24.365	8.278	3.22E-03	0.322	0.234
10uM MG132 x 1 day + 1.25uM JNJ 28543944 x 1 day	36.384	27.825	24.497	24.365	8.427	2.90E-03	0.290	0.276
10uM MG132 x 1 day + 2.5uM JNJ 28543944 x 1 day	35.638	27.825	23.767	24.365	8.411	2.94E-03	0.294	0.383
10uM MG132 x 1 day + 5uM JNJ 28543944 x 1 day	36.448	27.825	24.846	24.365	8.143	3.54E-03	0.354	0.260
5uM JNJ 28631590 x 1 day	36.286	27.825	21.874	24.365	10.952	5.05E-04	0.050	0.357
1uM MG132 x 1 day + 1.25uM JNJ 28631590 x 1 day	35.219	27.825	22.349	24.365	9.409	1.47E-03	0.147	0.320
1uM MG132 x 1 day + 2.5uM JNJ 28631590 x 1 day	35.248	27.825	22.024	24.365	9.764	1.15E-03	0.115	0.104
1uM MG132 x 1 day + 5uM JNJ 28631590 x 1 day	36.724	27.825	22.806	24.365	10.458	7.11E-04	0.071	0.011
5uM MG132 x 1 day + 1.25uM JNJ 28631590 x 1 day	36.048	27.825	24.140	24.365	8.448	2.86E-03	0.286	0.438
5uM MG132 x 1 day + 2.5uM JNJ 28631590 x 1 day	35.718	27.825	24.052	24.365	8.206	3.39E-03	0.339	0.273
5uM MG132 x 1 day + 5uM JNJ 28631590 x 1 day	36.514	27.825	23.948	24.365	9.106	1.81E-03	0.181	0.006
10uM MG132 x 1 day + 1.25uM JNJ 28631590 x 1 day	34.665	27.825	22.838	24.365	8.367	3.03E-03	0.303	0.125
10uM MG132 x 1 day + 2.5uM JNJ 28631590 x 1 day	36.250	27.825	23.627	24.365	9.163	1.74E-03	0.174	0.439
10uM MG132 x 1 day + 5uM JNJ 28631590 x 1 day	37.978	27.825	26.296	24.365	8.222	3.35E-03	0.335	0.682
5uM JNJ 31040074 x 1 day	34.586	27.825	20.266	24.365	10.860	5.38E-04	0.054	0.717
1uM MG132 x 1 day + 1.25uM JNJ 31040074 x 1 day	35.977	27.825	23.329	24.365	9.188	1.71E-03	0.171	0.399
1uM MG132 x 1 day + 2.5uM JNJ 31040074 x 1 day	35.865	27.825	22.948	24.365	9.457	1.42E-03	0.142	0.379
1uM MG132 x 1 day + 5uM JNJ 31040074 x 1 day	36.714	27.825	22.858	24.365	10.397	7.42E-04	0.074	0.076
5uM MG132 x 1 day + 1.25uM JNJ 31040074 x 1 day	36.155	27.825	24.389	24.365	8.306	3.16E-03	0.316	0.200
5uM MG132 x 1 day + 2.5uM JNJ 31040074 x 1 day	36.221	27.825	23.479	24.365	9.282	1.61E-03	0.161	0.093
5uM MG132 x 1 day + 5uM JNJ 31040074 x 1 day	36.536	27.825	23.897	24.365	9.179	1.72E-03	0.172	0.106
10uM MG132 x 1 day + 1.25uM JNJ 31040074 x 1 day	35.878	27.825	23.845	24.365	8.573	2.63E-03	0.263	0.607
10uM MG132 x 1 day + 2.5uM JNJ 31040074 x 1 day	36.008	27.825	23.322	24.365	9.226	1.67E-03	0.167	0.132
10uM MG132 x 1 day + 5uM JNJ 31040074 x 1 day	36.468	27.825	23.552	24.365	9.457	1.42E-03	0.142	0.358
5uM JNJ 31053854 x 1 day	33.632	27.825	19.947	24.365	10.225	8.36E-04	0.084	0.185
1uM MG132 x 1 day + 1.25uM JNJ 31053854 x 1 day	38.281	27.825	23.493	24.365	11.329	3.89E-04	0.039	0.893
1uM MG132 x 1 day + 2.5uM JNJ 31053854 x 1 day	36.741	27.825	23.468	24.365	9.813	1.11E-03	0.111	0.272
1uM MG132 x 1 day + 5uM JNJ 31053854 x 1 day	36.485	27.825	22.937	24.365	10.088	9.19E-04	0.092	0.078

5uM MG132 x 1 day + 1.25uM JNJ 31053854 x 1 day	36.628	27.825	24.771	24.365	8.397	2.97E-03	0.297	0.321
5uM MG132 x 1 day + 2.5uM JNJ 31053854 x 1 day	35.302	27.825	23.764	24.365	8.078	3.70E-03	0.370	0.215
5uM MG132 x 1 day + 5uM JNJ 31053854 x 1 day	35.769	27.825	23.740	24.365	8.569	2.63E-03	0.263	0.234
10uM MG132 x 1 day + 1.25uM JNJ 31053854 x 1 day	36.324	27.825	25.037	24.365	7.826	4.41E-03	0.441	0.001
10uM MG132 x 1 day + 2.5uM JNJ 31053854 x 1 day	34.539	27.825	23.207	24.365	7.872	4.27E-03	0.427	0.170
10uM MG132 x 1 day + 5uM JNJ 31053854 x 1 day	35.660	27.825	23.908	24.365	8.292	3.19E-03	0.319	0.031
1uM MG132 x 1 day + 1.25uM TSA x 1 day	-	27.825	24.100	24.365	-	-	-	-
1uM MG132 x 1 day + 2.5uM TSA x 1 day	36.059	27.825	23.226	24.365	9.373	1.51E-03	0.151	0.028
5uM MG132 x 1 day + 1.25uM TSA x 1 day	34.793	27.825	23.465	24.365	7.868	4.28E-03	0.428	0.386
5uM MG132 x 1 day + 2.5uM TSA x 1 day	35.403	27.825	23.796	24.365	8.148	3.53E-03	0.353	0.551
10uM MG132 x 1 day + 1.25uM TSA x 1 day	33.002	27.825	22.010	24.365	7.532	5.40E-03	0.540	0.127
10uM MG132 x 1 day + 2.5uM TSA x 1 day	35.353	27.825	23.703	24.365	8.190	3.42E-03	0.342	0.214

TABLE XXII. EFFECTS OF A HDAC INHIBITOR AND MG-132 TREATMENT ON GENE EXPRESSION IN AN ADULT PANCREAS-DERIVED CELL LINE.

H5F3P16 Cell Treatment	Insulin Sample Ct	Pancreas Insulin Ct	Sample GAPDH Ct	Pancreas GAPDH Ct	ΔΔCt	2 [^] (-ΔΔCt)=RQ	% RQ	Std err
Untreated 1 day control	-	19.401	20.774	24.365	-	-	-	-
1uM MG132 x 1 day	-	19.401	20.564	24.365	-	-	-	-
5uM MG132 x 1 day	-	19.401	20.693	24.365	-	-	-	-
10uM MG132 x 1 day	-	19.401	20.783	24.365	-	-	-	-
Untreated 2 day control	-	19.401	21.227	24.365	-	-	-	-
5uM JNJ 27652677 x 1 day	-	19.401	22.388	24.365	-	-	-	-
1uM MG132 x 1 day + 1.25uM JNJ 27652677 x 1 day	-	19.401	20.536	24.365	-	-	-	-
1uM MG132 x 1 day + 2.5uM JNJ 27652677 x 1 day	-	19.401	21.766	24.365	-	-	-	-
1uM MG132 x 1 day + 5uM JNJ 27652677 x 1 day	-	19.401	21.092	24.365	-	-	-	-
5uM MG132 x 1 day + 1.25uM JNJ 27652677 x 1 day	-	19.401	24.274	24.365	-	-	-	-
5uM MG132 x 1 day + 2.5uM JNJ 27652677 x 1 day	-	19.401	21.658	24.365	-	-	-	-
5uM MG132 x 1 day + 5uM JNJ 27652677 x 1 day	-	19.401	22.892	24.365	-	-	-	-
10uM MG132 x 1 day + 1.25uM JNJ 27652677 x 1 day	-	19.401	24.048	24.365	-	-	-	-
10uM MG132 x 1 day + 2.5uM JNJ 27652677 x 1 day	-	19.401	25.043	24.365	-	-	-	-
10uM MG132 x 1 day + 5uM JNJ 27652677 x 1 day	-	19.401	24.012	24.365	-	-	-	-
5uM JNJ 28404844 x 1 day	-	19.401	22.218	24.365	-	-	-	-
1uM MG132 x 1 day + 1.25uM JNJ 28404844 x 1 day	-	19.401	20.354	24.365	-	-	-	-
1uM MG132 x 1 day + 2.5uM JNJ 28404844 x 1 day	-	19.401	20.163	24.365	-	-	-	-
1uM MG132 x 1 day + 5uM JNJ 28404844 x 1 day	-	19.401	21.446	24.365	-	-	-	-
5uM MG132 x 1 day + 1.25uM JNJ 28404844 x 1 day	-	19.401	23.279	24.365	-	-	-	-
5uM MG132 x 1 day + 2.5uM JNJ 28404844 x 1 day	-	19.401	23.586	24.365	-	-	-	-
5uM MG132 x 1 day + 5uM JNJ 28404844 x 1 day	-	19.401	23.079	24.365	-	-	-	-
10uM MG132 x 1 day + 1.25uM JNJ 28404844 x 1 day	-	19.401	23.845	24.365	-	-	-	-
10uM MG132 x 1 day + 2.5uM JNJ 28404844 x 1 day	-	19.401	23.502	24.365	-	-	-	-
10uM MG132 x 1 day + 5uM JNJ 28404844 x 1 day	-	19.401	23.604	24.365	-	-	-	-
5uM JNJ 28543944 x 1 day	-	19.401	21.387	24.365	-	-	-	-

