



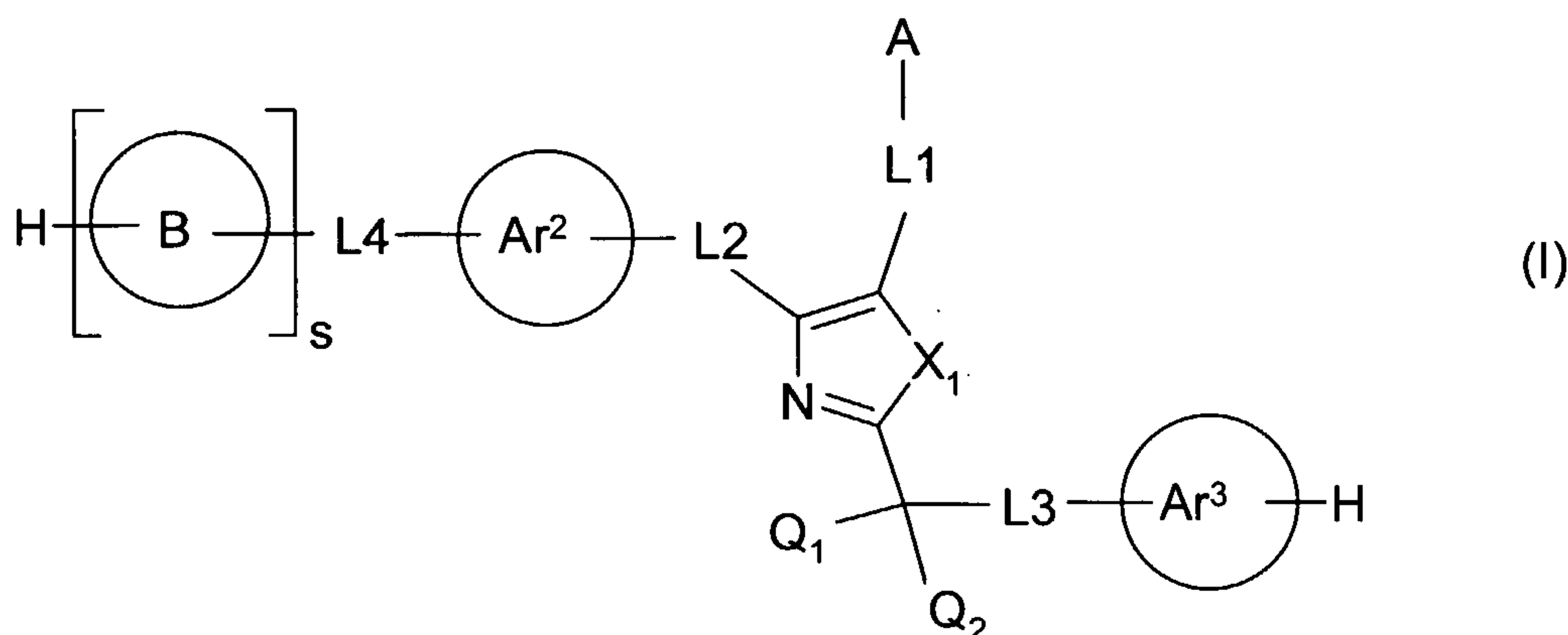
(86) Date de dépôt PCT/PCT Filing Date: 2005/05/30  
(87) Date publication PCT/PCT Publication Date: 2005/12/08  
(85) Entrée phase nationale/National Entry: 2006/11/29  
(86) N° demande PCT/PCT Application No.: EP 2005/005882  
(87) N° publication PCT/PCT Publication No.: 2005/116001  
(30) Priorités/Priorities: 2004/05/29 (GB0412198.4);  
2004/06/24 (GB0414194.1); 2004/10/29 (GB0424016.4)

(51) Cl.Int./Int.Cl. *C07D 277/30* (2006.01),  
*A61K 31/426* (2006.01), *A61K 31/427* (2006.01),  
*A61P 11/06* (2006.01), *C07D 417/04* (2006.01),  
*C07D 417/06* (2006.01)

(71) Demandeur/Applicant:  
7TM PHARMA A/S, DK

(72) Inventeurs/Inventors:  
ULVEN, TROND, DK;  
FRIMURER, THOMAS, DK;  
RIST, OEYSTEIN, DK;  
KOSTENIS, EVI, DK;  
HOEGBERG, THOMAS, DK;  
RECEVEUR, JEAN-MARIE, DK;  
GRIMSTRUP, MARIE, DK

(54) Titre : ACIDES THIAZOLEACETIQUES SUBSTITUES EN TANT QUE LIGANDS CRTH2  
(54) Title: SUBSTITUTED THIAZOLEACETIC AS CRTH2 LIGANDS



(57) **Abrégé/Abstract:**

Compounds of formula (I) are useful for the treatment of disease responsive to modulation of CRTH2 receptor activity, such as asthma, rhinitis, allergic airway syndrome, and allergic rhinobronchitis; wherein  $X_1$  is -S-, -O-, -N=N-, -NR<sub>7</sub>-, -CR<sub>7</sub>=CR<sub>8</sub>-, -CR<sub>7</sub>=N-, wherein R<sub>7</sub> and R<sub>8</sub> are independently hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl; A is a carboxyl group -COOH, or a carboxyl bioisostere; rings Ar<sup>2</sup> and Ar<sup>3</sup> each independently represent a phenyl or 5- or 6-membered monocyclic heteroaryl ring, or a bicyclic ring system consisting of a 5- or 6-membered carbocyclic or heterocyclic ring which is benz-fused or fused to a 5- or 6-membered monocyclic heteroaryl ring, said ring or ring system being optionally substituted; ring B is as defined for Ar<sup>2</sup> and Ar<sup>3</sup>, or an optionally substituted N-pyrrolidinyl, N-piperidinyl or N-azepinyl ring; s is 0 or 1; L1, L2 and L4 are linker radicals as defined in the description; Q<sub>1</sub> and Q<sub>2</sub> represent substituents as defined in the description.

(74) **Agent:** GOWLING LAFLEUR HENDERSON LLP

## (12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
8 December 2005 (08.12.2005)

PCT

(10) International Publication Number  
**WO 2005/116001 A1**

(51) International Patent Classification<sup>7</sup>: **C07D 277/30**,  
417/06, 417/04, A61K 31/426, 31/427, A61P 11/06

[NO/DK]; 7TM Pharma A/S, Fremtidsvej 3, DK-2970  
Hoersholm (DK).

(21) International Application Number:  
PCT/EP2005/005882

(74) Agent: **WALLS, Alan, James**; P.O. Box 223, Tadworth,  
Surrey KT20 5SS (GB).

(22) International Filing Date: 30 May 2005 (30.05.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
0412198.4 29 May 2004 (29.05.2004) GB  
0414194.1 24 June 2004 (24.06.2004) GB  
0424016.4 29 October 2004 (29.10.2004) GB

(81) Designated States (unless otherwise indicated, for every  
kind of national protection available): AE, AG, AL, AM,  
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,  
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,  
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,  
KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA,  
MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ,  
OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL,  
SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC,  
VN, YU, ZA, ZM, ZW.

(71) Applicant (for all designated States except US): **7TM  
PHARMA A/S** [DK/DK]; Fremtidsvej 3, DK-2970 Ho-  
ersholm (DK).

(84) Designated States (unless otherwise indicated, for every  
kind of regional protection available): ARIPO (BW, GH,  
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,  
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,  
FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO,  
SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN,  
GQ, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

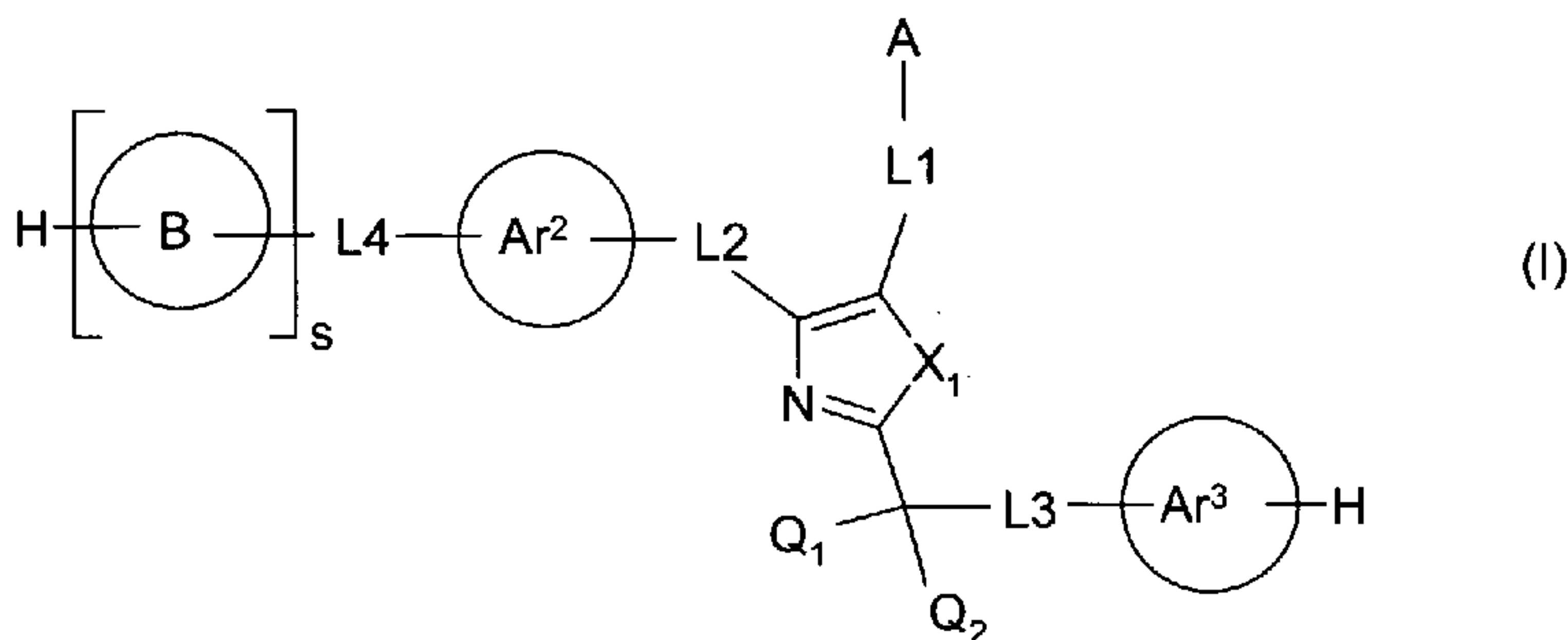
(75) Inventors/Applicants (for US only): **ULVEN, Trond**  
[NO/DK]; 7TM Pharma A/S, Fremtidsvej 3, DK-2970  
Hoersholm (DK). **FRIMURER, Thomas** [DK/DK]; 7TM  
Pharma A/S, Fremtidsvej 3, DK-2970 Hoersholm (DK).  
**RIST, Øystein** [NO/DK]; 7TM Pharma A/S, Fremtidsvej  
3, DK-2970 Hoersholm (DK). **KOSTENIS, Evi** [DE/DK];  
7TM Pharma A/S, Fremtidsvej 3, DK-2970 Hoersholm  
(DK). **HÖGBERG, Thomas** [SE/SE]; 7TM Pharma A/S,  
Fremtidsvej 3, DK-2970 Hoersholm (DK). **RECEVEUR,**  
**Jean-Marie** [FR/DK]; 7TM Pharma A/S, Fremtidsvej  
3, DK-2970 Hoersholm (DK). **GRIMSTRUP, Marie**

## Published:

- with international search report
- before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments

For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.

(54) Title: SUBSTITUTED THIAZOLEACETIC AS CRTH2 LIGANDS



(57) Abstract: Compounds of formula (I) are useful for the treatment of disease responsive to modulation of CRTH2 receptor activity, such as asthma, rhinitis, allergic airway syndrome, and allergic rhinobronchitis; wherein X<sub>1</sub> is -S-, -O-, -N=N-. -NR<sub>7</sub>-, -CR<sub>7</sub>=CR<sub>8</sub>-, -CR<sub>7</sub>=N-, wherein R<sub>7</sub> and R<sub>8</sub> are independently hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl; A is a carboxyl group -COOH, or a carboxyl bioisostere; rings Ar<sup>2</sup> and Ar<sup>3</sup> each independently represent a phenyl or 5- or 6-membered monocyclic heteroaryl ring, or a bicyclic ring system consisting of a 5- or 6-membered carbocyclic or heterocyclic ring which is benz-fused or fused to a 5- or 6-membered monocyclic heteroaryl ring, said ring or ring system being optionally substituted; ring B is as defined for Ar<sup>2</sup> and Ar<sup>3</sup>, or an optionally substituted N-pyrrolidinyl, N-piperidinyl or N-azepinyl ring; s is 0 or 1; L<sub>1</sub>, L<sub>2</sub> and L<sub>4</sub> are linker radicals as defined in the description; Q<sub>1</sub> and Q<sub>2</sub> represent substituents as defined in the description.

WO 2005/116001 A1



## SUBSTITUTED THIAZOLEACETIC ACIDS AS CRTH2 LIGANDS

This invention relates to a class of compounds which are ligands of the CRTH2 receptor (Chemoattractant Receptor-homologous molecule expressed on T Helper cells type 2), and their use in the treatment of diseases responsive to modulation of CRTH2 receptor activity, principally diseases having a significant inflammatory component. The invention also relates to novel members of that class of ligands and pharmaceutical compositions containing them.

Background to the Invention

The natural ligand of the G-protein coupled receptor CRTH2 is prostaglandin D<sub>2</sub>. As its name implies, CRTH2 is expressed on T helper cells type 2 (TH<sub>2</sub> cells) but it is also known to be expressed on eosinophils and basophil cells. Cell activation as a result of binding of PGD<sub>2</sub> to the CRTH2 receptor results in a complex biological response, including release of inflammatory mediators. Elevated levels of PGD<sub>2</sub> are therefore associated with many diseases which have a strong inflammatory component, such as asthma, rhinitis and allergies. Blocking binding of PGD<sub>2</sub> to the CRTH2 receptor is therefore a useful therapeutic strategy for treatment of such diseases.

Some small molecule ligands of CRTH2, apparently acting as antagonists of PGD<sub>2</sub>, are known, for example as proposed in the following patent publications: WO 03/097042, WO 03/097598, WO 03/066046, WO 03/066047, WO 03/101961, WO 03/101981, GB 2388540, WO 04/089885 and WO 05/018529.