1uM MG132 x 1 day + 1.25uM JNJ 28543944 x 1 day	-	19.401	23.158	24.365	-	-	-	-	-
1uM MG132 x 1 day + 2.5uM JNJ 28543944 x 1 day	-	19.401	23.075	24.365	-	-	-	-	-
1uM MG132 x 1 day + 5uM JNJ 28543944 x 1 day	-	19.401	23.144	24.365	-	-	-	-	-
5uM MG132 x 1 day + 1.25uM JNJ 28543944 x 1 day	-	19.401	24.379	24.365	-	-	-	-	-
5uM MG132 x 1 day + 2.5uM JNJ 28543944 x 1 day	-	19.401	23.992	24.365	-	-	-	-	-
5uM MG132 x 1 day + 5uM JNJ 28543944 x 1 day	-	19.401	24.519	24.365	-	-	-	-	-
10uM MG132 x 1 day + 1.25uM JNJ 28543944 x 1 day	-	19.401	24.497	24.365	-	-	-	-	-
10uM MG132 x 1 day + 2.5uM JNJ 28543944 x 1 day	-	19.401	23.767	24.365	-	-	-	-	-
10uM MG132 x 1 day + 5uM JNJ 28543944 x 1 day	-	19.401	24.846	24.365	-	-	-	-	-
5uM JNJ 28631590 x 1 day	-	19.401	21.874	24.365	-	-	-	-	-
1uM MG132 x 1 day + 1.25uM JNJ 28631590 x 1 day	-	19.401	22.349	24.365	-	-	-	-	-
1uM MG132 x 1 day + 2.5uM JNJ 28631590 x 1 day	-	19.401	22.024	24.365	-	-	-	-	-
1uM MG132 x 1 day + 5uM JNJ 28631590 x 1 day	-	19.401	22.806	24.365	-	-	-	-	-
5uM MG132 x 1 day + 1.25uM JNJ 28631590 x 1 day	38.603	19.401	24.140	24.365	19.427	1.42E-06	0.000	0.314	-
5uM MG132 x 1 day + 2.5uM JNJ 28631590 x 1 day	-	19.401	24.052	24.365	-	-	-	-	-
5uM MG132 x 1 day + 5uM JNJ 28631590 x 1 day	-	19.401	23.948	24.365	-	-	-	-	-
10uM MG132 x 1 day + 1.25uM JNJ 28631590 x 1 day	-	19.401	22.838	24.365	-	-	-	-	-
10uM MG132 x 1 day + 2.5uM JNJ 28631590 x 1 day	-	19.401	23.627	24.365	-	-	-	-	-
10uM MG132 x 1 day + 5uM JNJ 28631590 x 1 day	-	19.401	26.296	24.365	-	-	-	-	-
5uM JNJ 31040074 x 1 day	-	19.401	20.266	24.365	-	-	-	-	-
1uM MG132 x 1 day + 1.25uM JNJ 31040074 x 1 day	38.645	19.401	23.329	24.365	20.280	7.85E-07	0.000	0.413	-
1uM MG132 x 1 day + 2.5uM JNJ 31040074 x 1 day	-	19.401	22.948	24.365	-	-	-	-	-
1uM MG132 x 1 day + 5uM JNJ 31040074 x 1 day	-	19.401	22.858	24.365	-	-	-	-	-
5uM MG132 x 1 day + 1.25uM JNJ 31040074 x 1 day	-	19.401	24.389	24.365	-	-	-	-	-
5uM MG132 x 1 day + 2.5uM JNJ 31040074 x 1 day	-	19.401	23.479	24.365	-	-	-	-	-
5uM MG132 x 1 day + 5uM JNJ 31040074 x 1 day	-	19.401	23.897	24.365	-	-	-	-	-
10uM MG132 x 1 day + 1.25uM JNJ 31040074 x 1 day	-	19.401	23.845	24.365	-	-	-	-	-
10uM MG132 x 1 day + 2.5uM JNJ 31040074 x 1 day	-	19.401	23.322	24.365	-	-	-	-	-
10uM MG132 x 1 day + 5uM JNJ 31040074 x 1 day	-	19.401	23.552	24.365	-	-	-	-	-
5uM JNJ 31053854 x 1 day	-	19.401	19.947	24.365	-	-	-	-	-
1uM MG132 x 1 day + 1.25uM JNJ 31053854 x 1 day	-	19.401	23.493	24.365	-	-	-	-	-
1uM MG132 x 1 day + 2.5uM JNJ 31053854 x 1 day	-	19.401	23.468	24.365	-	-	-	-	-
1uM MG132 x 1 day + 5uM JNJ 31053854 x 1 day	-	19.401	22.937	24.365	-	-	-	-	-

5uM MG132 x 1 day + 1.25uM JNJ 31053854 x 1 day	19.401	24.771	24.365	-	19.270	-	1.58E-06	-	-
5uM MG132 x 1 day + 2.5uM JNJ 31053854 x 1 day	19.401	23.764	24.365	38.070	-	19.270	-	0.000	0.222
5uM MG132 x 1 day + 5uM JNJ 31053854 x 1 day	19.401	23.740	24.365	-	-	-	-	-	-
10uM MG132 x 1 day + 1.25uM JNJ 31053854 x 1 day	19.401	25.037	24.365	-	-	-	-	-	-
10uM MG132 x 1 day + 2.5uM JNJ 31053854 x 1 day	19.401	23.207	24.365	-	-	-	-	-	-
10uM MG132 x 1 day + 5uM JNJ 31053854 x 1 day	19.401	23.908	24.365	-	-	-	-	-	-
1uM MG132 x 1 day + 1.25uM TSA x 1 day	19.401	24.100	24.365	-	-	-	-	-	-
1uM MG132 x 1 day + 2.5uM TSA x 1 day	19.401	23.226	24.365	-	-	-	-	-	-
5uM MG132 x 1 day + 1.25uM TSA x 1 day	19.401	23.465	24.365	-	-	-	-	-	-
5uM MG132 x 1 day + 2.5uM TSA x 1 day	19.401	23.796	24.365	-	-	-	-	-	-
10uM MG132 x 1 day + 1.25uM TSA x 1 day	19.401	22.010	24.365	-	-	-	-	-	-
10uM MG132 x 1 day + 2.5uM TSA x 1 day	19.401	23.703	24.365	-	-	-	-	-	-

TABLE XXIII. EFFECTS OF A HDAC INHIBITOR AND A DNA-DEMETHYLATING AGENT TREATMENT ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

AFCA010-B-P8 Cells Treatment	Pdx1 Ct	Pdx1 RQ	HNF3-β Ct	HNF3-β RQ
no treatment	nd		nd	
5-AZA 0.156uM	nd		nd	
5-AZA 0.3125uM	nd		nd	
5-AZA 0.625uM	nd		nd	
5-AZA 1.25uM	nd		nd	
5-AZA 2.5uM	nd		nd	
TSA 1.25uM	35.318	0.001	34.029	0.001
Human pancreas control	30.342	1.000	29.054	1.000

TABLE XXIV. EFFECTS OF A HDAC INHIBITOR AND A DNA-DEMETHYLATING AGENT TREATMENT ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

AFCA010-B-P8 Cells Treatment	Pdx1 Ct	Pdx1 RQ	HNF3-β Ct	HNF3-β RQ
no treatment	nd		nd	
5-AZA 0.156uM	nd		nd	
5-AZA 0.3125uM	nd		nd	
5-AZA 0.625uM	nd		nd	
5-AZA 1.25uM	nd		nd	
5-AZA 2.5uM	nd		nd	
TSA 1.25uM	35.318	0.001	34.029	0.001
TSA 1.25uM with 5-AZA 0.156uM	34.469	0.002	33.734	0.001
TSA 1.25uM with 5-AZA 0.3125uM	34.415	0.002	33.598	0.001
TSA 1.25uM with 5-AZA 0.625uM	34.117	0.003	33.600	0.002
TSA 1.25uM with 5-AZA 1.25uM	33.347	0.002	33.347	0.003
TSA 1.25uM with 5-AZA 2.5uM	33.231	0.002	33.061	0.001
Human pancreas control	30.342	1.000	29.054	1.000

TABLE XXV. EFFECTS OF A HDAC INHIBITOR AND A DNA-DEMETHYLATING AGENT TREATMENT ON GENE EXPRESSION IN AN AMNIOTIC FLUID-DERIVED CELL LINE.

AFCA010-B-P12 Cells Treatment		Pdx1 Ct	Pdx1 RQ	HNF3- β Ct	HNF3- β RQ
Part 1 (0-6 hrs)	Part 2 (7-24 hrs)				
no treatment	no treatment	nd		nd	
TSA 1.25uM	TSA 1.25uM	34.427	9.94E-04	32.522	0.002
TSA 2.5uM	TSA 2.5uM	31.145	0.011	31.144	0.006
5-AZA 2.5uM	5-AZA 2.5uM	nd		nd	
5-AZA 5.0uM	5-AZA 5.0uM	nd		nd	
5-AZA 2.5uM	TSA 1.25uM	32.52	0.004	31.242	0.005
5-AZA 2.5uM	TSA 2.5uM	30.515	0.013	30.348	0.008
5-AZA 5.0uM	TSA 1.25uM	35.241	0.001	32.451	0.002
5-AZA 5.0uM	TSA 2.5uM	30.543	0.013	29.853	0.012
Human pancreas control		28.802	1.000	27.962	1.000

- 5 Publications cited throughout this document are hereby incorporated by reference in their entirety. Although the various aspects of the invention have been illustrated above by reference to examples and preferred embodiments, it will be appreciated that the scope of the invention is defined not by the foregoing description, but by the following claims properly construed under principles of patent law.

What is claimed is:

1. An *ex-vivo* or *in-vitro* method for increasing the expression of PDX-1 in mammalian cells, comprising the steps of:

- a. Providing the cells, and

- b. Contacting the cells with at least one chromatin-remodeling agent, wherein the at least one chromatin-remodeling agent increases the expression of PDX-1 within the cells;

wherein the cells are selected from the group consisting of an undifferentiated cell, a partially differentiated cell, a fully differentiated cell, a stem cell and a progenitor cell; and

wherein the at least one chromatin-remodeling agent is an inhibitor of histone deacetylase activity.

2. The method of claim 1, wherein the cells do not express PDX-1 prior to the treatment with the at least one chromatin-remodeling agent.

3. The method of claim 1, wherein the treatment of at least one chromatin-remodeling agent restores the expression of PDX-1.

4. The method of claim 1, wherein the inhibitor is selected from the group consisting of butyrates, hydroxamic acids, cyclic peptides and benzamides.

5. The method of claim 1, wherein the inhibitor is selected from the group consisting of valproic acid, 4-phenylbutyrate, sodium butyrate, trichostatin A, suberoyl anilide hydroxamic acid (SAHA), oxamflatin, trapoxin B, FR901228, apicidin, chlamydocin, depuecin, scriptaid, depsipeptide, and N-acetyldinaline.

6. An *ex-vivo* or *in-vitro* method for promoting the differentiation of mammalian cells into a pancreatic progenitor cell, comprising the steps of:

- a. Providing cells that do not express PDX-1, and

- b. Contacting the cells with at least one chromatin-remodeling agent, wherein the at least one chromatin-remodeling agent increases the expression of PDX-1;

wherein the cells are selected from the group consisting of an undifferentiated cell, a partially differentiated cell, a fully differentiated cell, a stem cell and a progenitor cell; and

wherein the at least one chromatin-remodeling agent is an inhibitor of histone deacetylase activity.