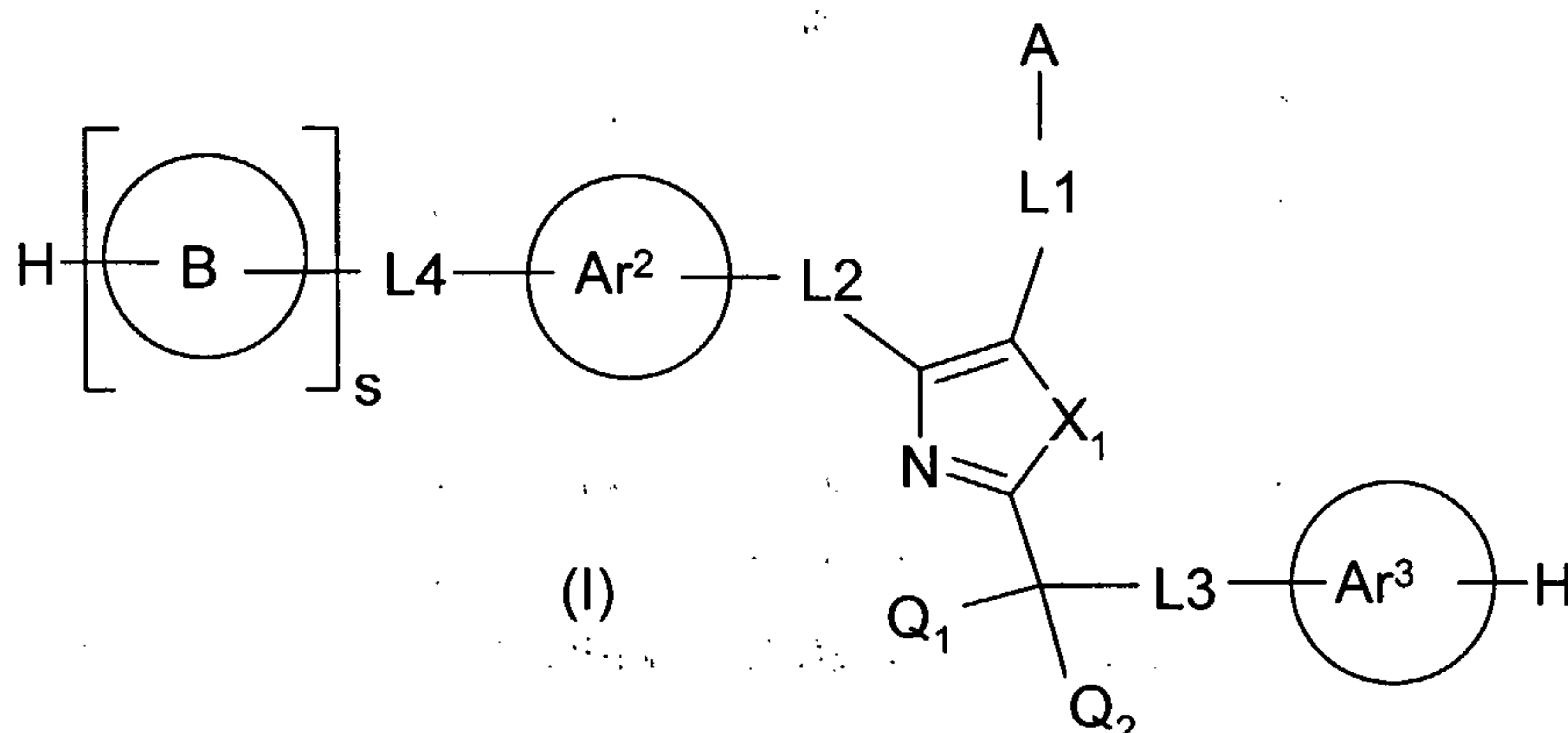
NSAIDs (non-steroidal anti-inflammatory drugs) constitute another class of anti-inflammatory agents. One NSAID is 4-(4-chlorophenyl)-2-phenyl thiazole-5 acetic acid (fentiazac). Some other thiazole compounds have been investigated as anti-inflammatory agents (see for example Nagatomi et. al. *Arzneimittel-Forschung* (1984), 34(5), 599-603; Bonina et. al. *Farmaco, Edizione Scientifica* (1987), 42(12), 905-13; Gioldanowski et. al. *Archivum Immunologiae et Therapiae Experimentalis*, 1978, 26, 921-929; Brown et. al. *J. Med. Chem.*, 1974, Vol 17, No.11 1177-1181; Attimarad et. al. *Asian J. Chem.* 2004, 16(1), 179-182; Japanese Patent publications JP07149745 and 07149746; and International patent publications WO 9727190, WO 2003103657

Brief Description of the Invention

The structures of the PGD2 antagonist compounds referred to in the foregoing publications have a bicyclic or tricyclic core ring system related to the indole core of indomethacin, a known anti-inflammatory agent, now known to bind to CRTH2. The present invention arises from the identification of a class of compounds having a 5- or 6-membered nitrogen-containing monocyclic core such as a thiazole ring, whose substituent moieties are orientated by the monocyclic core, to interact with and bind to CRTH2. The class of compounds with which this invention is concerned are thus capable of modulating CRTH2 activity, and are useful in the treatment of diseases which benefit from such modulation, for example asthma, allergy and rhinitis.

Detailed Description of the Invention

According to the present invention, there is provided a compound of formula (I) or a salt, hydrate or solvate thereof:



wherein

X<sub>1</sub> is -S-, -O-, -N=N-, -NR<sub>7</sub>-, -CR<sub>7</sub>=CR<sub>8</sub>-, -CR<sub>7</sub>=N-, wherein R<sub>7</sub> and R<sub>8</sub> are independently hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl;

A is a carboxyl group -COOH, or a carboxyl bioisostere;

rings Ar<sup>2</sup> and Ar<sup>3</sup> each independently represent a phenyl or 5- or 6-membered monocyclic heteroaryl ring, or a bicyclic ring system consisting of a 5- or 6-membered carbocyclic or heterocyclic ring which is benz-fused or fused to a 5- or 6-membered monocyclic heteroaryl ring, said ring or ring system being optionally substituted;

ring B is as defined for Ar<sup>2</sup> and Ar<sup>3</sup>, or an optionally substituted N-pyrrolidinyl, N-piperidinyl or N-azepinyl ring;



**s** is 0 or 1;

**L1** represents a divalent radical of formula  $-(\text{Alk}^1)_m-$  and **L2** and **L4** each independently represents a divalent radical of formula  $-(\text{Alk}^1)_m-(\text{Z})_n-(\text{Alk}^2)_p-$  wherein

**m**, **n** and **p** are independently 0 or 1,

**Alk<sup>1</sup>** and **Alk<sup>2</sup>** are independently optionally substituted straight or branched chain C<sub>1</sub>-C<sub>3</sub> alkylene or C<sub>2</sub>-C<sub>3</sub> alkenylene radicals which may contain a compatible -O-, -S- or -NR- link wherein R is hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl, and

**Z** is -O-, -S-, -C(=O)-, -SO<sub>2</sub>-, -SO-, -NR-, -NRSO<sub>2</sub>-, -C(=O)NR-, -NRCONH-, NRC(=NR)NH-, or =N-NR- wherein R is hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl; or a divalent 5- or 6-membered monocyclic carbocyclic or heterocyclic radical;

**L3** represents a divalent radical of formula  $-(\text{Alk}^3)_m-(\text{Z})_n-(\text{Alk}^2)_p-$  wherein **m**, **n**, **p**, **Alk<sup>2</sup>** and **Z** are as defined in relation to **L2** and **L4**, and **Alk<sup>3</sup>** is an optionally substituted straight or branched chain C<sub>1</sub>-C<sub>2</sub> alkylene or C<sub>1</sub>-C<sub>2</sub> alkenylene radical which may contain a compatible -O-, -S- or -NR- link wherein R is hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl;

**Q<sub>1</sub>** represents hydrogen or (C<sub>1</sub>-C<sub>6</sub>)alkyl;

**Q<sub>2</sub>** represents

(i) (C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>6</sub>)alkoxy, hydroxy, hydroxy(C<sub>1</sub>-C<sub>6</sub>)alkyl, nitrile (-CN), phenyl, phenoxy, monocyclic heteroaryl or heteroaryloxy with 5 or 6 ring atoms, -CONR<sup>A</sup>R<sup>B</sup>, -NR<sup>B</sup>COR<sup>A</sup>, -NR<sup>B</sup>SO<sub>2</sub>R<sup>A</sup> or -NR<sup>A</sup>CONR<sup>A</sup>R<sup>B</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring, and when **Q** is phenyl, phenoxy or monocyclic heteroaryl or heteroaryloxy with 5 or 6 ring atoms the phenyl or heteroaryl ring is optionally substituted by any of (C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>6</sub>)alkoxy, hydroxy, hydroxy(C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>3</sub>)alkylthio, halo, fully or partially fluorinated (C<sub>1</sub>-C<sub>3</sub>)alkyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy or (C<sub>1</sub>-C<sub>3</sub>)alkylthio, trifluoromethylthio, nitro, nitrile (-CN), -COOR<sup>A</sup>, -COR<sup>A</sup>, -OCOR<sup>A</sup>, -SO<sub>2</sub>R<sup>A</sup>, -CONR<sup>A</sup>R<sup>B</sup>, -SO<sub>2</sub>NR<sup>A</sup>R<sup>B</sup>, -NR<sup>A</sup>R<sup>B</sup>, -NR<sup>B</sup>COR<sup>A</sup>, -NR<sup>B</sup>COOR<sup>A</sup>, -NR<sup>B</sup>SO<sub>2</sub>R<sup>A</sup> or -NR<sup>A</sup>CONR<sup>A</sup>R<sup>B</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring, or

(ii) hydrogen, but only when, in L3, Z represents an optionally substituted divalent 5- or 6-membered monocyclic carbocyclic or heterocyclic radical;

or  $Q_1$  and  $Q_2$  taken together with the carbon atom to which they are attached form a  $C_3$ - $C_6$  cycloalkyl ring or a monocyclic non-aromatic heterocyclic ring with 4-6 ring atoms;

and wherein the total length of L2 and L3 does not exceed that of an unbranched saturated chain of 10 carbon atoms

In a narrower definition of the compounds (I), (i) the length of each of L2, L3 and L4 does not exceed that of an unbranched saturated chain of 5 atoms and (ii) the total length of L2, L3 and L4 does not exceed that of an unbranched saturated chain of 7 atoms, and (iii) none of L1, L2, L3 and L4 includes more than two R substituents different from hydrogen.

The compounds with which the invention is concerned are defined by reference to formula (I) as a result of studies towards elucidation of the ligand binding site of CRTH2. Such studies led to the overall conclusion that a general pharmacophore comprising one negatively charged moiety, represented by  $AL1^-$ , and two aromatic and/or hydrophobic moieties, represented by  $H(B)_sL4Ar^2L2$  and either the ring containing  $X_1$  or the ring containing  $X_1$  together with the  $H(Ar^3)L3C(Q_1)(Q_2)^-$  fragment, oriented in an approximate triangle, would form an arrangement for interaction with the receptor binding site. It was concluded that the substituent groupings  $AL1^-$ ,  $H(B)_sL4Ar^2L2^-$  should be on adjacent ring atoms of the ring containing  $X_1$ . The linkers L1, L2, L3 and L4 provide some flexibility to the molecule to facilitate optimum binding. The restrictions on the lengths of, and and substitutions in, the linkers L2, L3 and L4 are in order to restrict the total molecular size and complexity of structures for use in accordance with the invention. For the avoidance of doubt, the total length of L2 and L3 is, for the purposes of this description and claims, the sum  $n_2+n_3$ , where  $n_2$  is the number of connected atoms in the shortest chain of atoms from terminal atom to terminal atom of linker L2, and  $n_3$  is the number of connected atoms in the shortest chain of atoms from terminal atom to terminal atom of linker L2. Preferably the compounds with which the invention is concerned should have a molecular weight of no more than 600. Optional substituents in any element of the compounds (I) are permitted as in the definition of compounds (I). Such substituents can



modulate pharmacokinetic and solubility properties, as well as picking up additional binding interactions with the receptor.

In another aspect, the invention provides the use of a compound as defined and discussed herein in the manufacture of a composition for the treatment of disease responsive to modulation of CRTH2 receptor activity.

In another aspect, the invention provides a method of treatment of a subject suffering from a disease responsive to modulation of CRTH2 receptor activity, which comprised administering to the subject an amount of a compound (I) as defined and discussed herein, effective to ameliorate the disease.

In particular, compounds with which the invention is concerned are useful in the treatment of disease associated with elevated levels of prostaglandin D2 (PGD2) or one or more active metabolites thereof.

Examples of such diseases include asthma, rhinitis, allergic airway syndrome, allergic rhinobronchitis, bronchitis, chronic obstructive pulmonary disease (COPD), nasal polyposis, sarcoidosis, farmer's lung, fibroid lung, cystic fibrosis, chronic cough, conjunctivitis, atopic dermatitis, Alzheimer's disease, amyotrophic lateral sclerosis, AIDS dementia complex, Huntington's disease, frontotemporal dementia, Lewy body dementia, vascular dementia, Guillain-Barre syndrome, chronic demyelinating polyradiculoneuropathy, multifocal motor neuropathy, plexopathy, multiple sclerosis, encephalomyelitis, panencephalitis, cerebellar degeneration and encephalomyelitis, CNS trauma, migraine, stroke, rheumatoid arthritis, ankylosing spondylitis, Behçet's Disease, bursitis, carpal tunnel syndrome, inflammatory bowel disease, Crohn's disease, ulcerative colitis, dermatomyositis, Ehlers-Danlos Syndrome (EDS), fibromyalgia, myofascial pain, osteoarthritis (OA), osteonecrosis, psoriatic arthritis, Reiter's syndrome (reactive arthritis), sarcoidosis, scleroderma, Sjogren's Syndrome, soft tissue disease, Still's Disease, tendinitis, polyarteritis Nodosa, Wegener's Granulomatosis, myositis (polymyositis dermatomyositis), gout, atherosclerosis, lupus erythematosus, systemic lupus erythematosus (SLE), type I diabetes, nephritic syndrome, glomerulonephritis, acute and chronic renal failure, eosinophilia fascitis, hyper IgE syndrome, sepsis, septic shock, ischemic reperfusion injury in the heart, allograft rejection after transplantations, and graft versus host disease.



However, the compounds with which the invention is concerned are primarily of value for the treatment asthma, rhinitis, allergic airway syndrome, and allergic rhinobronchitis

As used herein, the term " $(C_a-C_b)$ alkyl" wherein a and b are integers refers to a straight or branched chain alkyl radical having from a to b carbon atoms. Thus when a is 1 and b is 6, for example, the term includes methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, sec-butyl, t-butyl, n-pentyl and n-hexyl.

As used herein the term "divalent  $(C_a-C_b)$ alkylene radical" wherein a and b are integers refers to a saturated hydrocarbon chain having from a to b carbon atoms and two unsatisfied valences.

As used herein the term " $(C_a-C_b)$ alkenyl" wherein a and b are integers refers to a straight or branched chain alkenyl moiety having from a to b carbon atoms having at least one double bond of either E or Z stereochemistry where applicable. The term includes, for example, vinyl, allyl, 1- and 2-butenyl and 2-methyl-2-propenyl.

As used herein the term "divalent  $(C_a-C_b)$ alkenylene radical" means a hydrocarbon chain having from a to a carbon atoms, at least one double bond, and two unsatisfied valences.

As used herein the term " $C_a-C_b$  alkynyl" wherein a and b are integers refers to straight chain or branched chain hydrocarbon groups having from two to six carbon atoms and having in addition one triple bond. This term would include for example, ethynyl, 1- and 2-propynyl, 1-, 2- and 3-butyne, 1, 2-, 3- and 4-pentyne, 1-, 2-, 3-, 4- and 5-hexynyl, 3-methyl-1-butyne, 1-methyl-2-pentyne.

As used herein the term "divalent  $(C_a-C_b)$ alkynylene radical" wherein a and b are integers refers to a divalent hydrocarbon chain having from 2 to 6 carbon atoms, at least one triple bond, and two unsatisfied valences.

As used herein the term "carbocyclic" refers to a mono-, bi- or tricyclic radical having up to 16 ring atoms, all of which are carbon, and includes aryl and cycloalkyl.

As used herein the term "cycloalkyl" refers to a monocyclic saturated carbocyclic radical having from 3-8 carbon atoms and includes, for example, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, cycloheptyl and cyclooctyl.

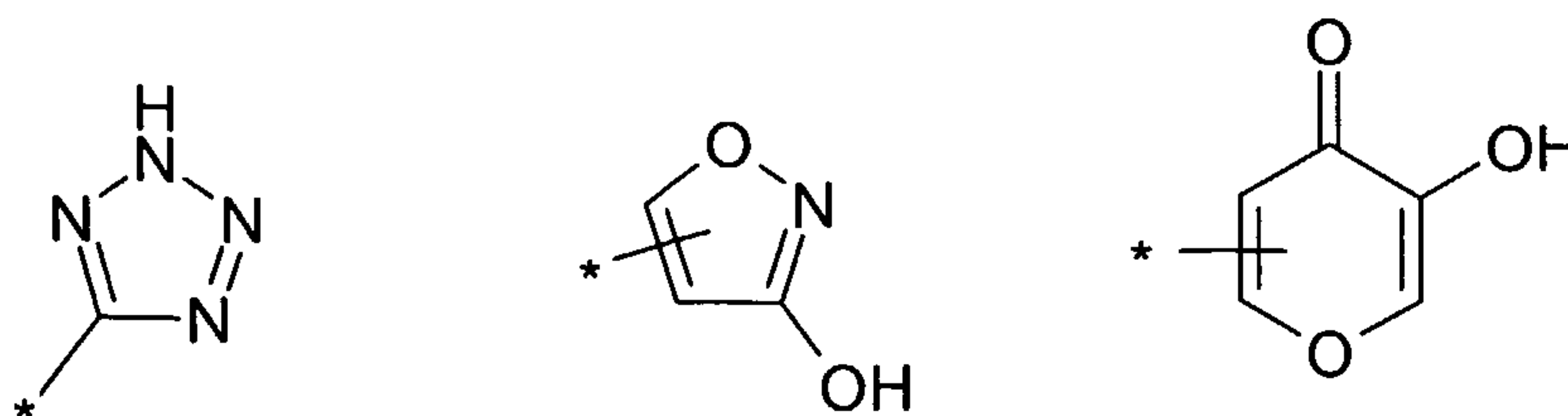
As used herein the unqualified term "aryl" refers to a mono-, bi- or tri-cyclic carbocyclic aromatic radical, and includes radicals having two monocyclic carbocyclic aromatic rings which are directly linked by a covalent bond. Illustrative of such radicals are phenyl, biphenyl and naphthyl.

As used herein the unqualified term "heteroaryl" refers to a mono-, bi- or tri-cyclic aromatic radical containing one or more heteroatoms selected from S, N and O, and includes radicals having two such monocyclic rings, or one such monocyclic ring and one monocyclic aryl ring, which are directly linked by a covalent bond. Illustrative of such radicals are thienyl, benzthienyl, furyl, benzfuryl, pyrrolyl, imidazolyl, benzimidazolyl, thiazolyl, benzthiazolyl, isothiazolyl, benzisothiazolyl, pyrazolyl, oxazolyl, benzoxazolyl, isoxazolyl, benzisoxazolyl, isothiazolyl, triazolyl, benztriazolyl, thiadiazolyl, oxadiazolyl, pyridinyl, pyridazinyl, pyrimidinyl, pyridazinyl, triazinyl, indolyl and indazolyl.