- 7. The method of claim 8, wherein the treatment of the cells with the at least on chromatin-remodeling agent causes increases in the expression of at least one of the genes HNF-3 beta or Sox-17.

- 8. The method of claim 6, wherein the cells do not express PDX-1 prior to the treatment with the at least one chromatin-remodeling agent.

- 9. The method of claim 6, wherein the treatment of at least one chromatin-remodeling agent restores the expression of PDX-1.

- 10. The method of claim 6, wherein the inhibitor is selected from the group consisting of butyrates, hydroxamic acids, cyclic peptides and benzamides.

- 11. The method of claim 6, wherein the inhibitor is selected from the group consisting of valproic acid, 4-phenylbutyrate, sodium butyrate, trichostatin A, suberoyl anilide hydroxamic acid (SAHA), oxamflatin, trapoxin B, FR901228, apicidin, chlamydocin, depuecin, scriptaid, depsipeptide, and N-acetyldinaline.

- 12. An *ex-vivo* or *ex-vitro* method for promoting the differentiation of mammalian cells into a pancreatic hormone-secreting cell, comprising the steps of:

- a. Providing cells the do not express PDX-1, and
- b. Contacting the cells with at least one chromatin-remodeling agent, wherein the chromatin-remodeling agent increases the expression of PDX-1;

wherein the cells are selected from the group consisting of an undifferentiated cell, a partially differentiated cell, a fully differentiated cell, a stem cell and a progenitor cell; and

wherein the at least one chromatin-remodeling agent is an inhibitor of histone deacetylase activity.

13. The method of claim 12, wherein the treatment of the cells with the at least one chromatin-remodeling agent causes increases in the expression of at least one of the genes HNF-3 beta, Sox-17, insulin, glucagons, or somatostatin.

14. The method of claim 12, wherein the cells do not express PDX-1 prior to the treatment with the at least one chromatin-remodeling agent.

15. The method of claim 12, wherein the treatment of at least one chromatin-remodeling agent restores the expression of PDX-1.

16. The method of claim 12, wherein the inhibitor is selected from the group consisting of butyrates, hydroxamic acids, cyclic peptides and benzamides.

17. The method of claim 12, wherein the inhibitor is selected from the group consisting of valproic acid, 4-phenylbutyrate, sodium butyrate, trichostatin A, suberoyl anilide hydroxamic acid (SAHA), oxamflatin, trapoxin B, FR901228, apicidin, chlamydocin, depuecin, scriptaid, depsipeptide, and N-acetyldinaline.

18. Use of at least one chromatin-remodeling agent for increasing the expression of PDX-1 in mammalian cells, wherein the at least one chromatin-remodeling agent increases the expression of PDX-1 within the cells; wherein the cells are selected from the group consisting of an undifferentiated cell, a partially differentiated cell, a fully differentiated cell, a stem cell and a progenitor cell; and wherein the at least one chromatin-remodeling agent is an inhibitor of histone deacetylase activity.

19. The use of claim 18, wherein the cells do not express PDX-1 prior to use of the at least one chromatin-remodeling agent.

20. The use of claim 18, wherein the use restores the expression of PDX-1.

21. The use of claim 18, wherein the inhibitor is selected from the group consisting of butyrates, hydroxamic acids, cyclic peptides and benzamides.
22. The use of claim 18, wherein the inhibitor is selected from the group consisting of valproic acid, 4-phenylbutyrate, sodium butyrate, trichostatin A, suberoyl anilide hydroxamic acid (SAHA), oxamflatin, trapoxin B, FR901228, apicidin, chlamydocin, depuecin, scriptaid, depsipeptide, and N-acetyldinaline.
23. Use of at least one chromatin-remodeling agent for promoting the differentiation of mammalian cells into a pancreatic progenitor cell, wherein the at least one chromatin-remodeling agent increases the expression of PDX-1 in the cells which do not express PDX-1; wherein the cells are selected from the group consisting of an undifferentiated cell, a partially differentiated cell, a fully differentiated cell, a stem cell and a progenitor cell; and wherein the at least one chromatin-remodeling agent is an inhibitor of histone deacetylase activity.
24. The use of claim 23, wherein the use causes increases in the expression of at least one of the genes HNF-3 beta or Sox-17.
25. The use of claim 23, wherein the cells do not express PDX-1 prior to the use of the at least one chromatin-remodeling agent.
26. The use of claim 23, wherein the use restores the expression of PDX-1.
27. The use of claim 23, wherein the inhibitor is selected from the group consisting of butyrates, hydroxamic acids, cyclic peptides and benzamides.
28. The use of claim 23, wherein the inhibitor is selected from the group consisting of valproic acid, 4-phenylbutyrate, sodium butyrate, trichostatin A, suberoyl anilide hydroxamic acid (SAHA), oxamflatin, trapoxin B, FR901228, apicidin, chlamydocin, depuecin, scriptaid, depsipeptide, and N-acetyldinaline.
29. Use of at least one chromatin-remodeling agent for promoting the differentiation of mammalian cells into a pancreatic hormone-secreting cell, wherein the chromatin-remodeling agent increases the expression of PDX-1 in the cells which do not express

PDX-1; wherein the cells are selected from the group consisting of an undifferentiated cell, a partially differentiated cell, a fully differentiated cell, a stem cell and a progenitor cell; and wherein the at least one chromatin-remodeling agent is an inhibitor of histone deacetylase activity.

- 5 30. The use of claim 29, wherein the treatment of the cells with the at least one chromatin-remodeling agent causes increases in the expression of at least one of the genes HNF-3 beta, Sox-17, insulin, glucagons, or somatostatin.
31. The use of claim 29, wherein the cells do not express PDX-1 prior to the use of the at least one chromatin-remodeling agent.
- 10 32. The use of claim 29, wherein the use restores the expression of PDX-1.
33. The use of claim 29, wherein the inhibitor is selected from the group consisting of butyrates, hydroxamic acids, cyclic peptides and benzamides.
34. The use of claim 29, wherein the inhibitor is selected from the group consisting of valproic acid, 4-phenylbutyrate, sodium butyrate, trichostatin A, suberoyl anilide
15 hydroxamic acid (SAHA), oxamflatin, trapoxin B, FR901228, apicidin, chlamydocin, depuecin, scriptaid, depsipeptide, and N-acetyldinaline.
35. The use of any one of claims 18-34, wherein the cells are of pancreatic lineage.
36. The method of any one of claims 1-17, wherein the cells are of pancreatic lineage.