As used herein the unqualified term "heterocyclyl" or "heterocyclic" includes "heteroaryl" as defined above, and in addition means a mono-, bi- or tri-cyclic non-aromatic radical containing one or more heteroatoms selected from S, N and O, and to groups consisting of a monocyclic non-aromatic radical containing one or more such heteroatoms which is covalently linked to another such radical or to a monocyclic carbocyclic radical. Illustrative of such radicals are pyrrolyl, furanyl, thienyl, piperidinyl, imidazolyl, oxazolyl, isoxazolyl, thiazolyl, thiadiazolyl, pyrazolyl, pyridinyl, pyrrolidinyl, pyrimidinyl, morpholinyl, piperazinyl, indolyl, morpholinyl, benzfuranyl, pyranyl, isoxazolyl, benzimidazolyl, methylenedioxyphenyl, ethylenedioxyphenyl, maleimido and succinimido groups.

The term "carboxyl bioisostere" is a term familiar to medicinal chemists (see for example "The Organic Chemistry of Drug Design and Drug Action", by Richard B. Silverman, pub. Academic Press, 1992), and refers to a group which has similar acid-base characteristics to those of a carboxyl group. Well known carboxyl bioisosteres include  $-\text{SO}_2\text{NHR}$  or  $-\text{P}(=\text{O})(\text{OH})(\text{OR})$  wherein R is, for example, hydrogen methyl or ethyl,  $-\text{SO}_2\text{OH}$ ,  $-\text{P}(=\text{O})(\text{OH})(\text{NH}_2)$ ,  $-\text{C}(=\text{O})\text{NHCN}$  and groups of formulae:





Unless otherwise specified in the context in which it occurs, the term "substituted" as applied to any moiety herein means substituted with up to four compatible substituents, each of which independently may be, for example, (C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>6</sub>)alkoxy, hydroxy, hydroxy(C<sub>1</sub>-C<sub>6</sub>)alkyl, mercapto, mercapto(C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>6</sub>)alkylthio, halo (including fluoro, bromo and chloro), fully or partially fluorinated (C<sub>1</sub>-C<sub>3</sub>)alkyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy or (C<sub>1</sub>-C<sub>3</sub>)alkylthio such as trifluoromethyl, trifluoromethoxy, and trifluoromethylthio, nitro, nitrile (-CN), oxo, phenyl, phenoxy, monocyclic heteroaryl or heteroaryloxy with 5 or 6 ring atoms, -COOR<sup>A</sup>, -COR<sup>A</sup>, -OCOR<sup>A</sup>, -SO<sub>2</sub>R<sup>A</sup>, -CONR<sup>A</sup>R<sup>B</sup>, -SO<sub>2</sub>NR<sup>A</sup>R<sup>B</sup>, -NR<sup>A</sup>R<sup>B</sup>, OCONR<sup>A</sup>R<sup>B</sup>, -NR<sup>B</sup>COR<sup>A</sup>, -NR<sup>B</sup>COOR<sup>A</sup>, -NR<sup>B</sup>SO<sub>2</sub>OR<sup>A</sup> or -NR<sup>A</sup>CONR<sup>A</sup>R<sup>B</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group or, in the case where R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom, R<sup>A</sup> and R<sup>B</sup> taken together with that nitrogen may form a cyclic amino ring. Where the substituent is phenyl, phenoxy or monocyclic heteroaryl or heteroaryloxy with 5 or 6 ring atoms, the phenyl or heteroaryl ring thereof may itself be substituted by any of the above substituents except phenyl phenoxy, heteroaryl or heteroaryloxy. An "optional substituent" may be one of the foregoing substituent groups.

As used herein the term "salt" includes base addition, acid addition and quaternary salts. Compounds of the invention which are acidic can form salts, including pharmaceutically acceptable salts, with bases such as alkali metal hydroxides, e.g. sodium and potassium hydroxides; alkaline earth metal hydroxides e.g. calcium, barium and magnesium hydroxides; with organic bases e.g. N-methyl-D-glucamine, choline tris(hydroxymethyl)amino-methane, L-arginine, L-lysine, N-ethyl piperidine, dibenzylamine and the like. Those compounds (I) which are basic can form salts, including pharmaceutically acceptable salts with inorganic acids, e.g. with hydrohalic acids such as hydrochloric or hydrobromic acids, sulphuric acid, nitric acid or phosphoric acid and the like, and with organic acids e.g. with acetic, tartaric, succinic, fumaric, maleic, malic, salicylic, citric, methanesulphonic, p-toluenesulphonic, benzoic, benzenesulfonic, glutamic, lactic, and mandelic acids and the like.



Compounds with which the invention is concerned which may exist in one or more stereoisomeric form, because of the presence of asymmetric atoms or rotational restrictions, can exist as a number of stereoisomers with R or S stereochemistry at each chiral centre or as atropisomers with R or S stereochemistry at each chiral axis. The invention includes all such enantiomers and diastereoisomers and mixtures thereof.

Use of prodrugs, such as esters, of compounds (I) with which the invention is concerned is also part of the invention.

For use in accordance with the invention, the following structural characteristics are currently preferred, in any compatible combination, in the compounds (I):

Q<sub>1</sub> is hydrogen, and Q<sub>2</sub> is phenyl or monocyclic heteroaryl with 5 or 6 ring atoms optionally substituted by any of (C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>6</sub>)alkoxy, hydroxy, hydroxy(C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>3</sub>)alkylthio, halo, fully or partially fluorinated (C<sub>1</sub>-C<sub>3</sub>)alkyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy or (C<sub>1</sub>-C<sub>3</sub>)alkylthio, trifluoromethylthio, nitro, nitrile (-CN), -COOR<sup>A</sup>, -COR<sup>A</sup>, -OCOR<sup>A</sup>, -SO<sub>2</sub>R<sup>A</sup>, -CONR<sup>A</sup>R<sup>B</sup>, -SO<sub>2</sub>NR<sup>A</sup>R<sup>B</sup>, -NR<sup>A</sup>R<sup>B</sup>, -NR<sup>B</sup>COR<sup>A</sup>, -NR<sup>B</sup>COOR<sup>A</sup>, -NR<sup>B</sup>SO<sub>2</sub>OR<sup>A</sup> or -NR<sup>A</sup>CONR<sup>A</sup>R<sup>B</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring; or

Q<sub>1</sub> is hydrogen, and Q<sub>2</sub> is phenyl, optionally substituted by any of fluoro, chloro, bromo, (C<sub>1</sub>-C<sub>3</sub>)alkyl, trifluoromethyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano, (C<sub>1</sub>-C<sub>3</sub>alkyl)SO<sub>2</sub>-, NH<sub>2</sub>SO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)NHSO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)<sub>2</sub>NSO<sub>2</sub>-, -CONR<sup>A</sup>R<sup>B</sup>, and -NR<sup>B</sup>COR<sup>A</sup>. wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring.

L3 is -CH<sub>2</sub>-, -O-, -S-, -SO<sub>2</sub>-, -NHC(=O)-, -CH=CH-, -NR<sub>11</sub>-, or -NR<sub>11</sub>CH<sub>2</sub>-, wherein R<sub>11</sub> is hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl; or

L3 represents a divalent radical of formula -(Alk<sup>3</sup>)<sub>m</sub>-(Z)<sub>n</sub>-(Alk<sup>2</sup>)<sub>p</sub>- wherein m is 0, n is 1, and Z is a phenylene radical optionally substituted by one or more of fluoro, chloro, bromo, (C<sub>1</sub>-C<sub>3</sub>)alkyl, trifluoromethyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano, (C<sub>1</sub>-C<sub>3</sub>alkyl)SO<sub>2</sub>-, NH<sub>2</sub>SO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)NHSO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)<sub>2</sub>NSO<sub>2</sub>-, -CONR<sup>A</sup>R<sup>B</sup>, and -

$\text{NR}^{\text{B}}\text{COR}^{\text{A}}$ . wherein  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are independently hydrogen or a  $(\text{C}_1\text{-C}_6)$ alkyl group, or  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are linked to the same N atom to form a cyclic amino ring. In these cases, Z may be, for example, a 1, 2-phenylene radical optionally substituted by one or more of fluoro, chloro, bromo,  $(\text{C}_1\text{-C}_3)$ alkyl, trifluoromethyl,  $(\text{C}_1\text{-C}_3)$ alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano,  $(\text{C}_1\text{-C}_3\text{alkyl})\text{SO}_2^-$ ,  $\text{NH}_2\text{SO}_2^-$ ,  $(\text{C}_1\text{-C}_3\text{alkyl})\text{NHSO}_2^-$ ,  $(\text{C}_1\text{-C}_3\text{alkyl})_2\text{NSO}_2^-$ ,  $-\text{CONR}^{\text{A}}\text{R}^{\text{B}}$ , and  $-\text{NR}^{\text{B}}\text{COR}^{\text{A}}$  wherein  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are independently hydrogen or a  $(\text{C}_1\text{-C}_6)$ alkyl group, or  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are linked to the same N atom to form a cyclic amino ring..

In particular,  $\text{Q}_1$  may be hydrogen,  $\text{X}_1$  may be  $-\text{S}-$ , and A is may be carboxyl group  $-\text{COOH}$ ;

L1 is a bond,  $-\text{CR}_{11}\text{R}_{12}-$ ,  $^*\text{-CH}_2\text{CR}_{11}\text{R}_{12}-$ ,  $^*\text{-OCR}_{11}\text{R}_{12}-$ ,  $^*\text{-SCR}_{11}\text{R}_{12}-$ ,  $^*\text{-NR}_{11}\text{CH}_2-$  or  $-\text{NR}_{11}-$  wherein  $\text{R}_{11}$  and  $\text{R}_{12}$  are independently hydrogen or  $\text{C}_1\text{-C}_3$  alkyl, the bond marked with an asterisk being the one connected to the ring containing  $\text{X}^1$ . For example L1 may be  $-\text{CH}_2-$  or  $-\text{CH}(\text{CH}_3)-$ .

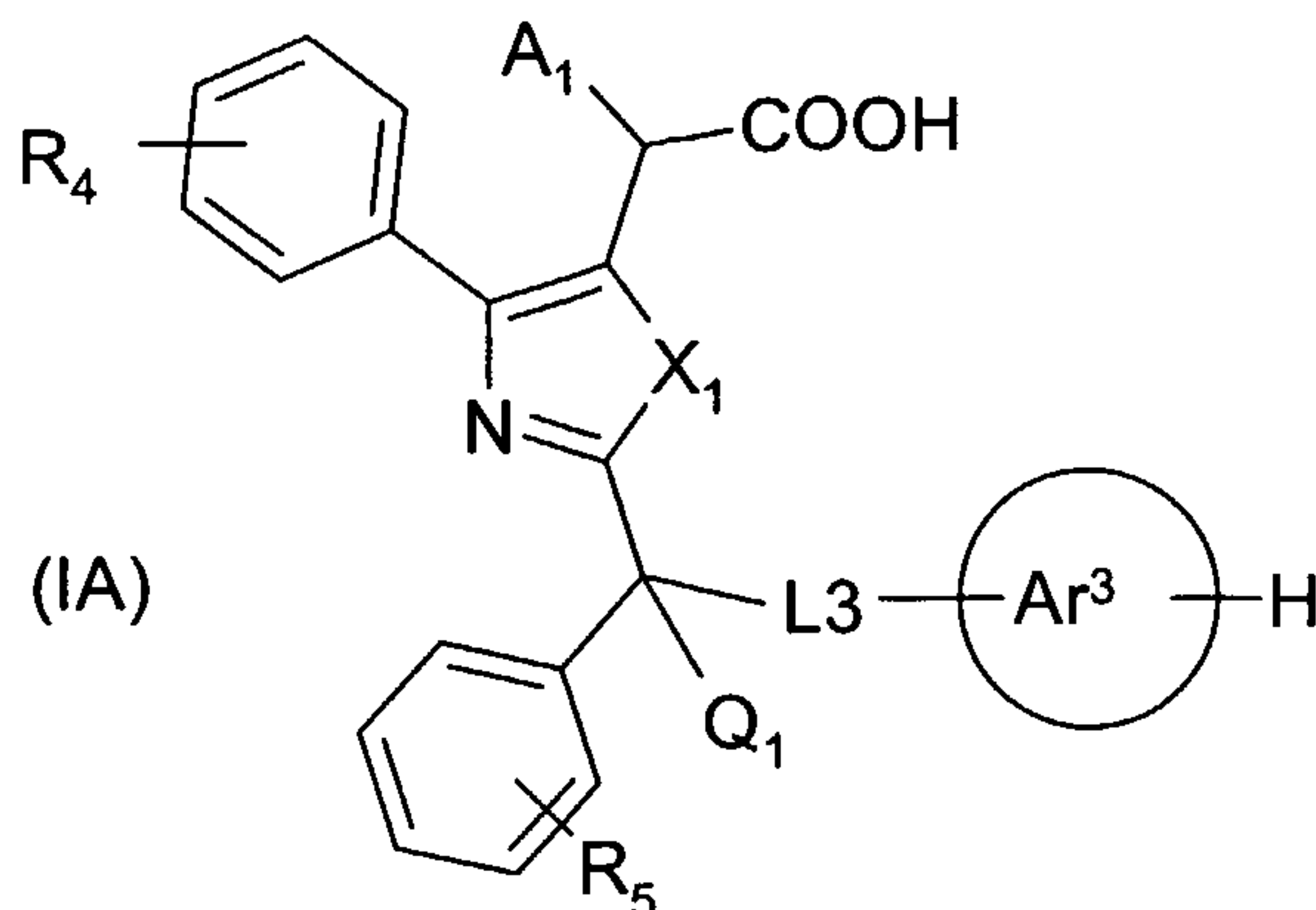
$\text{Ar}^3$  is phenyl, thienyl, naphthyl or 2-, 3- or 4-pyridyl, any of which is optionally substituted, for example by one or more substituents selected from fluoro, chloro, bromo,  $(\text{C}_1\text{-C}_3)$ alkyl, trifluoromethyl,  $(\text{C}_1\text{-C}_3)$ alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano,  $(\text{C}_1\text{-C}_3\text{alkyl})\text{SO}_2^-$ ,  $\text{NH}_2\text{SO}_2^-$ ,  $(\text{C}_1\text{-C}_3\text{alkyl})\text{NHSO}_2^-$ ,  $(\text{C}_1\text{-C}_3\text{alkyl})_2\text{NSO}_2^-$ ,  $-\text{CONR}^{\text{A}}\text{R}^{\text{B}}$ , and  $-\text{NR}^{\text{B}}\text{COR}^{\text{A}}$  wherein  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are independently hydrogen or a  $(\text{C}_1\text{-C}_6)$ alkyl group, or  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are linked to the same N atom to form a cyclic amino ring;

L2 is a bond and  $\text{Ar}^2$  is an optionally substituted phenyl, thienyl, furanyl, pyrrolyl or pyridyl ring, optional substituents being selected from fluoro, chloro, bromo,  $(\text{C}_1\text{-C}_3)$ alkyl, trifluoromethyl,  $(\text{C}_1\text{-C}_3)$ alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano,  $(\text{C}_1\text{-C}_3\text{alkyl})\text{SO}_2^-$ ,  $\text{NH}_2\text{SO}_2^-$ ,  $(\text{C}_1\text{-C}_3\text{alkyl})\text{NHSO}_2^-$ ,  $(\text{C}_1\text{-C}_3\text{alkyl})_2\text{NSO}_2^-$ ,  $-\text{CONR}^{\text{A}}\text{R}^{\text{B}}$ , and  $-\text{NR}^{\text{B}}\text{COR}^{\text{A}}$  wherein  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are independently hydrogen or a  $(\text{C}_1\text{-C}_6)$ alkyl group, or  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are linked to the same N atom to form a cyclic amino ring;

s is 0.



One preferred subclass of the compounds with which the invention is concerned consists of compounds of formula (IA), and salts, hydrates and solvates thereof:



wherein  $A_1$  is hydrogen or methyl,  $X_1$ ,  $Q_1$ ,  $Ar^3$  and  $L3$  are as defined and discussed above, and  $R_4$  and  $R_5$  independently represent hydrogen or one or more optional substituents. In this subclass, it is currently preferred that

$A_1$  is hydrogen,

$Q_1$  is hydrogen,

$X_1$  is  $-S-$ ,

$Ar^3$  is optionally substituted phenyl,

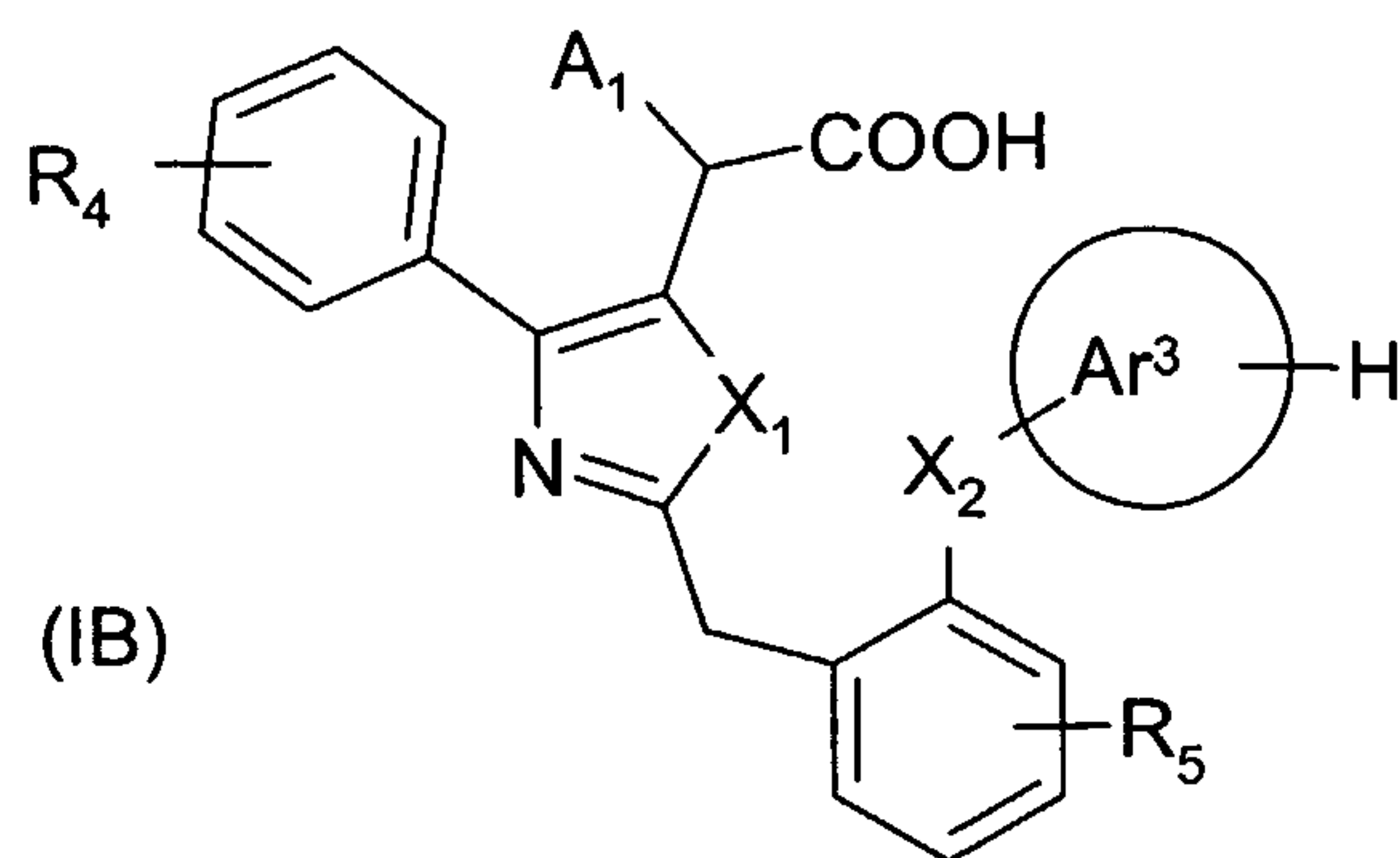
$L3$  is a bond,  $-O-$ ,  $-S-$ , or  $-NR-$  wherein  $R$  is hydrogen or  $C_1$ - $C_3$  alkyl.

Particularly preferred in this subclass are compounds (IA) wherein  $A_1$  is hydrogen,  $Q_1$  is hydrogen,  $X_1$  is  $-S-$ ,  $Ar^3$  is optionally substituted phenyl and  $L3$  is a bond.

In this subclass, optional substituents  $R_4$  and  $R_5$  and optional substituents in  $Ar^3$  are preferably independently selected from fluoro, chloro, bromo,  $(C_1-C_3)$ alkyl, trifluoromethyl,  $(C_1-C_3)$ alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano,  $(C_1-C_3)$ alkyl) $SO_2-$ ,  $NH_2SO_2-$ ,  $(C_1-C_3)$ alkyl) $NHSO_2-$ ,  $(C_1-C_3)$ alkyl) $_2NSO_2-$ ,  $-CONR^A R^B$ , and  $-NR^B COR^A$  wherein  $R^A$  and  $R^B$  are independently hydrogen or a  $(C_1-C_6)$ alkyl group, or  $R^A$  and  $R^B$  are linked to the same N atom to form a cyclic amino ring.

One preferred subclass of the compounds with which the invention is concerned consists of compounds of formula (IA), and salts, hydrates and solvates thereof:





wherein  $A_1$  is hydrogen or methyl,  $X_2$  is a bond,  $-\text{CH}_2-$ ,  $-\text{O}-$ ,  $-\text{S}-$ , or  $-\text{NR}-$  wherein R is hydrogen or  $\text{C}_1$ - $\text{C}_3$  alkyl and  $X_1$  and  $\text{Ar}^3$  are as defined in claim 1, and  $R_4$  and  $R_5$  independently represent hydrogen or one or more optional substituents. In this subclass, it is currently preferred that

$A_1$  is hydrogen,

$X_1$  is  $-\text{S}-$ ,

$\text{Ar}^3$  is optionally substituted phenyl,

$X_2$  is  $-\text{CH}_2-$  or a bond.

In this subclass, optional substituents  $R_4$  and  $R_5$  and optional substituents in  $\text{Ar}^3$  are independently selected from fluoro, chloro, bromo,  $(\text{C}_1$ - $\text{C}_3)$ alkyl, trifluoromethyl,  $(\text{C}_1$ - $\text{C}_3)$ alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano,  $(\text{C}_1$ - $\text{C}_3$ alkyl) $\text{SO}_2-$ ,  $\text{NH}_2\text{SO}_2-$ ,  $(\text{C}_1$ - $\text{C}_3$ alkyl) $\text{NHSO}_2-$ ,  $(\text{C}_1$ - $\text{C}_3$ alkyl) $_2\text{NSO}_2-$ ,  $-\text{CONR}^A\text{R}^B$ , and  $-\text{NR}^B\text{COR}^A$  wherein  $\text{R}^A$  and  $\text{R}^B$  are independently hydrogen or a  $(\text{C}_1$ - $\text{C}_6)$ alkyl group, or  $\text{R}^A$  and  $\text{R}^B$  are linked to the same N atom to form a cyclic amino ring.

Specific examples of compounds with which the invention is concerned include:

[2-benzhydryl-4-(4-chlorophenyl)-thiazol-5-yl]-acetic acid,  
 [2-benzhydryl-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-[1-(4-chloro-phenyl)-2-phenyl-ethyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 {4-(4-chloro-phenyl)-2-[(4-chloro-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid,  
 [2-[(4-chloro-phenyl)-phenyl-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-[bis-(4-fluoro-phenyl)-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 {4-(4-fluoro-phenyl)-2-[(4-methoxy-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid,  
 {4-(4-chloro-phenyl)-2-[(4-methoxy-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid,  
 [2-[(3,4-difluoro-phenyl)-phenyl-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-[bis-(4-methoxy-phenyl)-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,

[2-benzhydryl-4-(3-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
[2-[bis-(4-fluoro-phenyl)-methyl]-4-(3,4-difluoro-phenyl)-thiazol-5-yl]-acetic acid,  
[2-benzhydryl-4-(3,4-difluoro-phenyl)-thiazol-5-yl]-acetic acid,  
[2-[bis-(4-fluoro-phenyl)-methyl]-4-(3-fluoro-phenyl)-thiazol-5-yl]-acetic acid,

and salts hydrates and solvates thereof.

The invention also includes pharmaceutical compositions comprising a compound formula (II) or (IIA) together with a pharmaceutically acceptable carrier.

### Compositions

As mentioned above, the compounds with which the invention is concerned are capable of modulating CRTH2 activity, and are useful in the treatment of diseases which benefit from such modulation. Examples of such diseases are referred to above, and include asthma, rhinitis, allergic airway syndrome, and allergic rhinobronchitis.

It will be understood that the specific dose level for any particular patient will depend upon a variety of factors including the activity of the specific compound employed, the age, body weight, general health, sex, diet, time of administration, route of administration, rate of excretion, drug combination and the severity of the particular disease undergoing treatment. Optimum dose levels and frequency of dosing will be determined by clinical trial, as is required in the pharmaceutical art.

The compounds with which the invention is concerned may be prepared for administration by any route consistent with their pharmacokinetic properties. The orally administrable compositions may be in the form of tablets, capsules, powders, granules, lozenges, liquid or gel preparations, such as oral, topical, or sterile parenteral solutions or suspensions. Tablets and capsules for oral administration may be in unit dose presentation form, and may contain conventional excipients such as binding agents, for example syrup, acacia, gelatin, sorbitol, tragacanth, or polyvinyl-pyrrolidone; fillers for example lactose, sugar, maize-starch, calcium phosphate, sorbitol or glycine; tableting lubricant, for example magnesium stearate, talc, polyethylene glycol or silica; disintegrants for example potato starch, or acceptable wetting agents such as sodium lauryl sulphate. The tablets may be coated according to methods well known in normal pharmaceutical practice. Oral



liquid preparations may be in the form of, for example, aqueous or oily suspensions, solutions, emulsions, syrups or elixirs, or may be presented as a dry product for reconstitution with water or other suitable vehicle before use. Such liquid preparations may contain conventional additives such as suspending agents, for example sorbitol, syrup, methyl cellulose, glucose syrup, gelatin hydrogenated edible fats; emulsifying agents, for example lecithin, sorbitan monooleate, or acacia; non-aqueous vehicles (which may include edible oils), for example almond oil, fractionated coconut oil, oily esters such as glycerine, propylene glycol, or ethyl alcohol; preservatives, for example methyl or propyl p-hydroxybenzoate or sorbic acid, and if desired conventional flavouring or colouring agents.

For topical application to the skin, the drug may be made up into a cream, lotion or ointment. Cream or ointment formulations which may be used for the drug are conventional formulations well known in the art, for example as described in standard textbooks of pharmaceutics such as the British Pharmacopoeia.

For topical application to the eye, the drug may be made up into a solution or suspension in a suitable sterile aqueous or non aqueous vehicle. Additives, for instance buffers such as sodium metabisulphite or disodium edeate; preservatives including bactericidal and fungicidal agents such as phenyl mercuric acetate or nitrate, benzalkonium chloride or chlorhexidine, and thickening agents such as hypromellose may also be included.

The drug may also be formulated for inhalation, for example as a nasal spray, or dry powder or aerosol inhalers.

The active ingredient may also be administered parenterally in a sterile medium. Depending on the vehicle and concentration used, the drug can either be suspended or dissolved in the vehicle. Advantageously, adjuvants such as a local anaesthetic, preservative and buffering agents can be dissolved in the vehicle.

The compounds with which the invention is concerned may be administered alone, or as part of a combination therapy with other drugs used for treatment of diseases with a major inflammatory component. In the case of asthma, rhinitis, and allergic airway syndrome such drugs include corticosteroids, long-acting inhaled beta-agonists, beta agonists, cromolyn, nedocromil, theophylline, leukotriene receptor antagonists,



antihistamines, and anticholinergics (e.g. ipratropium), and are often administered as nasal sprays, dry powder or aerosol inhalers.

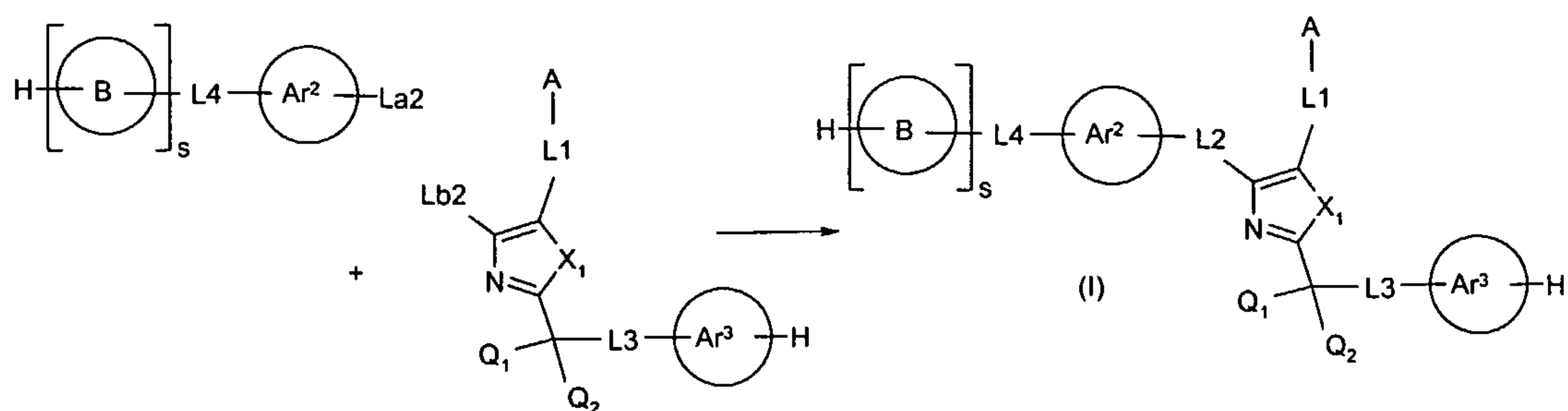
In the case of arthritis and related inflammatory diseases other known drugs include glucocorticoids, NSAIDs (Non Steroidal Anti-Inflammatory Drugs – conventional prostaglandin synthesis inhibitors, COX-2 inhibitors, salicylates), and DMARDs (disease-modifying anti-rheumatic drugs such as methotrexate, sulfasalazine, gold, cyclosporine).

### Synthetic Routes

There are multiple synthetic strategies for the synthesis of the compounds (I) with which the present invention is concerned, but all rely on known chemistry, known to the synthetic organic chemist. Thus, compounds according to formula (I) can be synthesised according to procedures described in the standard literature and are well-known to the one skilled in the art. Typical literature sources are “*Advanced organic chemistry*”, 4<sup>th</sup> Edition (Wiley), J March, “*Comprehensive Organic Transformation*”, 2<sup>nd</sup> Edition (Wiley), R.C. Larock, “*Handbook of Heterocyclic Chemistry*”, 2<sup>nd</sup> Edition (Pergamon), A.R. Katritzky), review articles such as found in “*Synthesis*”, “*Acc. Chem. Res.*”, “*Chem. Rev*”, or primary literature sources identified by standard literature searches online or from secondary sources such as “*Chemical Abstracts*” or “*Beilstein*”.

In the following discussion of synthetic routes, the ring “Ar<sup>1</sup>” is the ring shown in formula (I) containing X<sub>1</sub>.

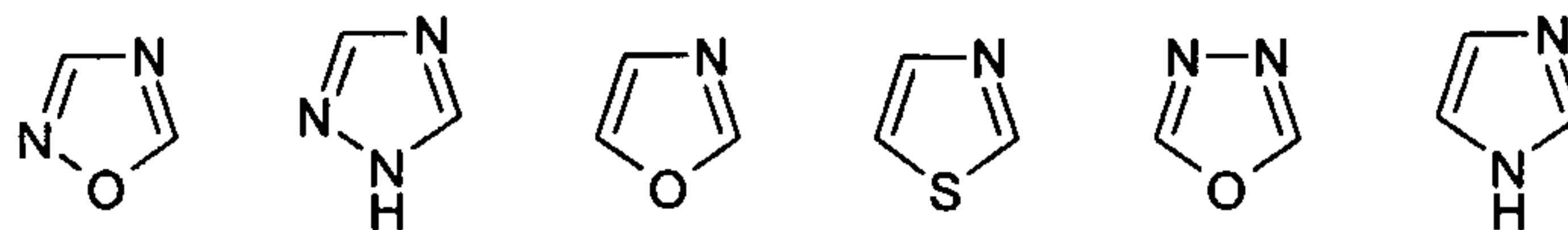
The linker L2 can be formed by joining two appropriately functionalised and, if needed, suitably protected fragments containing La2 and Lb2 as reactive moieties as outlined below. La2 and Lb2 are defined as any moieties that can react by e.g. a nucleophilic substitution, addition to multiple bonds or cyclisation reaction to form a given L2 linker as in:



For example, the linker -L2- being  $-\text{Alk}^1\text{-Z-(Alk}^2)_p\text{-}$  can be formed by reacting  $\text{HBL4Ar}^2\text{-Alk}^1\text{-"leaving group"}$  with a nucleophilic derivative  $\text{H-Z-(Alk}^2)_p\text{-Ar}^1(\text{L1A})\text{L3Ar}^3\text{H}$  wherein Z could be O, S or NR and  $\text{Alk}^1$  could be an alkyl group. The reactions can also be made by reversing the functionalisation of La2 and Lb2 to make the connection between Z and  $\text{Alk}^2$ . The linkers having Z being SO or  $\text{SO}_2$  can be obtained by oxidations of the corresponding  $-(\text{Alk}^1)_m\text{-S-(Alk}^2)_p\text{-}$  derivatives during appropriate conditions.