Figure 1

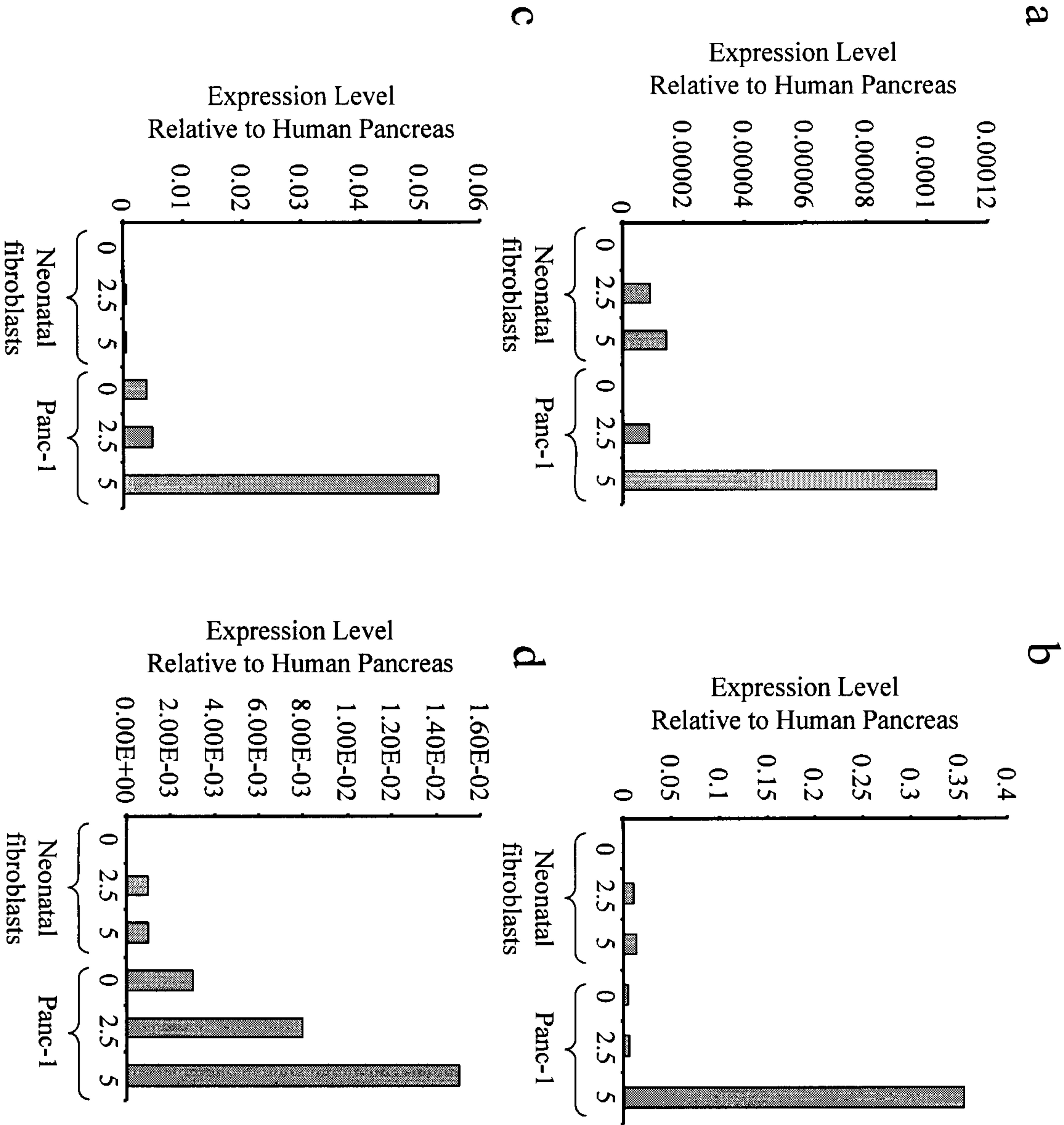


Figure 2

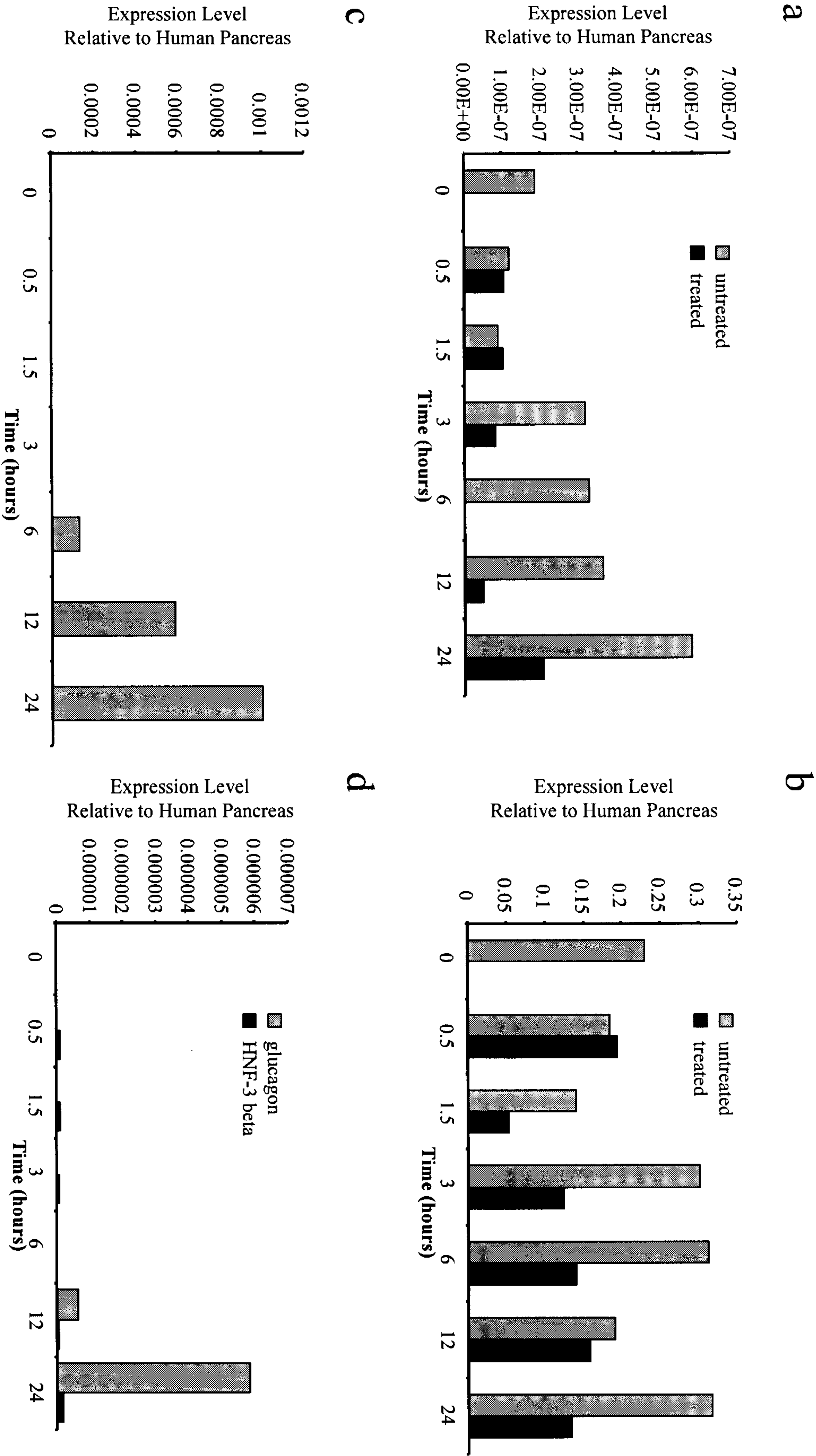


Figure 3

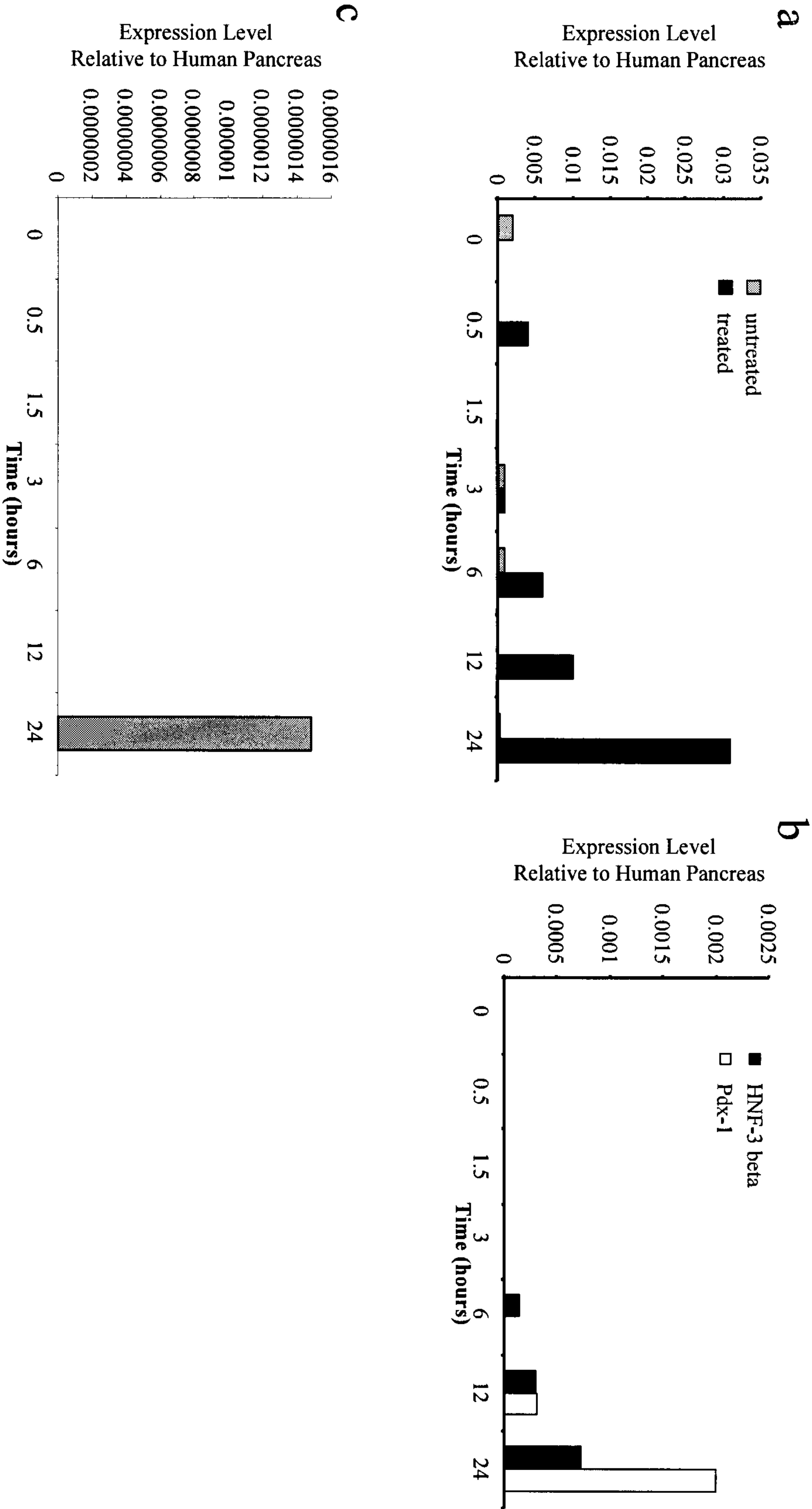


Figure 4

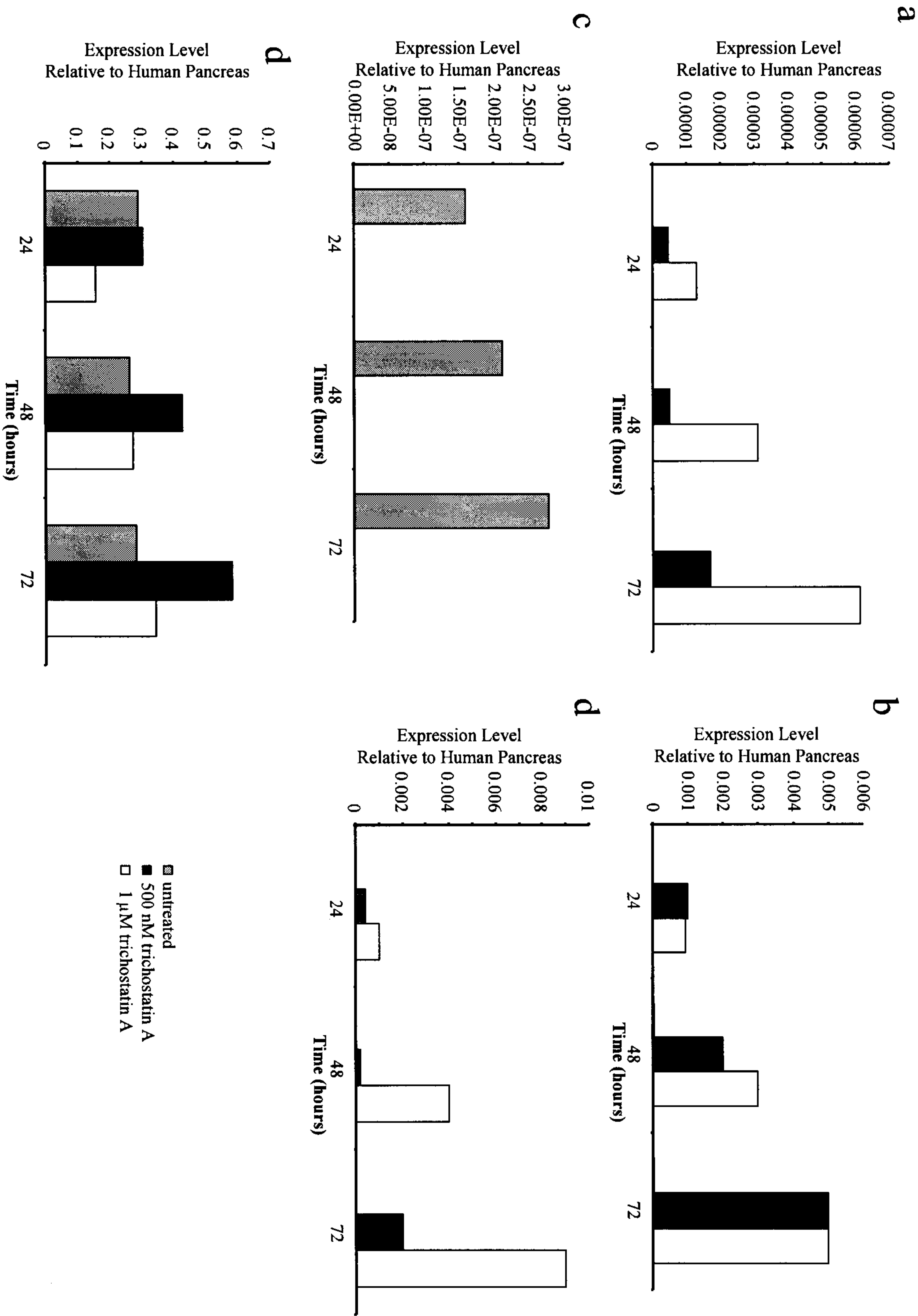


Figure 5

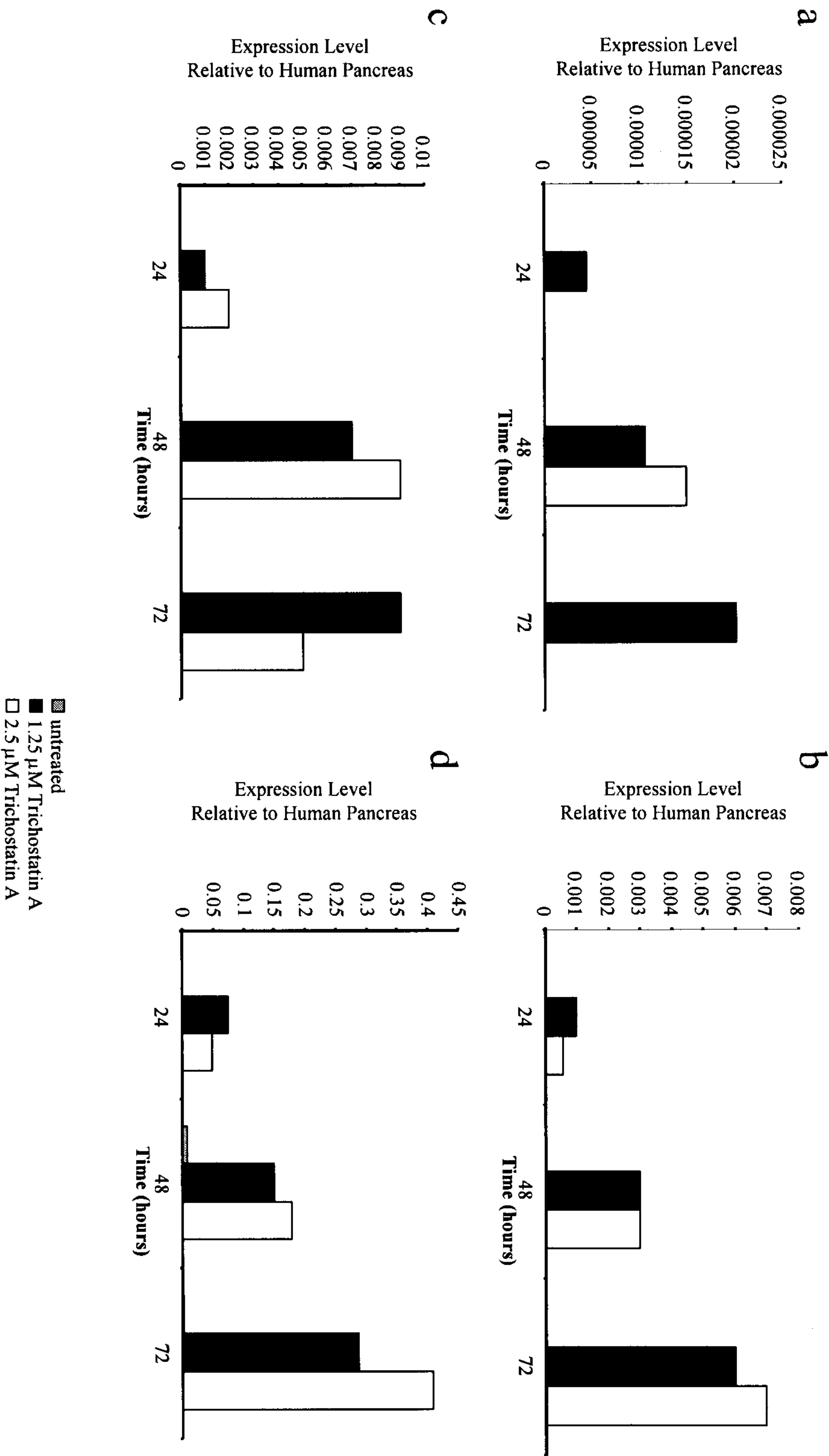


Figure 6

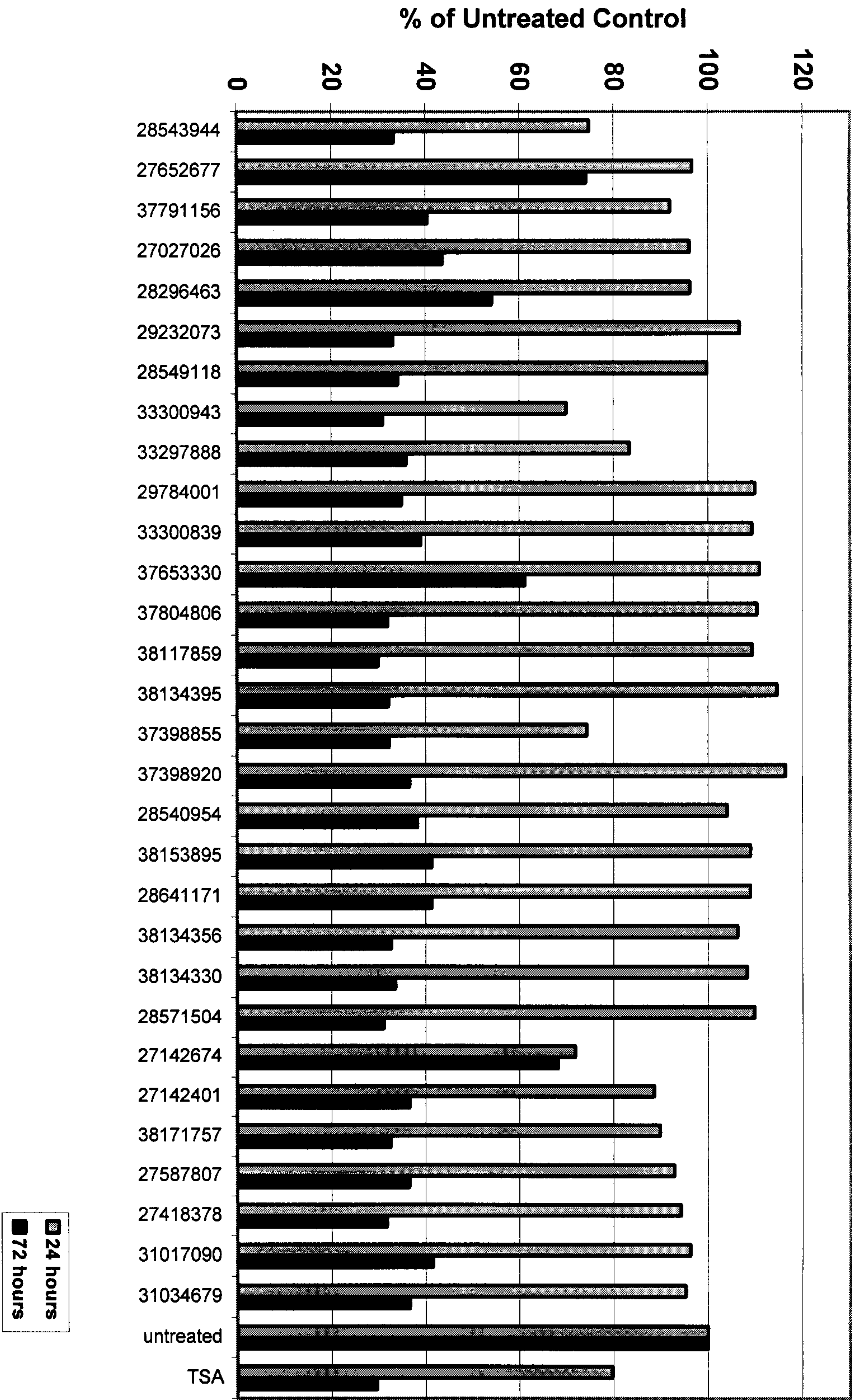