Further representative examples, -L2- being  $-\text{Alk}^1\text{-Z-(Alk}^2)_p\text{-}$  wherein Z is  $\text{NH(CO)}$  or  $\text{NHSO}_2$  can be formed by reacting  $\text{HBL4Ar}^2\text{-(Alk}^1\text{)-NH}_2$  with an acylating derivative "leaving group"- $\text{CO-(Alk}^2)_p\text{-Ar}^1(\text{L1A})\text{L3Ar}^3\text{H}$  or "leaving group"- $\text{SO}_2\text{-(Alk}^2)_p\text{-Ar}^1(\text{L1A})\text{L3Ar}^3\text{H}$ , respectively. Alternatively, the conversion can be made directly with the acids  $\text{HO-CO-(Alk}^2)_p\text{-Ar}^1(\text{L1A})\text{L3Ar}^3\text{H}$  and  $\text{HO-SO}_2\text{-(Alk}^2)_p\text{-Ar}^1(\text{L1A})\text{L3Ar}^3\text{H}$ , respectively, using suitable coupling reagents such as dicyclohexylcarbodiimide (DCC), and promoters such as 1-hydroxybenzotriazole. Analogously, -L2- being  $-\text{Alk}^1\text{-Z-(Alk}^2)_p\text{-}$  wherein Z being  $\text{NH(CO)NH}$  can be formed by reacting  $\text{HBL4Ar}^2\text{-(Alk}^1\text{)-NH}_2$  with an isocyanate derivative  $\text{OCN-(Alk}^2)_p\text{-Ar}^1(\text{L1A})\text{L3Ar}^3\text{H}$  using suitable acid or base catalysis. The reactions can also be made by reversing the functionalisation of La2 and Lb2 to provide the "retro-bonds" in the case of  $\text{NH(CO)}$  or  $\text{NHSO}_2$ . Analogously, the connections can be made between Z and  $\text{Alk}^2$ .

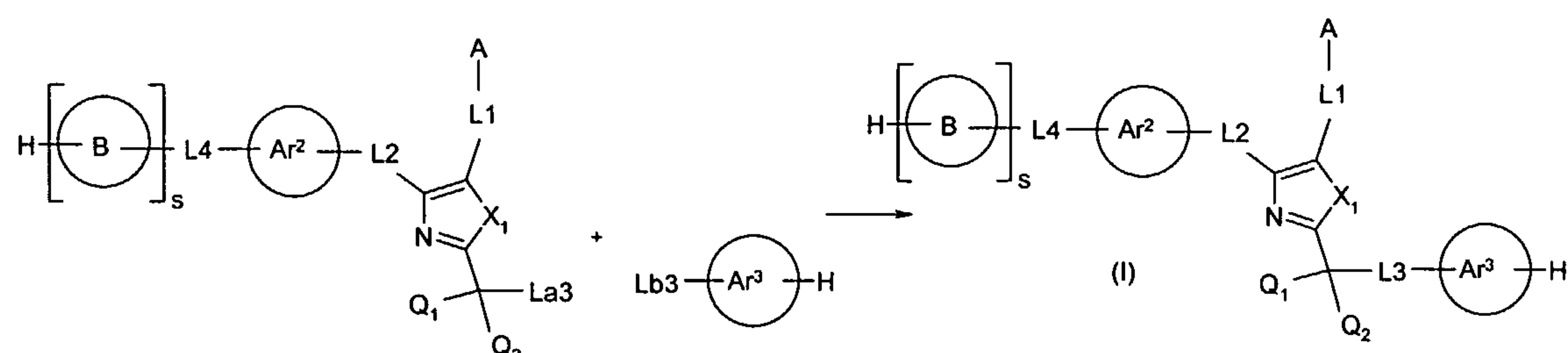
Likewise, L2 being  $-(\text{Alk}^1)_m\text{-Z-(Alk}^2)_p\text{-}$  wherein Z is a 5-membered heterocyclic system exemplified by



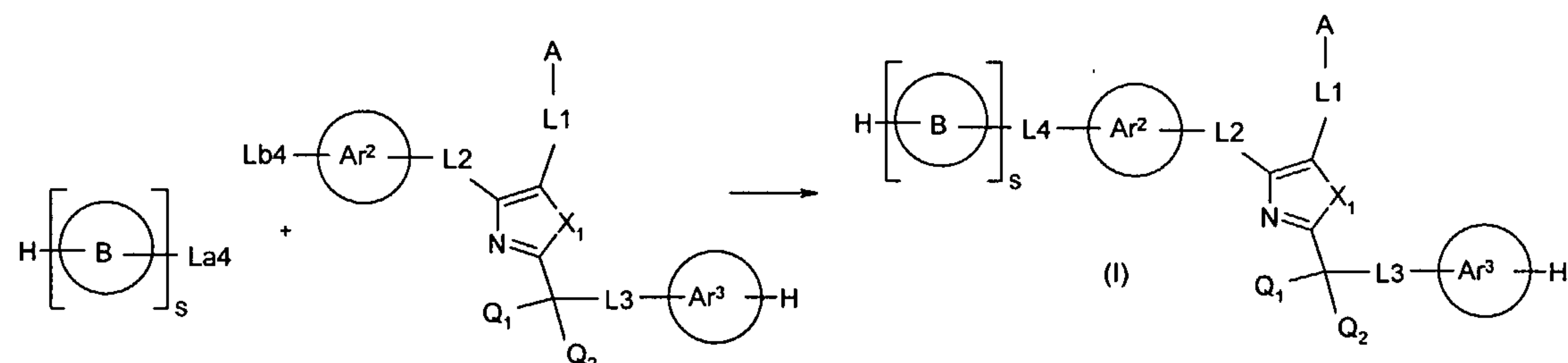
can be made according to standard cyclisation procedures using appropriate solvents, catalysts and temperatures. For example, formation of 1,2,4-triazole can be made with La2 being acylhydrazide and Lb2 being amide or thioamide or the reverse orientation of La2 and Lb2. 1,2,4-Oxadiazole can be formed from La2 being amidoxime and Lb2 being carboxylic ester or the reverse orientation of La2 and Lb2.

1,3,4-Oxadiazole can be formed from La2 being acylhydrazide and Lb2 being carboxylic ester or the reverse orientation of La2 and Lb2. The thiazole can be made from La2 being thioamide and Lb2 being an  $\alpha$ -haloketone or the reverse orientation of La2 and Lb2.

In an analogous manner the compounds of formula (I) can be made by forming the linkers L3 or L4, according to procedures outlined for L2, as depicted below. Thus, La and Lb are defined as any moieties that can react by e.g. a nucleophilic substitution, addition to multiple bonds or cyclisation reaction to form a given linker L as exemplified below.



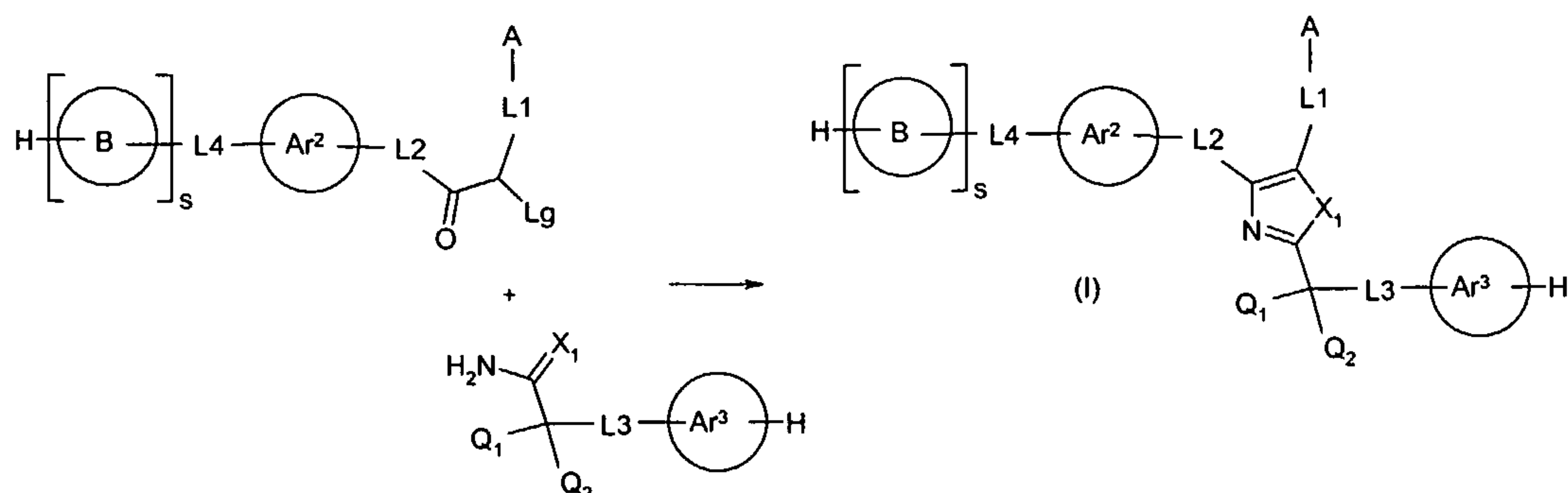
and



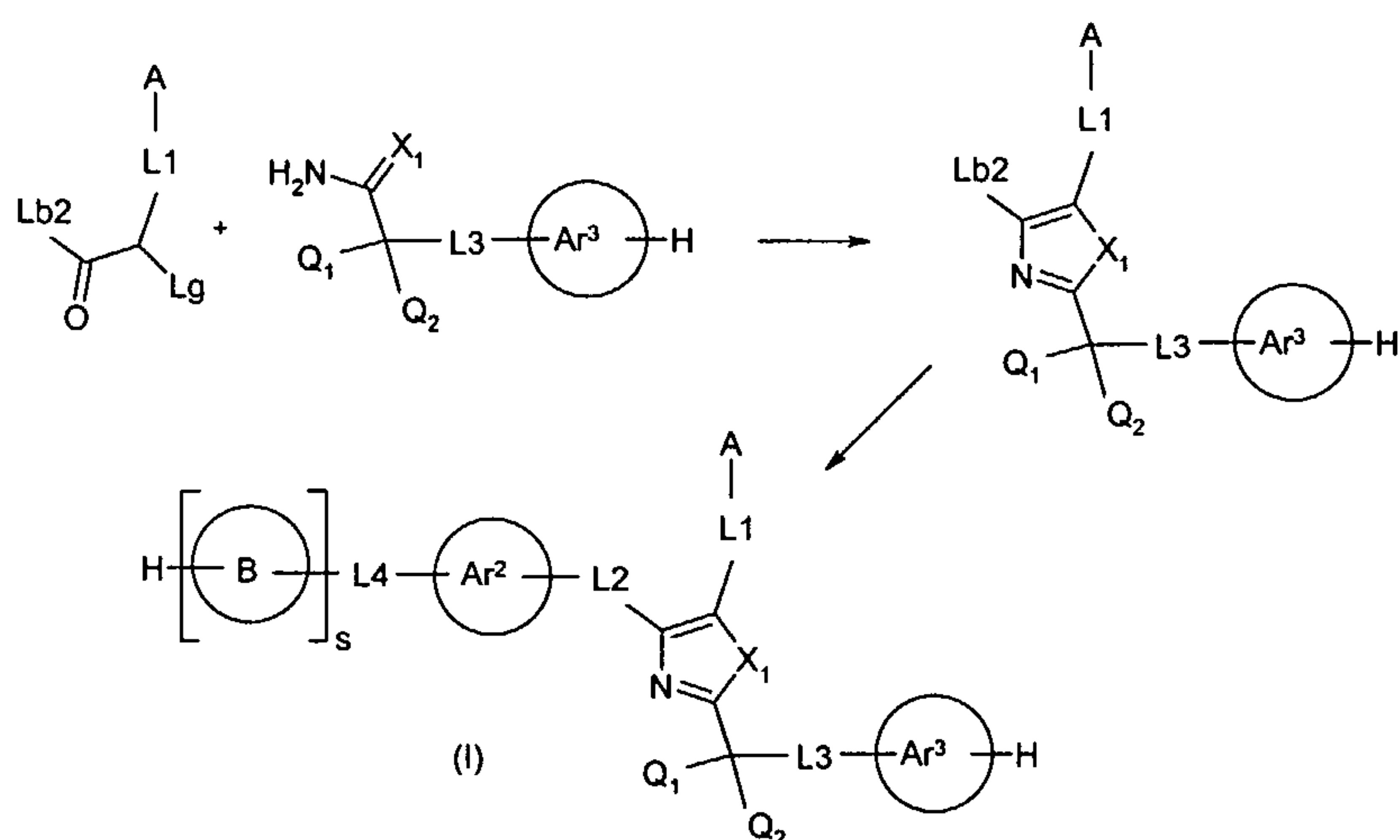
The Ar<sup>1</sup> moiety can also be the central scaffold that is used in connecting the L1, L2 and L3 parts in a stepwise fashion. This can be done via aromatic substitutions of the Ar<sup>1</sup> core to attach L1, L2 and/or L3, which then can be further functionalised to give the final Formula I compounds.

Furthermore, the five-membered X<sub>1</sub>-azole moiety can also be assembled via conventional ring cyclisation reactions with reactants containing the L1, L2 and L3 units either containing the full appendices as exemplified below wherein Lg is a leaving group such as halogen,





or in forms that can be further functionalised into the final formula (I) structures as described previously. One such illustration is given below:



For example, 1,2,4-triazoles can be made from acylhydrazides and amides or thioamides; 1,2,4-oxadiazoles from amidoximes and carboxylic esters; 1,3,4-oxadiazoles from acylhydrazides and carboxylic esters; thiazoles from thioamides and  $\alpha$ -haloketones; pyrazines, pyrimidines and pyridines via various condensation and cycloaddition reactions.

The building blocks used in the reactions are either commercially available or made according to standard procedures well-known to one skilled in the art as described in "Advanced organic chemistry", 4<sup>th</sup> Edition (Wiley), J March, "Comprehensive Organic Transformation", 2<sup>nd</sup> Edition (Wiley), R.C. Larock, "Handbook of Heterocyclic Chemistry", 2<sup>nd</sup> Edition (Pergamon), A.R. Katritzky or other suitable literature sources.

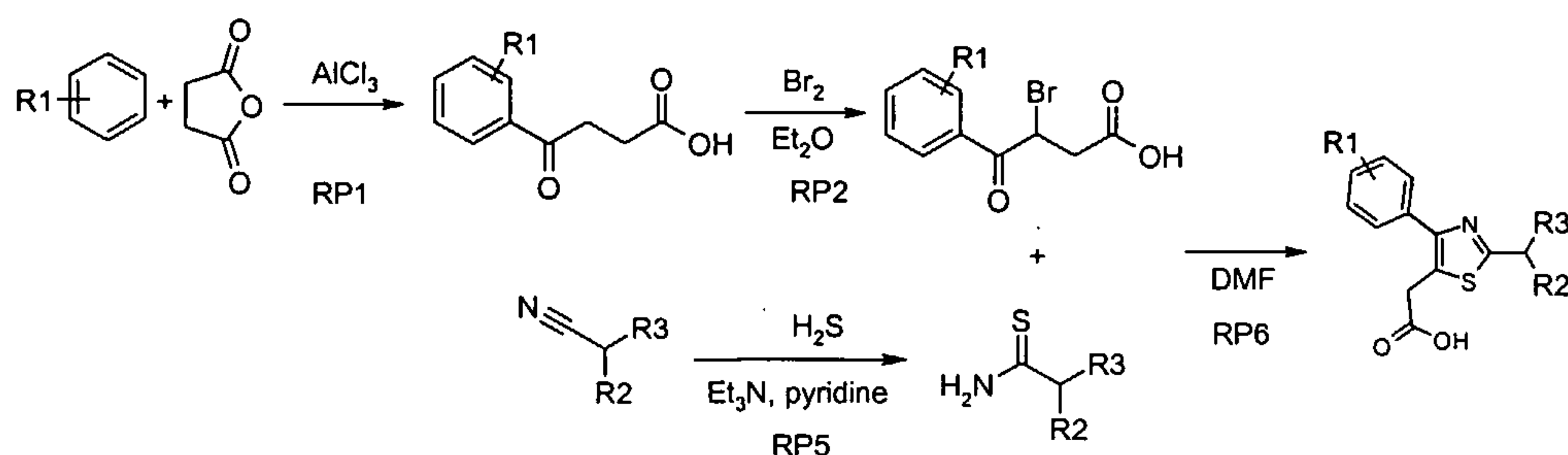
The Examples herein describe specific strategies for the synthesis of compounds (I) wherein X1 is S.