Figure 7

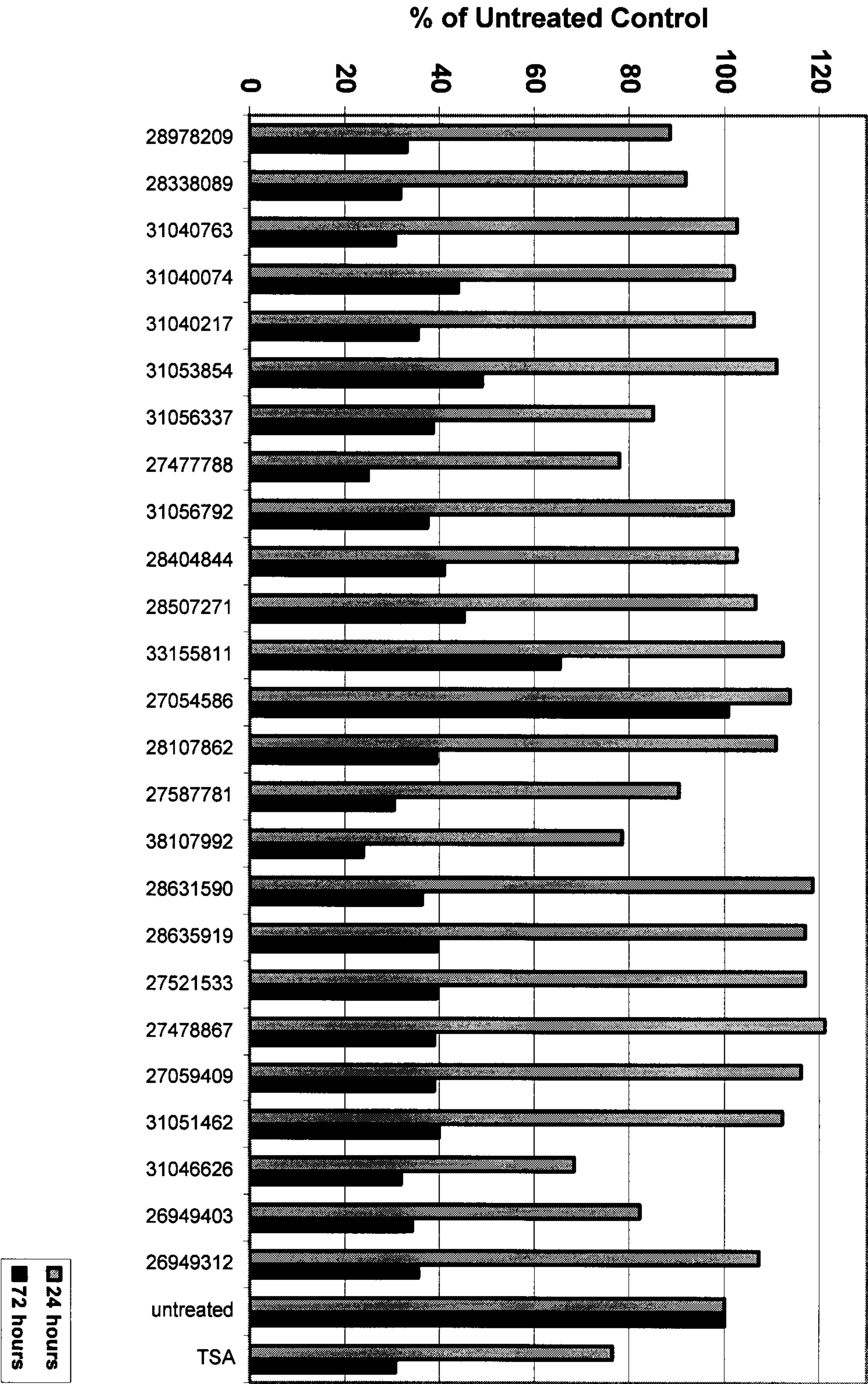


Figure 8

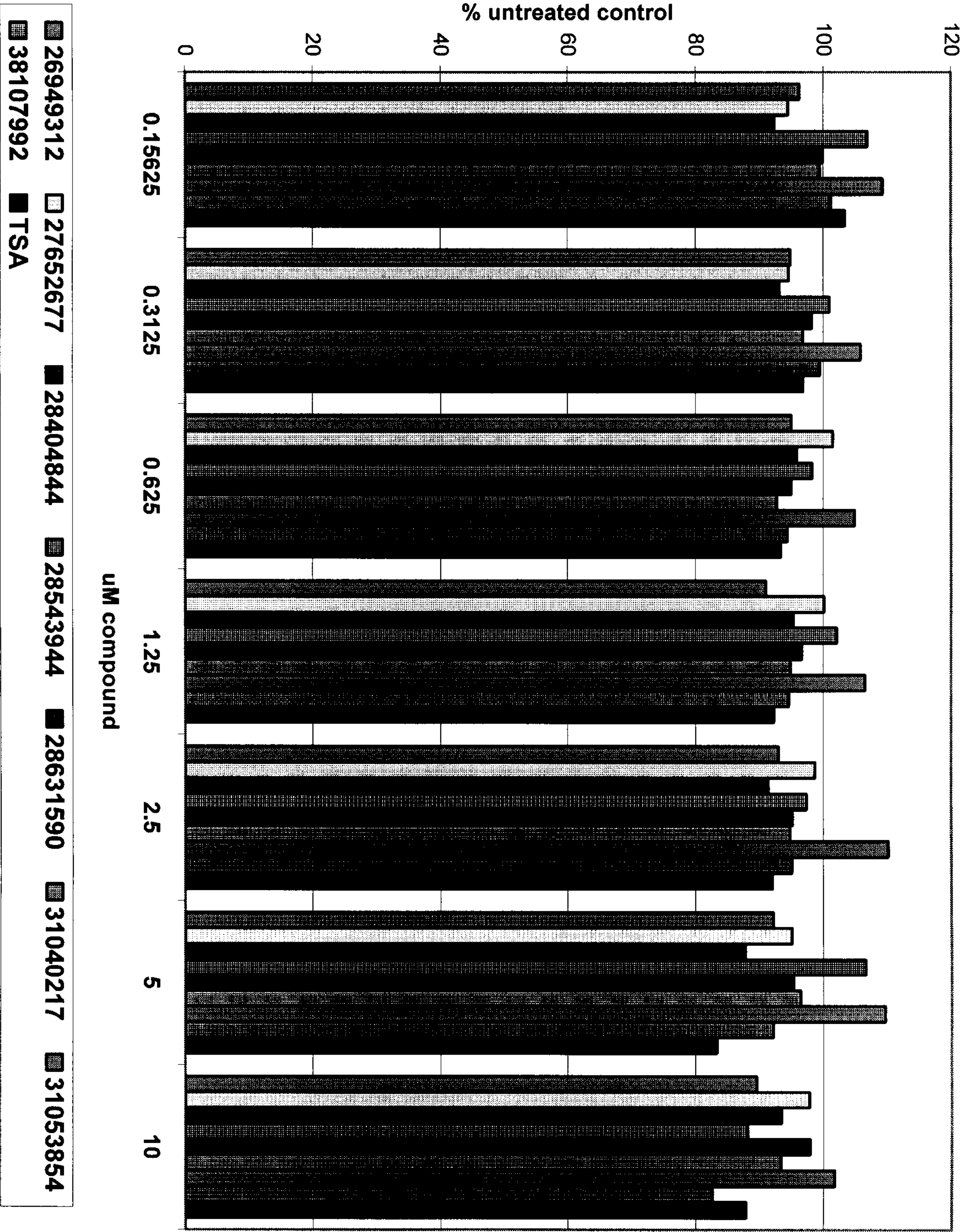


Figure 9

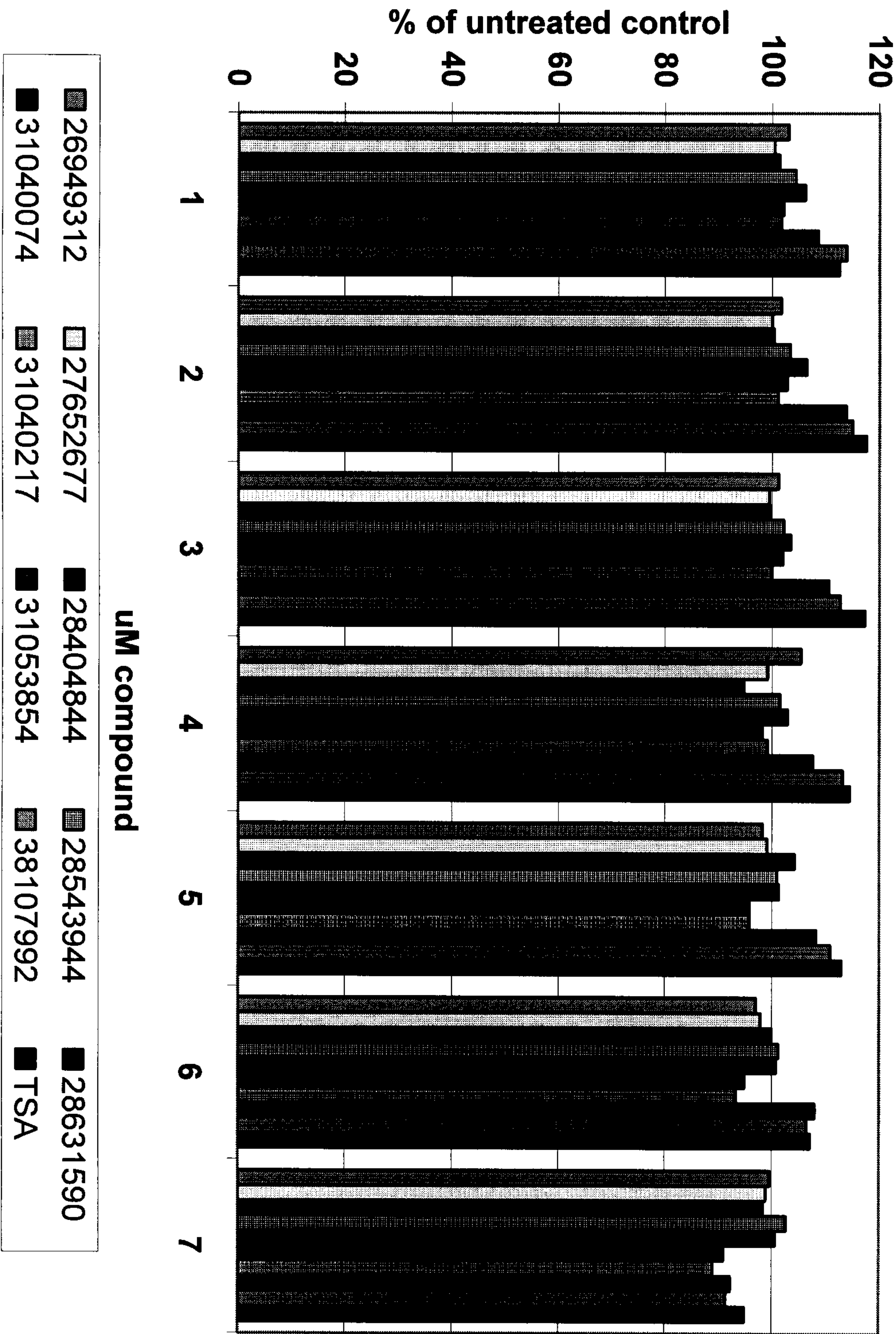