The following Examples illustrate the preparation of compounds with which this invention is concerned. Some compounds were synthesised, and some were acquired from commercial sources. In the Examples:

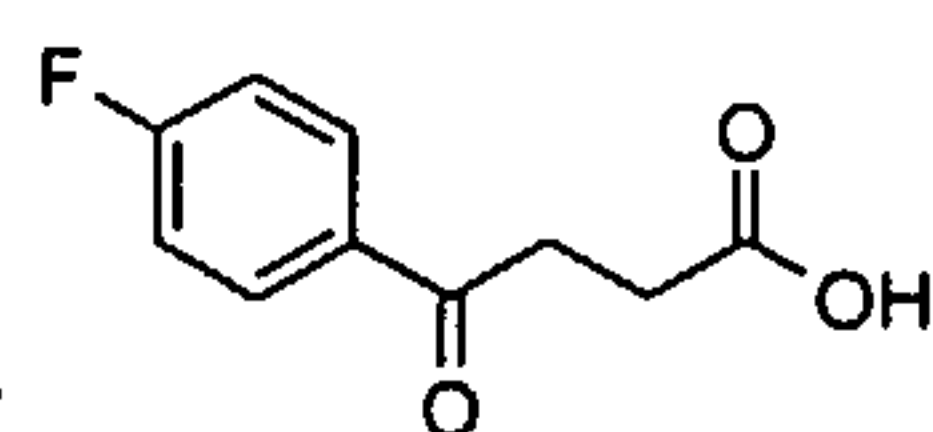
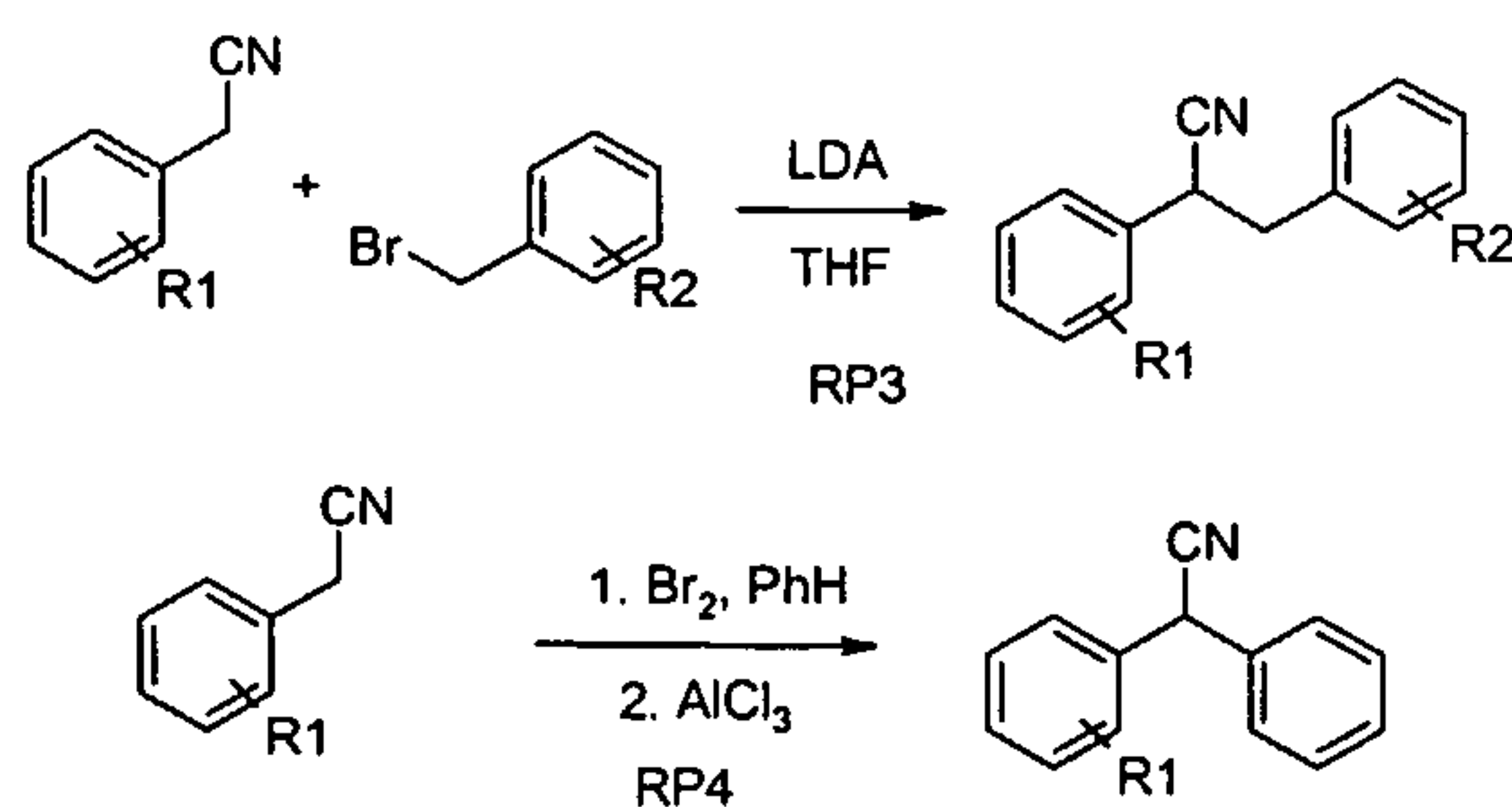
### General comments:

NMR spectra were obtained on a Bruker Avance AMX 300 MHz instrument. For some compounds only selected characteristic  $^1\text{H}$  NMR signals are reported. LC/MS was performed on an Agilent 1100-series instrument. LC/MS methods are as follows: An10p8: Column: XTerra MS C18; Flow: 1.0 mL/min; Gradient: 0-5 min: 15-100% MeCN in water, 5-7½ min: 100% MeCN; Modifier: 5 mM ammonium formate; MS-ionisation mode: API-ES (pos.). An10n8: Column: XTerra MS C18; Flow: 1.0 mL/min; Gradient: 0-5 min: 15-100% MeCN in water, 5-7½ min: 100% MeCN; Modifier: 5 mM ammonium formate; MS-ionisation mode: API-ES (neg.).

### General synthetic route I



### Synthetic routes to nitrile intermediates:



### Intermediate-1

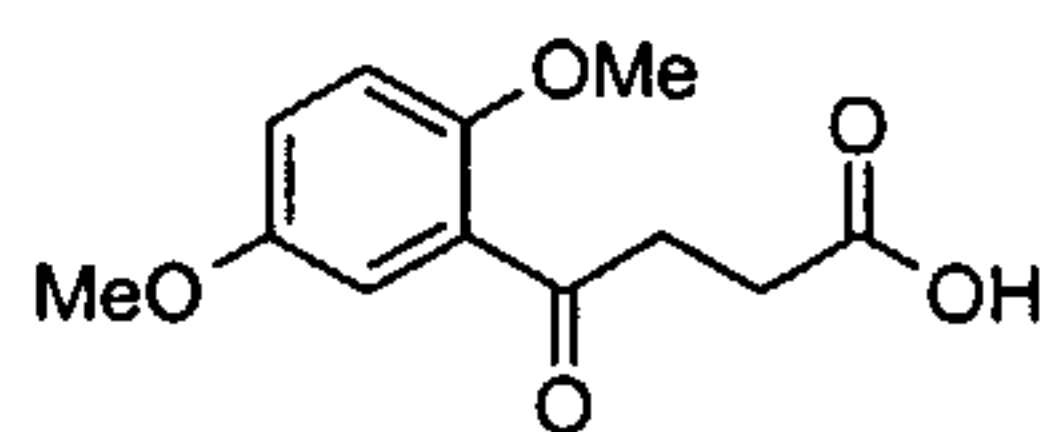
#### 4-(4-Fluoro-phenyl)-4-oxo-butyrac acid – Representative Procedure 1a (RP1a):

Succinic anhydride (1.0 g, 10 mmol) was dissolved in 4-fluorobenzene (3.75 ml, 40



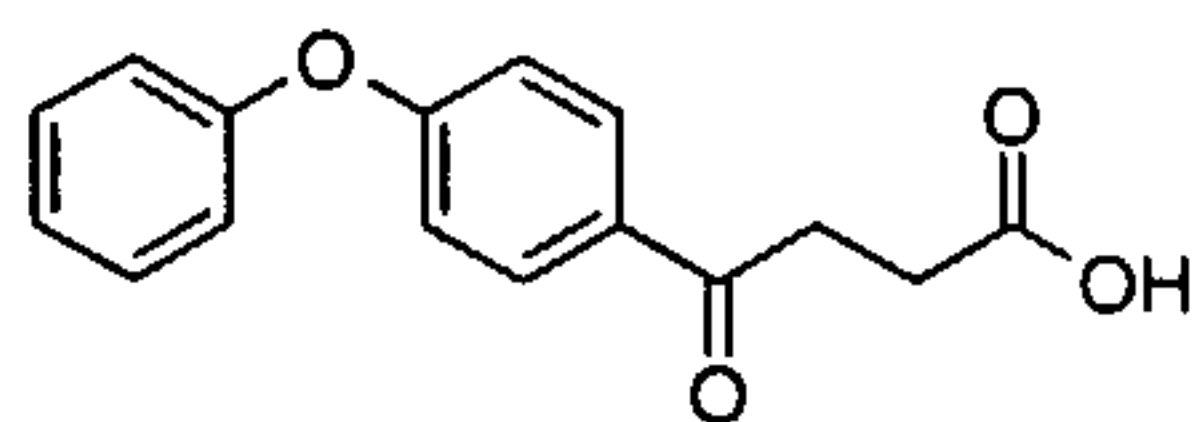
mmol) and cooled to -9 °C under nitrogen. AlCl<sub>3</sub> (2.67 g; 20 mmol) was added, and the temperature was kept between -9 and 0 °C for 4½ hours. The reaction was allowed to warm to room temperature and stirred over night. The reaction mixture was poured into aqueous 4 M HCl (10 ml) at 0 °C, and the precipitated was filtered and washed with water. The solid was recrystallized from toluene to give 1.40 g (71 %) of a colorless solid: LC/MS (an10n8): Rt 0.26 min, *m/z* 195 [M – H], 413 [2M-2H+Na]; <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.84 (t, *J* = 6.5 Hz, 2H), 3.31 (t, *J* = 6.5 Hz, 2H), 7.16 (m, 3H), 8.03 (m, 2H).

In an analogous way, the following compounds were made:



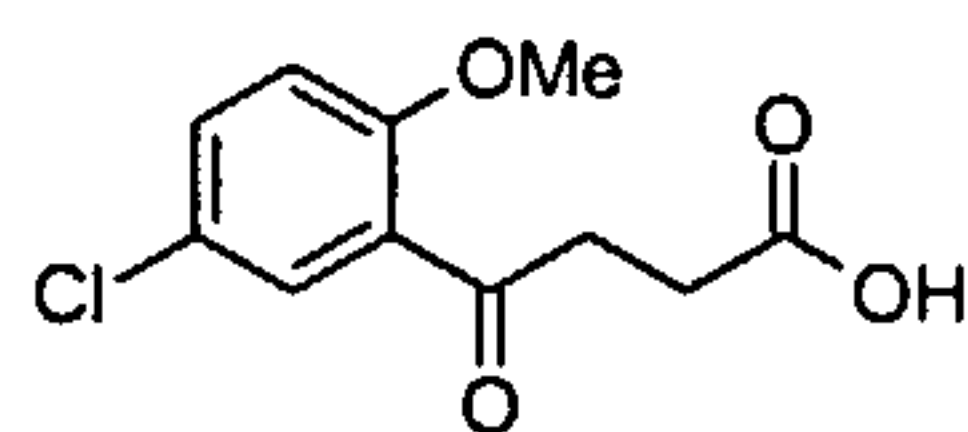
#### Intermediate-2

**4-(2,5-Dimethoxy-phenyl)-4-oxo-butanoic acid.** LC/MS (an10n8): Rt 0.50 min, *m/z* 237 [M-H], 497 [2M-2H+Na]; <sup>1</sup>H NMR (DMSO-*d*<sub>6</sub>): δ 2.53 (t, *J* = 6.0 Hz, 2H), 3.16 (t, *J* = 6.3 Hz, 2H), 3.73 (s, 3H), 3.85 (s, 3H), 7.12-7.14 (m, 3H). <sup>13</sup>C NMR/APT (DMSO-*d*<sub>6</sub>): δ 29.1 (CH<sub>2</sub>), 39.2 (CH<sub>2</sub>), 56.4 (CH<sub>3</sub>), 57.2 (CH<sub>3</sub>), 114.5 (CH), 115.0 (CH), 120.4 (CH), 128.5 (C), 153.8 (C), 174.7 (CO), 200.2 (CO).



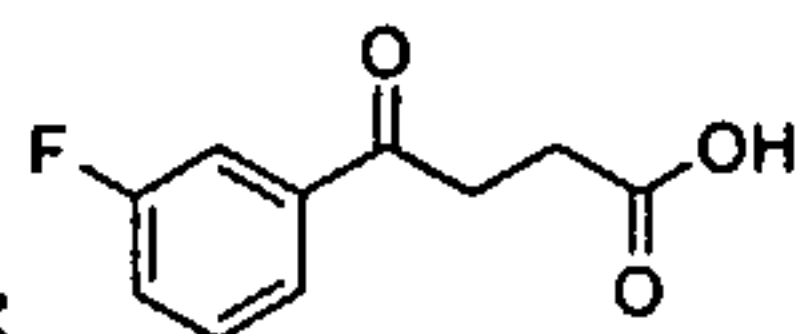
#### Intermediate-3

**4-Oxo-4-(4-phenoxy-phenyl)-butanoic acid.** <sup>1</sup>H NMR (DMSO-*d*<sub>6</sub>): δ 2.57 (t, *J* = 6.22, 2H), 3.21 (t, *J* = 6.22, 2H), 7.05 (m, 2H), 7.13 (m, 2H), 7.25 (m, 1H), 7.47 (m, 2H), 8.01 (m, 2H), 12.13 (br s, 1H (COOH)).



#### Intermediate-4

**4-(5-Chloro-2-methoxy-phenyl)-4-oxo-butanoic acid.** <sup>1</sup>H NMR (DMSO-*d*<sub>6</sub>): δ 2.53 (t, *J* = 6.6 Hz, 2H), 3.15 (t, *J* = 6.0 Hz, 2H), 3.90 (s, 3H), 7.23 (d, *J* = 8.9 Hz, 1H), 7.53 (d, *J* = 2.6 Hz, 1H), 7.60 (dd, *J* = 2.9, 8.9 Hz, 1H) and 12.11 (br s, 1H).

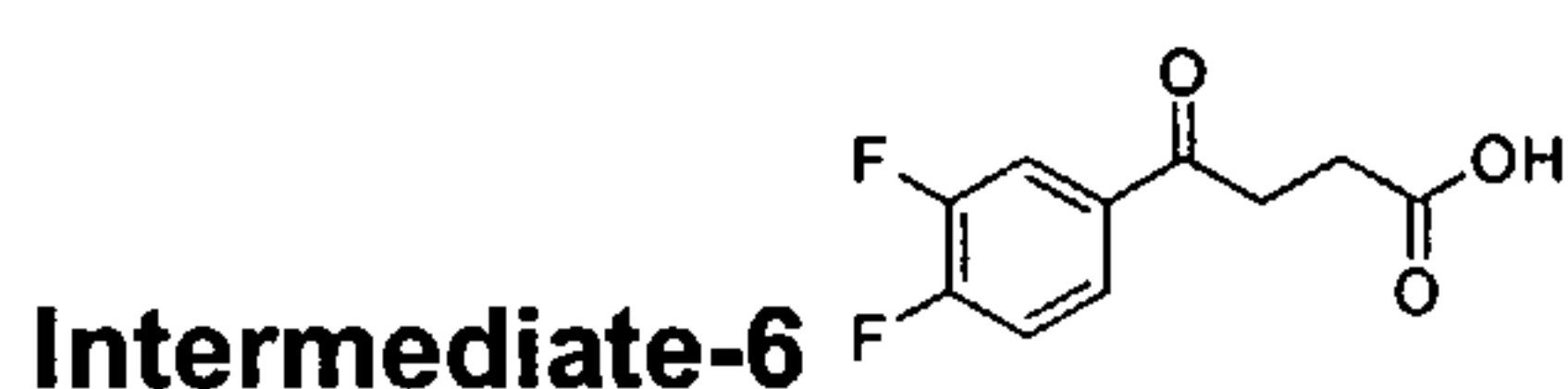


#### Intermediate-5

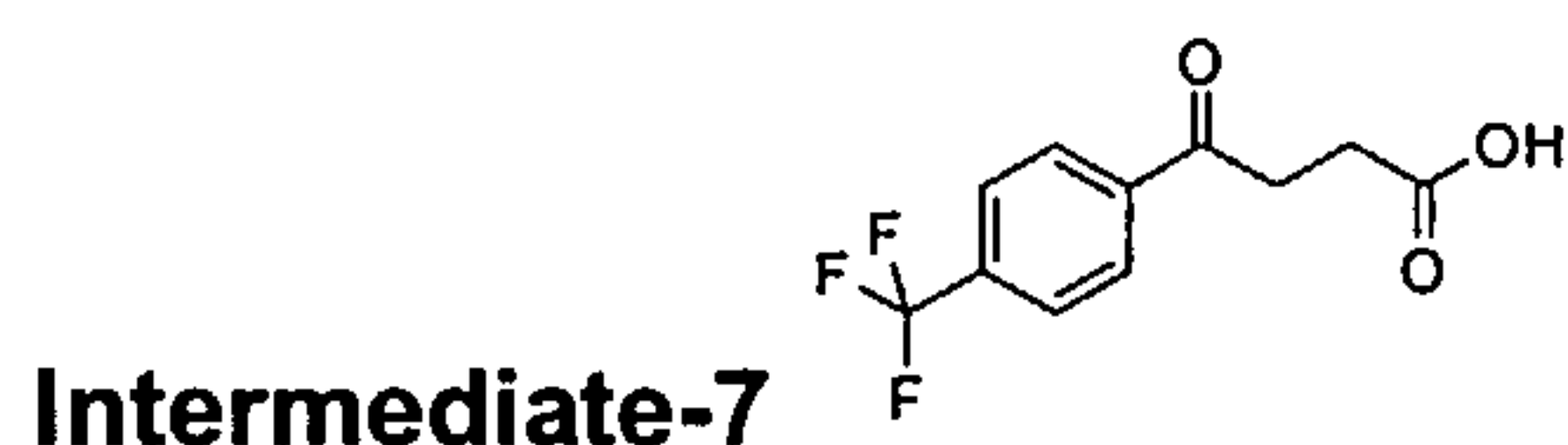
**4-(3-Fluoro-phenyl)-4-oxo-butyrlic acid – Representative Procedure 1b (RP1b):**

In a flame dried flask under nitrogen, succinic anhydride (471 mg, 4.7 mmol) was dissolved in dry THF (5 mL). The mixture was cooled to -78 °C. 3-Fluorophenyl-magnesium bromide in THF (1N, 5 mL, 5 mmol) was added slowly. The mixture was stirred at -78 °C for 3 h, then allowed to raise room temperature. The mixture was transferred into 1N HCl (aq.) then extracted with CH<sub>2</sub>Cl<sub>2</sub>. The organic layer was dried and evaporated. The residue was purified by flash chromatography on SiO<sub>2</sub> to give 350 mg (38%) of the title compound: <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.84 (t, *J* = 6.5 Hz, 2H), 3.31 (t, *J* = 6.5 Hz, 2H), 7.30 (m, 1H), 7.47 (td, *J* = 8.1, 5.7, 1H), 7.68 (m, 1H), 7.79 (m, 1H)

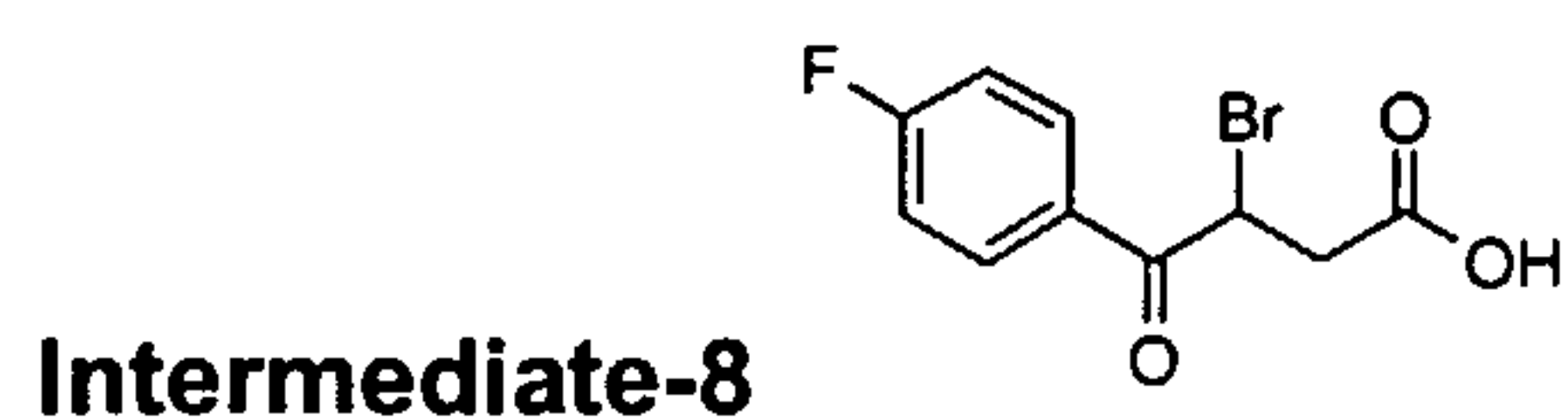
The following compounds were prepared by an analogous procedure:



**4-(3,4-Difluoro-phenyl)-4-oxo-butyrlic acid.** <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.57 (t, *J* = 6.2 Hz, 2H), 3.25 (t, *J* = 6.2 Hz, 2H), 7.60 (m, 1H), 7.87 (m, 1H), 8.02 (m, 1H), 12.17 (br s, 1H).



**4-Oxo-4-(4-trifluoromethyl-phenyl)-butyrlic acid.** 4-Iodobenzotrifluoride (500 μL, 3.4 mmol) was dissolved in dry diethylether (5 mL) in a flamedried flask under nitrogen. Magnesium (83 mg, 3.4 mmol) was added and the mixture was stirred at room temperature for 45 min. Succinic anhydride was dissolved in THF (5 mL) in a flamedried flask under nitrogen then cooled to -78°C. The freshly made Grignard reagent was added slowly. The mixture was allowed to warm to room temperature over 3 h. The mixture was transferred into NH<sub>4</sub>Cl (aq.) then extracted with CH<sub>2</sub>Cl<sub>2</sub>. The organic layer was dried (MgSO<sub>4</sub>) then evaporated. The product was purified by flash chromatography on SiO<sub>2</sub> to give 250 mg (30%): <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 2.86 (t, *J* = 6.4 Hz, 2H), 3.35 (t, *J* = 6.4 Hz, 2H), 7.76 (d, *J* = 8.3 Hz, 2H), 8.10 (d, *J* = 8.3 Hz, 2H).

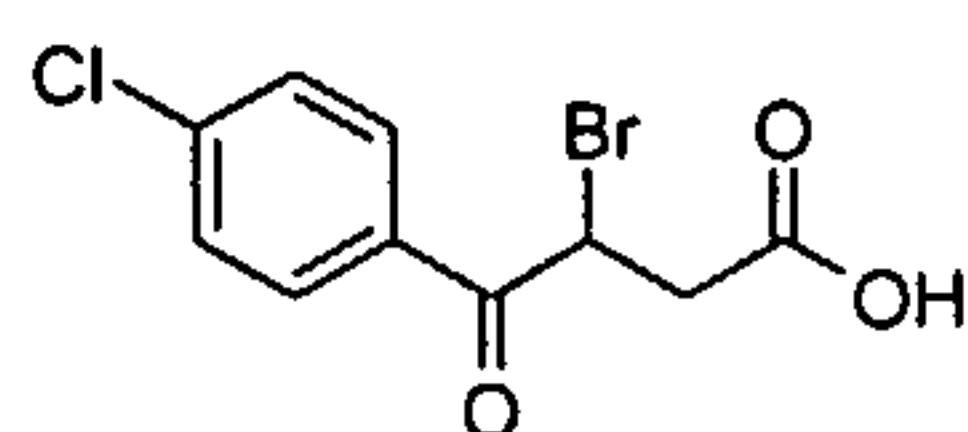




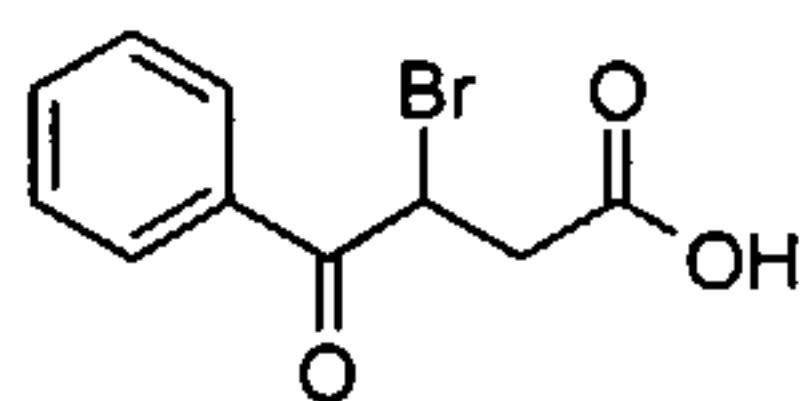
**3-Bromo-4-(4-fluoro-phenyl)-4-oxo-butyrac acid – Representative Procedure 2**

**(PR2):** 4-(4-Fluoro-phenyl)-4-oxo-butyrac acid (1.20 g, 6.12 mmol) was suspended in ether (10 mL) at room temperature. Bromine (0.34 ml, 6.73 mmol) was added drop-wise. After 4 hours, the reaction was concentrated and the residue was recrystallized from ether/heptane to give 1.26 g (75 %) of pale orange crystals.  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.16 (dd,  $J = 2.2, 6.9$  Hz, 1H), 3.56 (dd,  $J = 3.5, 6.9$  Hz, 1H), 5.41 (dd,  $J = 2.2, 3.5$  Hz, 1H), 7.19 (m, 2H), 8.08 (m, 2H);  $^{13}\text{C}$  NMR/APT ( $\text{CDCl}_3$ ):  $\delta$  190.9, 175.6, 168.3, 164.9, 132.3, 132.1, 116.6, 116.3, 38.8, 38.3.

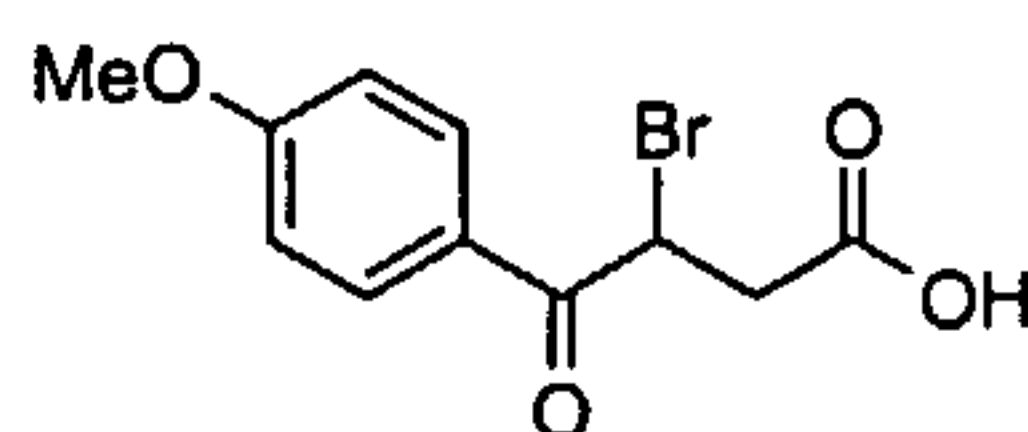
In an analogous way, the following compounds were made:

**Intermediate-9**

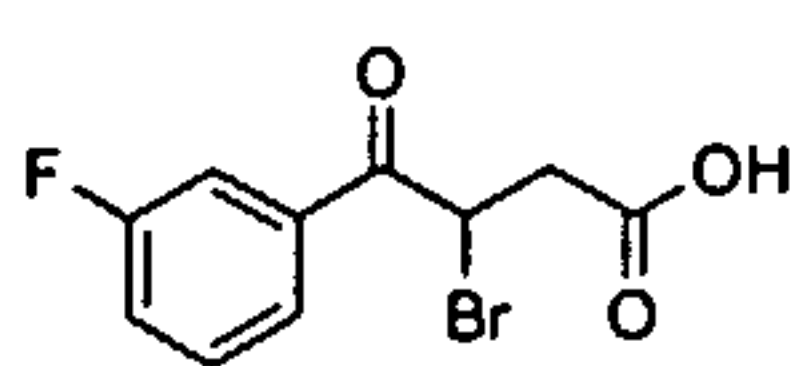
**3-Bromo-4-(4-chloro-phenyl)-4-oxo-butyrac acid.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz):  $\delta$  3.18 (dd,  $J = 5.7, 17.5$  Hz, 1H), 3.52 (dd,  $J = 8.5, 17.5$  Hz, 1H), 5.43 (dd,  $J = 5.8, 8.5$  Hz, 1H), 6.99 (d,  $J = 8.9$  Hz, 2H), 8.10 (d,  $J = 8.9$  Hz, 2H).

**Intermediate-10**

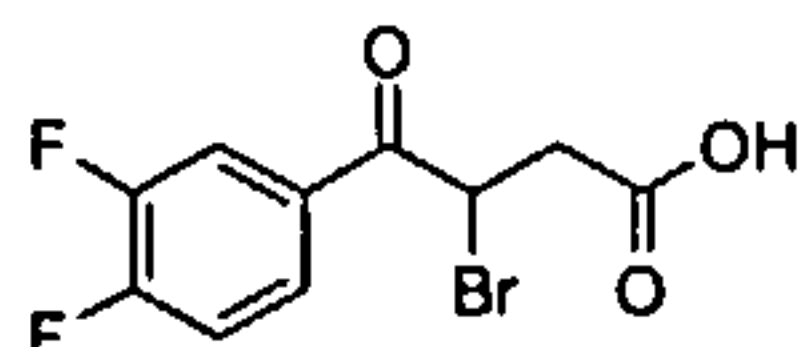
**3-Bromo-4-oxo-4-phenyl-butyrac acid.** LC/MS (an10p8): Rt 2.69 min,  $m/z$  257/259 [M+H], 279/281 [M+Na];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.17 (dd,  $J = 5.7, 17.6$  Hz, 1H), 3.56 (dd,  $J = 8.7, 17.6$  Hz, 1H), 5.46 (dd,  $J = 5.7, 8.7$  Hz, 1H), 7.52 (m, 2H), 7.64 (m, 1H), 8.05 (m, 2H).

**Intermediate-11**

**3-Bromo-4-(4-methoxy-phenyl)-4-oxo-butyrac acid.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.17 (dd,  $J = 5.7, 17.7$  Hz, 1H), 3.55 (dd,  $J = 9.0, 17.7$  Hz, 1H), 3.91 (s, 3H), 5.40 (dd,  $J = 5.5, 8.9$  Hz, 1H), 7.51 (d,  $J = 8.7$  Hz, 2H), 7.98 (d,  $J = 8.7$  Hz, 2H).

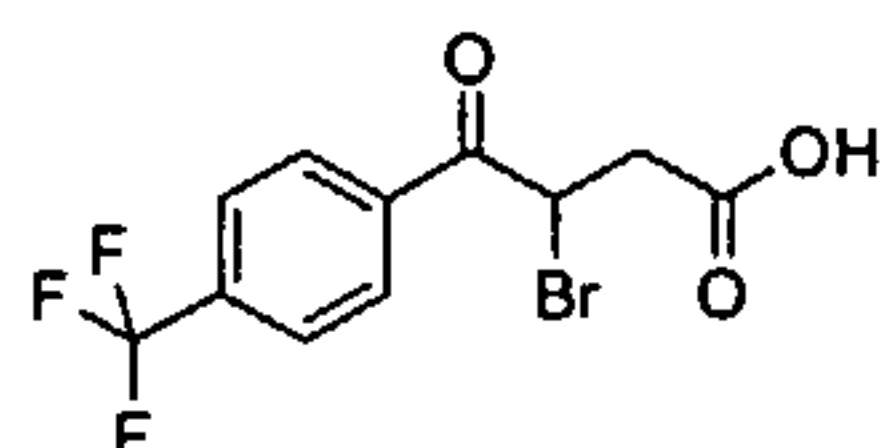
**Intermediate-12**

**3-Bromo-4-(3-fluoro-phenyl)-4-oxo-butyric acid.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.18 (m, 1H), 3.54 (m, 1H), 5.39 (m, 1H), 7.34 (m, 1H), 7.50 (m, 1H), 7.83 (m, 2H) and 10.11 (br s, 1H).