Figure 10

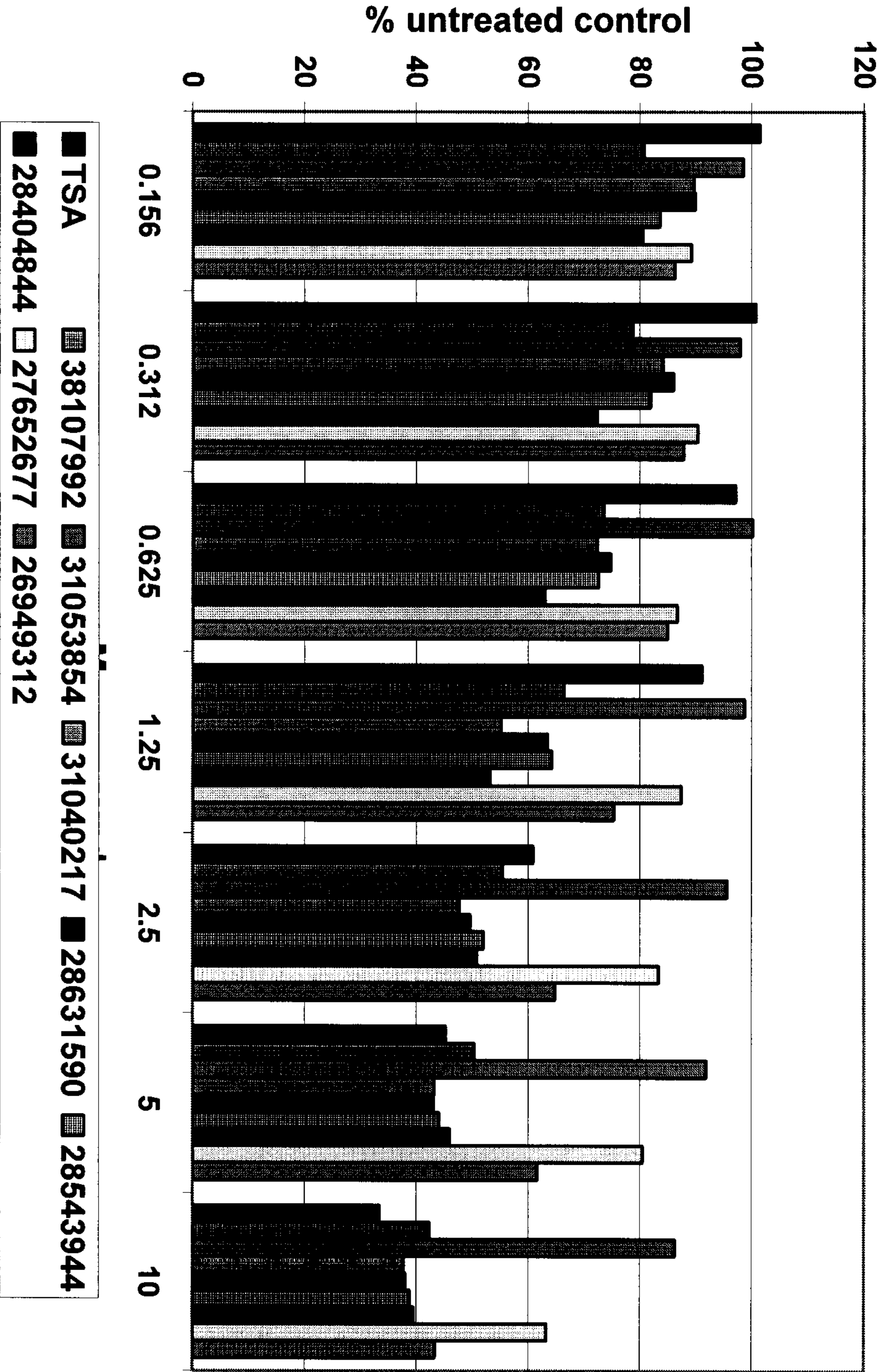


Figure 11

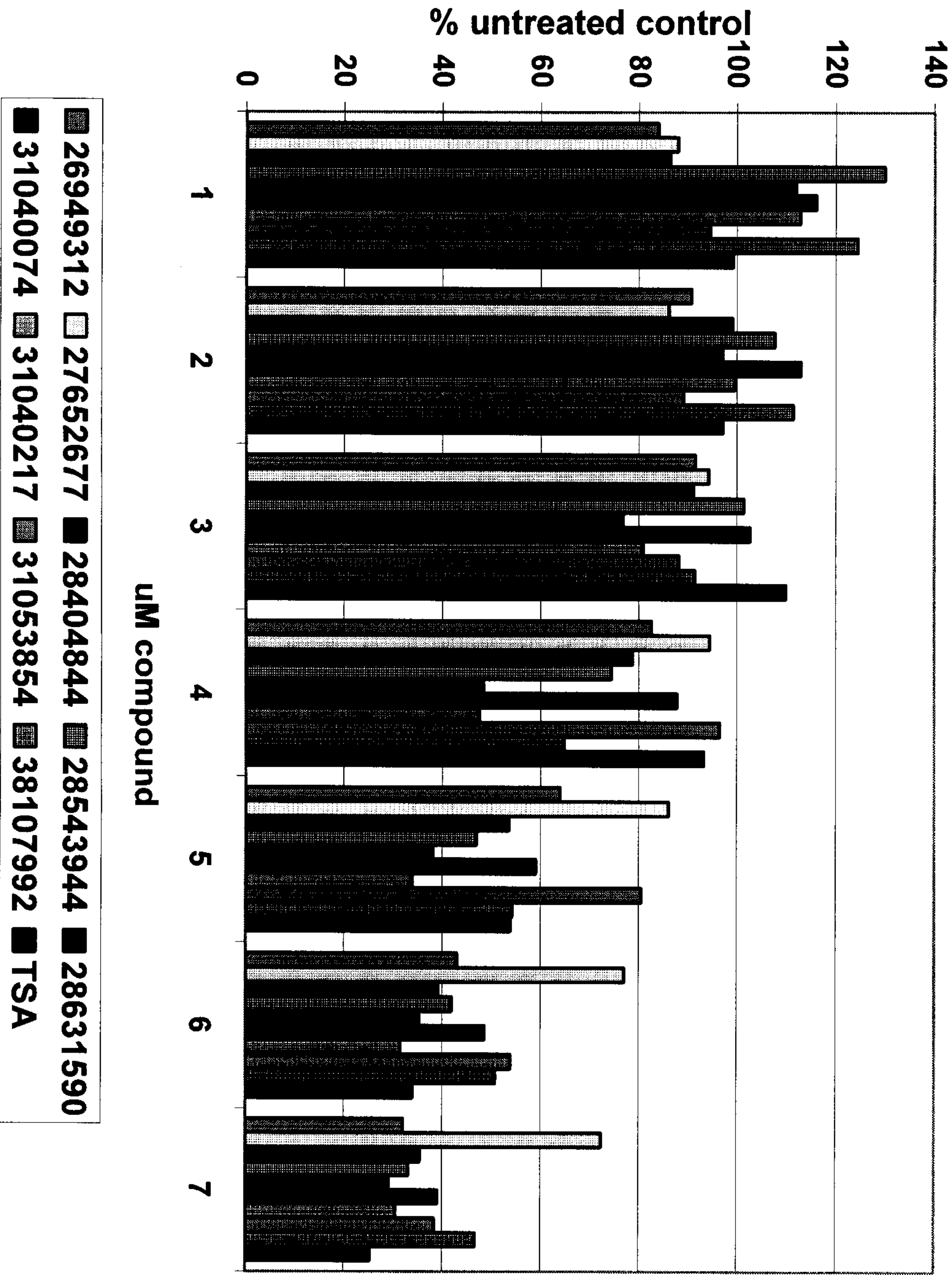
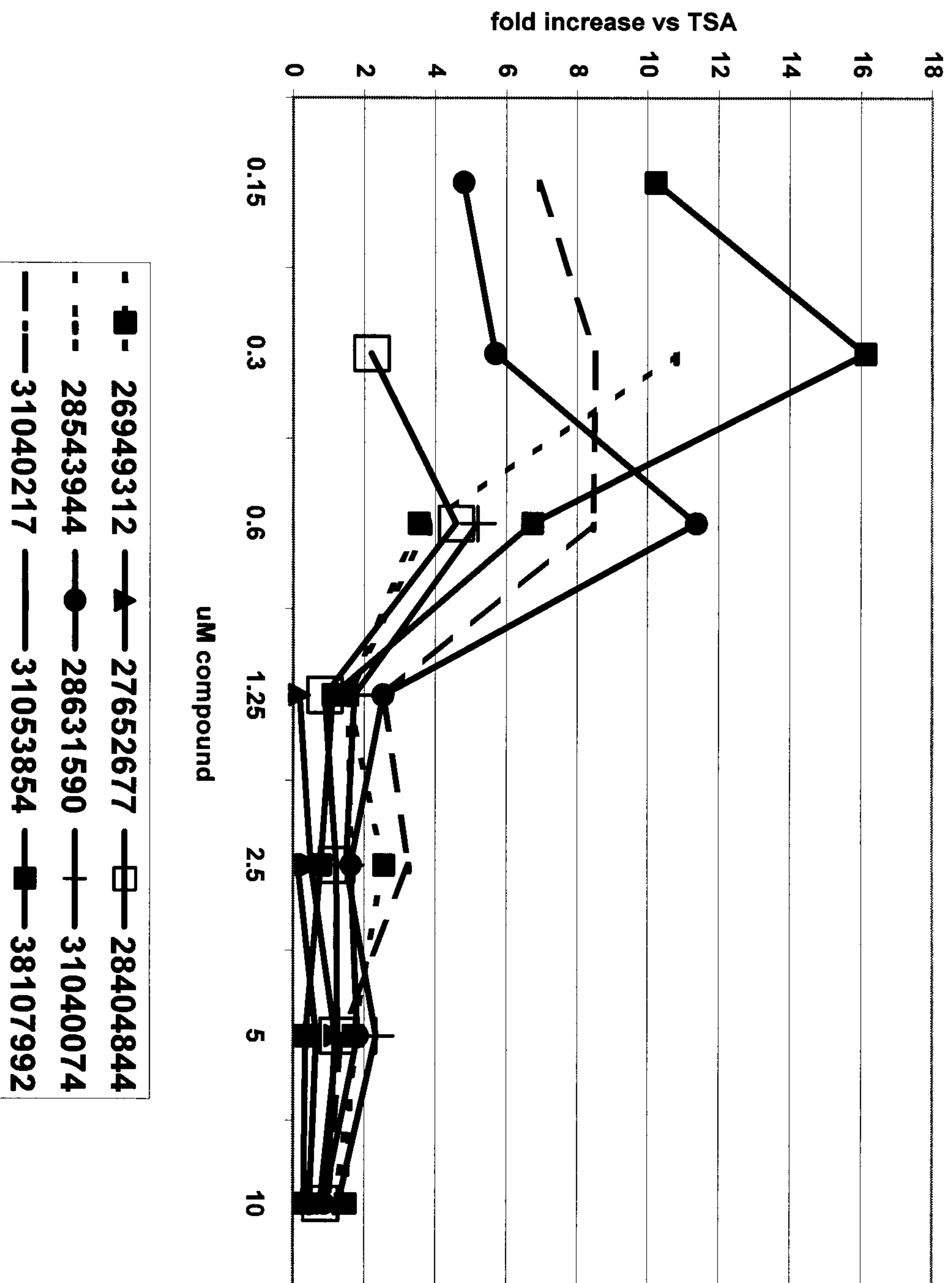
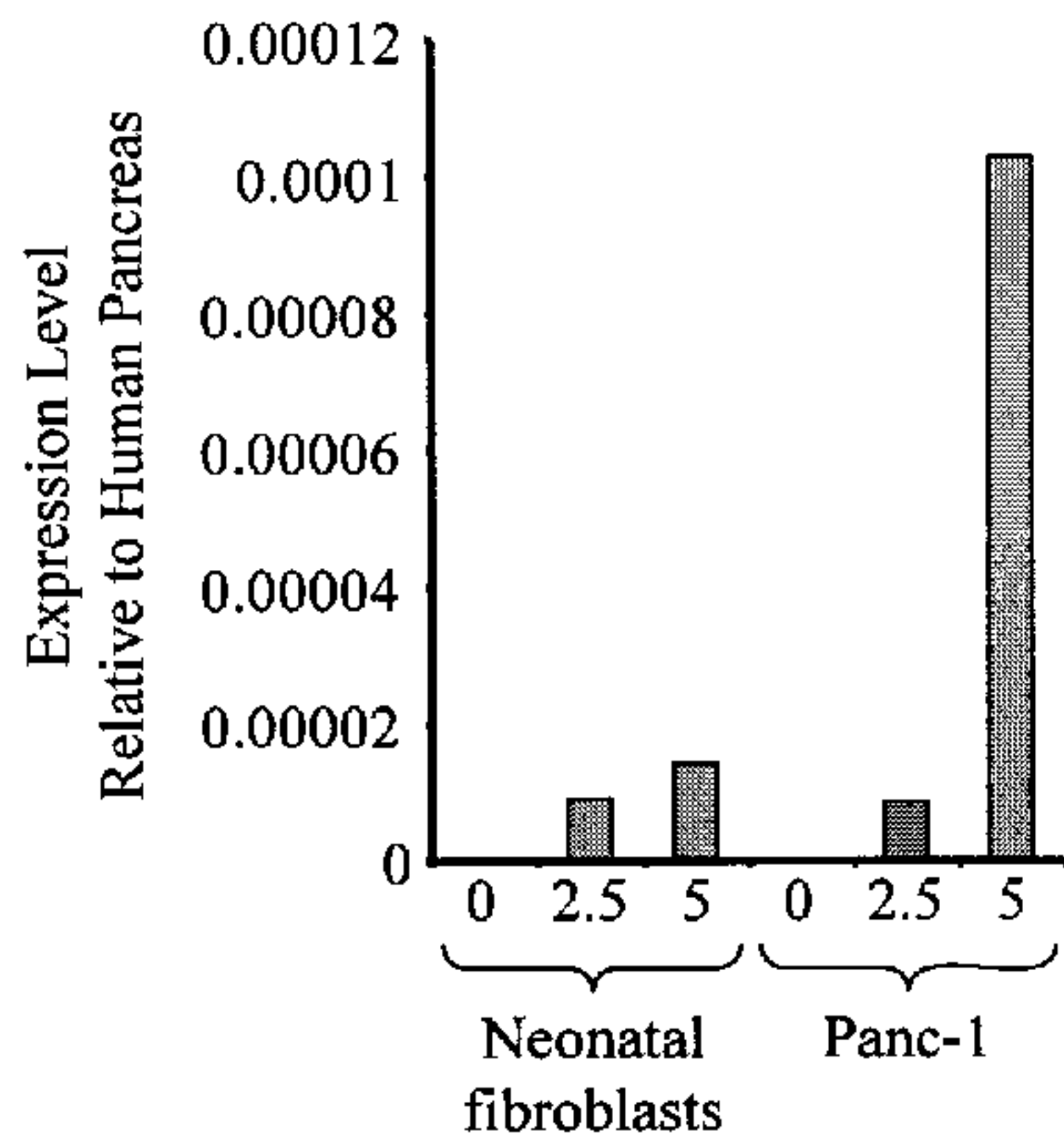
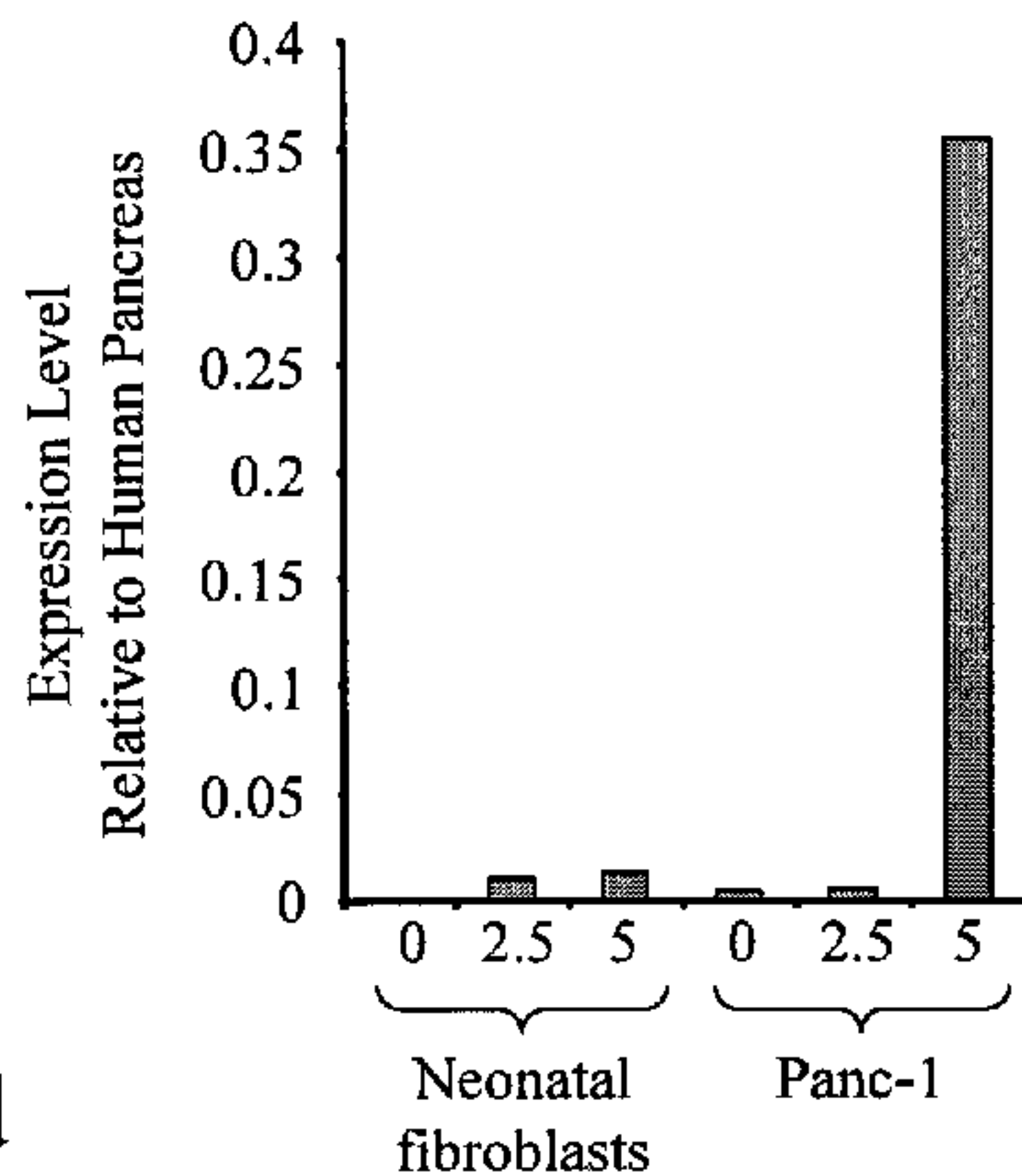
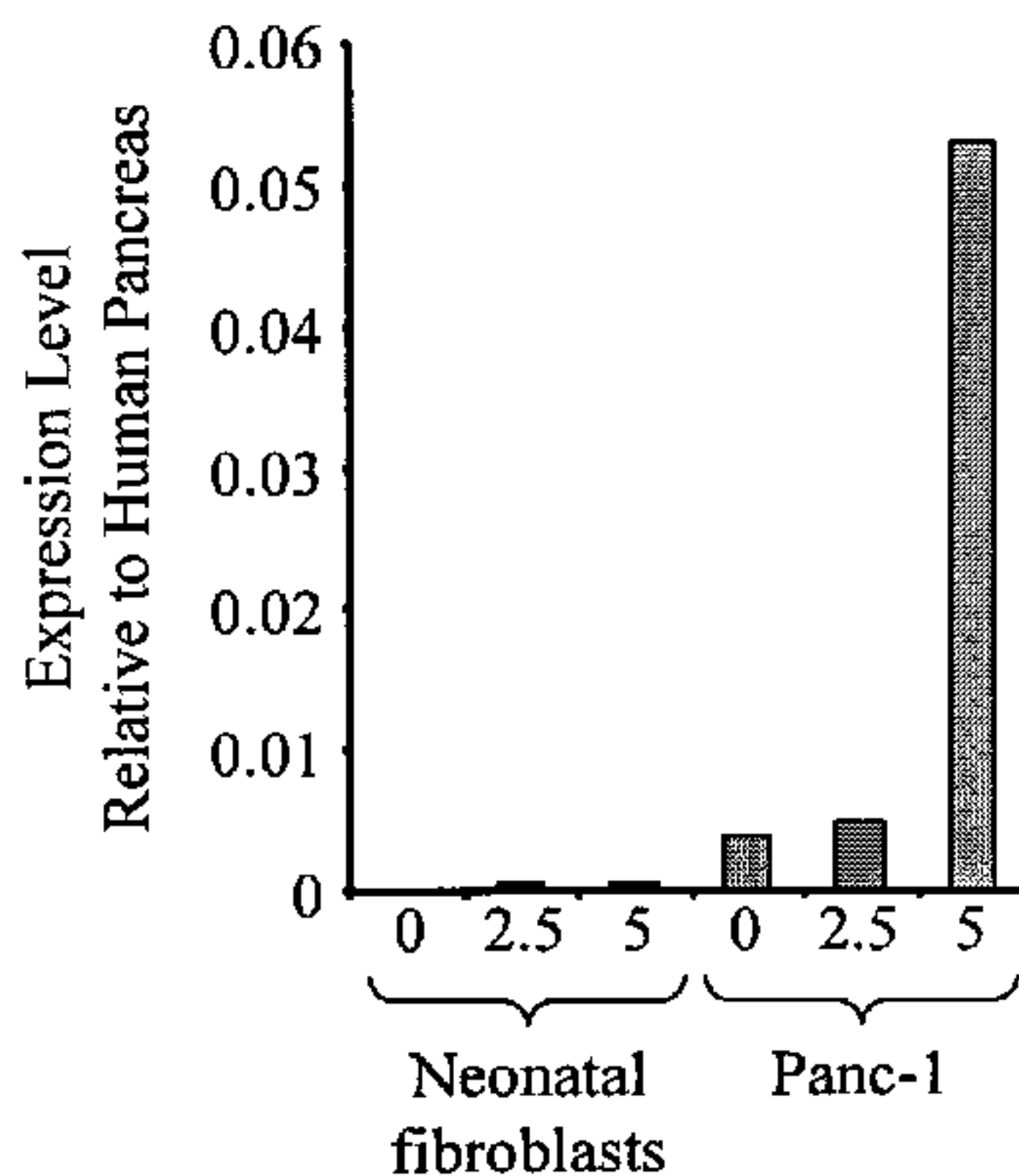


Figure 12



a**b****c****d**