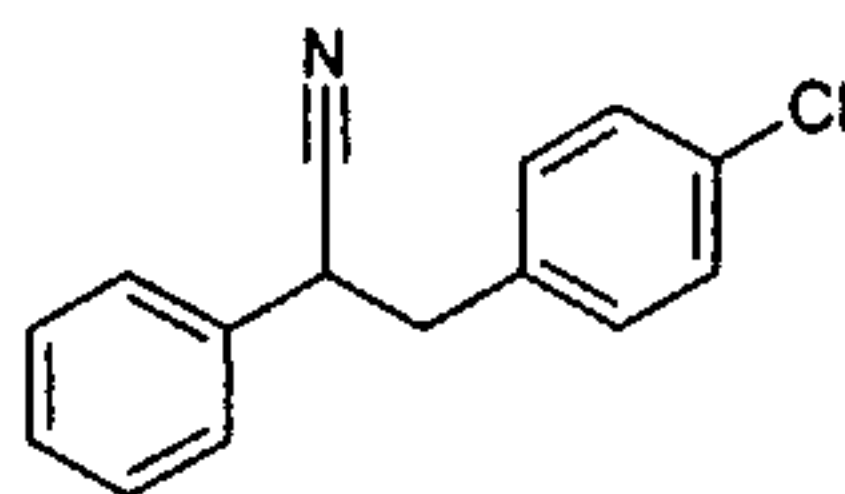
**Intermediate-13**

**3-Bromo-4-(3,4-difluoro-phenyl)-4-oxo-butyric acid.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.16 (dd,  $J = 17.7, 5.3$  Hz, 1H), 3.55 (dd,  $J = 17.7, 9.0$  Hz, 1H), 5.32 (dd,  $J = 9.0, 5.5$  Hz, 1H), 7.31 (m, 1H), 7.85 (m, 2H).



**Intermediate-14**

**3-Bromo-4-oxo-4-(4-trifluoromethyl-phenyl)-butyric acid.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.19 (dd,  $J = 17.7, 5.5$  Hz, 1H), 3.59 (dd,  $J = 17.5, 9.0$  Hz, 1H), 5.44 (dd,  $J = 9.0, 5.5$  Hz, 1H), 7.79 (d,  $J = 2.8$  Hz) and 8.16 (d,  $J = 3.0$  Hz).



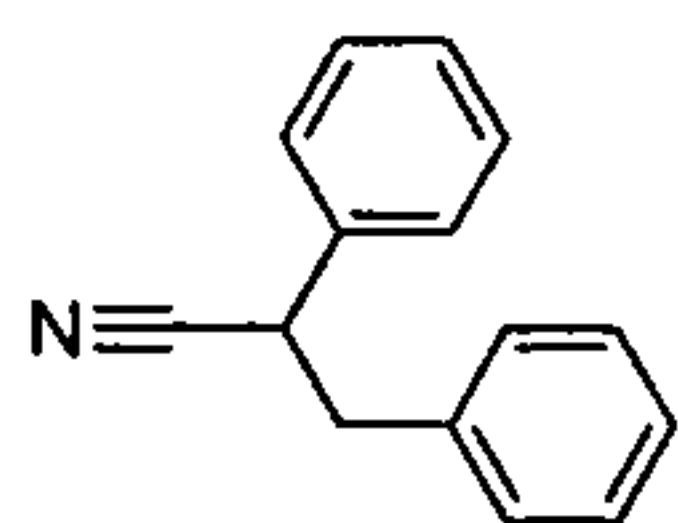
**Intermediate-15**

**3-(4-Chloro-phenyl)-2-phenyl-propionitrile – Representative Procedure 3 (RP3):**

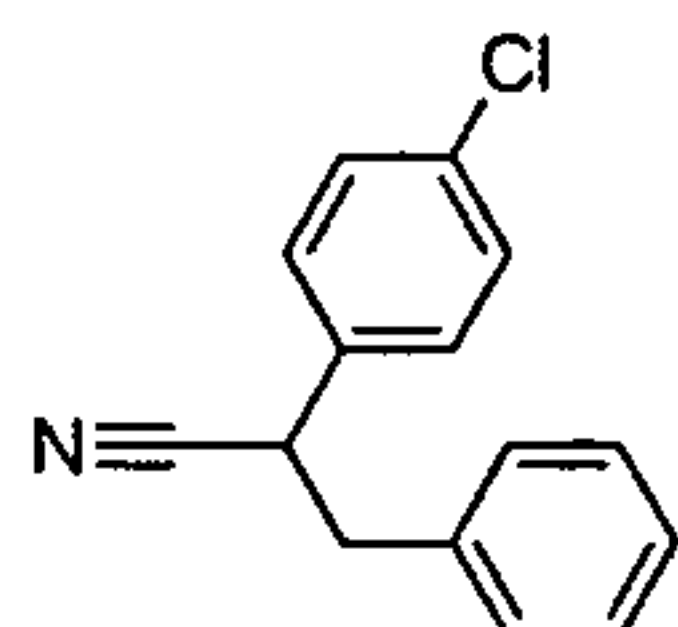
The reaction was preformed under  $\text{N}_2$  in flame dried glassware. Benzylcyanide (1.2 mL, 10 mmol) was added slowly (over a period of 40 min) to a solution of LDA (10 mmol) in THF (10 mL) at  $-78^\circ\text{C}$ . The mixture was stirred for 1 h at  $-78^\circ\text{C}$ , and then added slowly (over a period of 16 min) to a solution of 4-chlorobenzyl bromide in THF (10 mL) at  $-78^\circ\text{C}$ . The mixture was stirred for 1 h at  $-78^\circ\text{C}$  and left over night to reach room temperature. The reaction mixture was added saturated aq.  $\text{NH}_4\text{Cl}$  and the aqueous mixture was extracted with EtOAc. The organic phase was washed with brine, dried ( $\text{MgSO}_4$ ) and concentrated, and the residue was recrystallized from heptane to give 1.26 g (53%) of a light brown powder.  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.16 (m, 2H) and 4.01 (t,  $J = 7.2$  Hz, 1H), 7.05 (d,  $J = 8.3$  Hz, 2H), 7.32 (m, 7H).

In an analogous way, the following compounds were made:

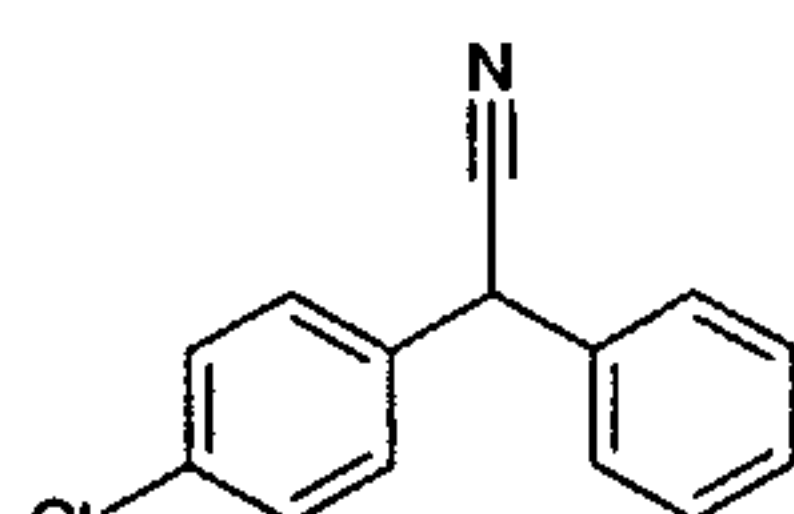


**Intermediate-16**

**2,3-Diphenyl-propionitrile.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.19 (m, 2H) and 4.02 (t,  $J = 7.9$  Hz, 1H).

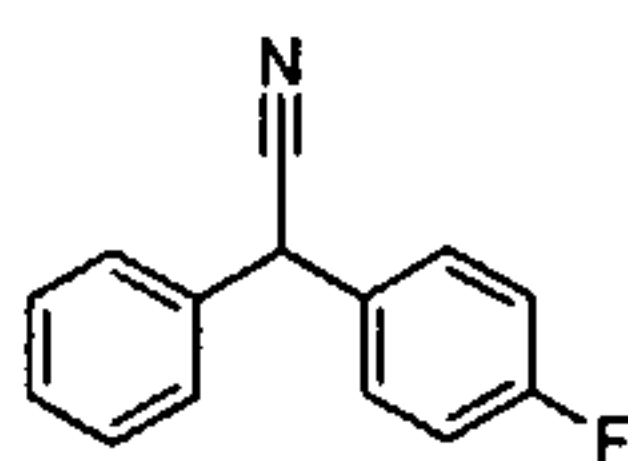
**Intermediate-17**

**2-(4-Chloro-phenyl)-3-phenyl-propionitrile.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.16 (m, 2H) and 4.14 (t,  $J = 7.2$  Hz, 1H).

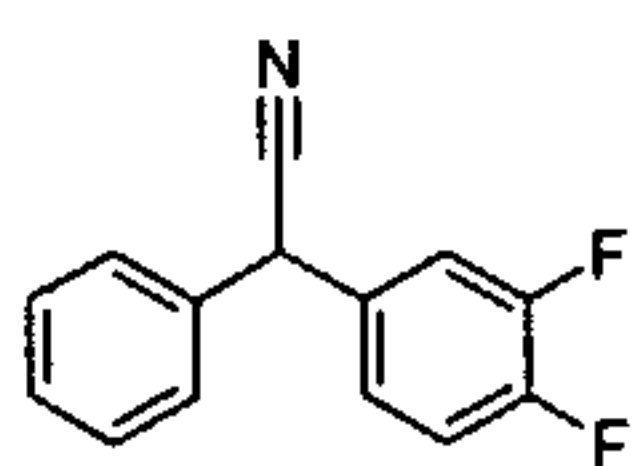
**Intermediate-18**

**(4-Chloro-phenyl)-phenyl-acetonitrile – Representative Procedure 4 (RP4):** The reaction was performed under  $\text{N}_2$  and flamedried glassware. 4-Chlorobenzyl cyanide (1 mL; 7.8 mmol) was dissolved in benzene (10 mL) and heated to reflux. Bromide (442  $\mu\text{L}$ ; 8.6 mmol) was added over 30 min. The mixture was stirred 20 min at reflux, then cooled to approx  $40^\circ\text{C}$  and added over 30 min to a refluxing mixture of aluminum chloride (1 g; 7.8 mmol) in benzene (10 mL). The mixture was stirred 1 h at reflux then cooled to r.t. The mixture was transferred into ice and conc. HCl (50 mL) then extracted with diethyl ether. The organic layer was dried ( $\text{MgSO}_4$ ) and concentrated in vacuum to give brown oil. The product was purified by flash chromatography on  $\text{SiO}_2$  to give 523 mg (28%) yellow oil.  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  5.14 (s, 1H) and 7.36 (m, 9H). APT ( $\text{CDCl}_3$ ):  $\delta$  42.42 (CH).

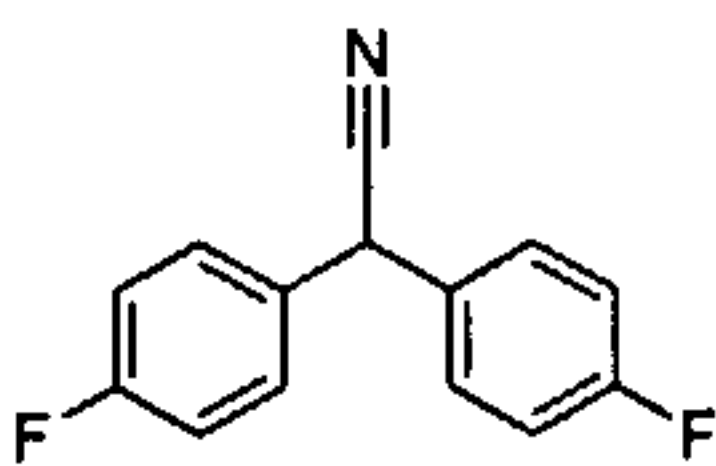
In an analogous way, the following compounds were made:

**Intermediate-19**

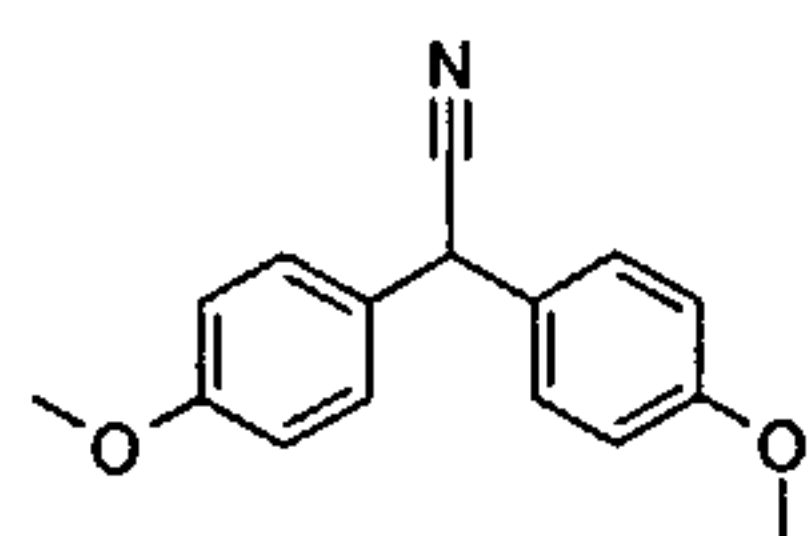
**(4-Fluoro-phenyl)-phenyl-acetonitrile.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  5.15 (s, 1H), 7.08 (m, 2H), 7.36 (m, 7H).

**Intermediate-20**

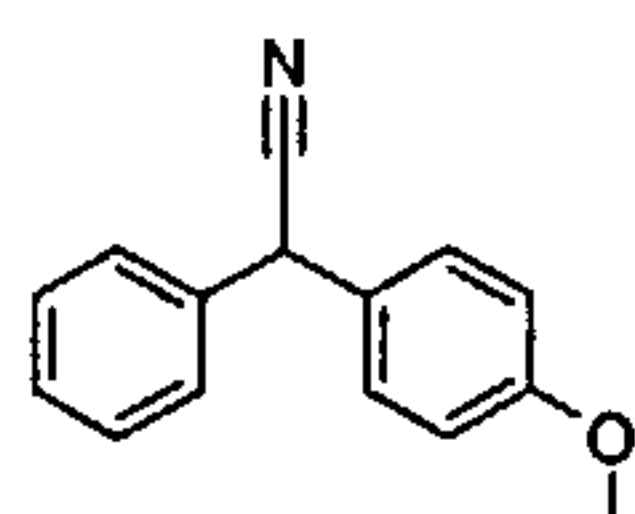
**(3,4-Difluorophenyl)-phenyl-acetonitrile.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz):  $\delta$  5.12 (s, 1H), 7.15 (m, 3H), 7.41 (m, 5H).

**Intermediate-21**

**Bis-(4-fluorophenyl)-acetonitrile.** 4,4'-Difluorobenzhydrol (1 g, 4.54 mmol) was dissolved in TFA (10 mL). Potassium cyanide (620 mg, 9.53 mmol) was added and the mixture was cooled to 0°C. Sulfuric acid (conc., 3 mL) was added slowly. The mixture was stirred at room temperature for 5h then quenched with  $\text{H}_2\text{O}$  and ethyl acetate. The organic phase was washed with water and brine, dried ( $\text{MgSO}_4$ ) and concentrated. The residue was purified by flash chromatography on  $\text{SiO}_2$  to give 450 mg (43%) of the title compound:  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  5.14 (s, 1H), 7.09 (m, 4H) and 7.32 (m, 4H).  $^{13}\text{C}$  NMR (APT,  $\text{CDCl}_3$ ):  $\delta$  41.53 (CH).

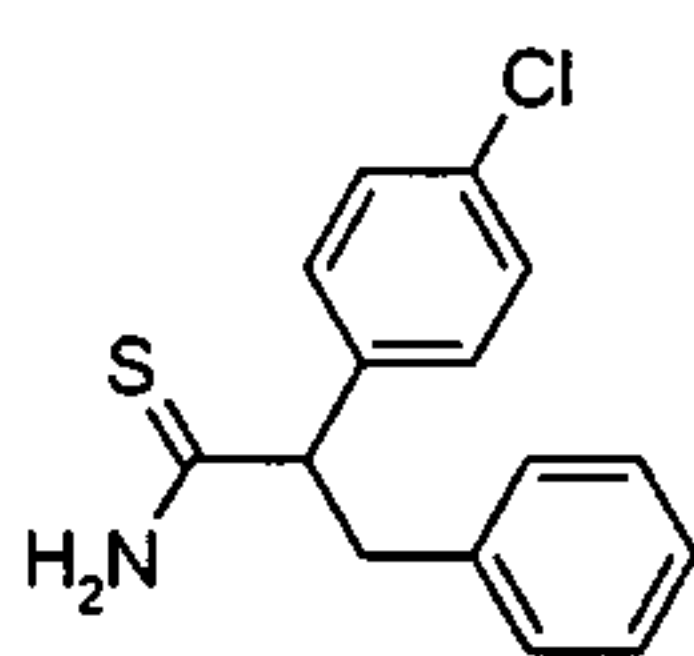
**Intermediate-22**

**Bis-(4-methoxyphenyl)-acetonitrile.** 4,4'-Dimethoxybenzhydrol (5 g, 20 mmol) was dissolved in dry  $\text{CH}_2\text{Cl}_2$  (50 mL) then cooled to 0 °C. Thionylchloride (1.5 mL, 20 mmol) was added slowly. The mixture was stirred at room temperature for 4h. The mixture was concentrated under vacuum. The product was dissolved in dry  $\text{CH}_2\text{Cl}_2$  (10 mL) and added to a mixture of potassium cyanide (2.6 g, 40 mmol) and 18-crown-6 (500 mg) dissolved in dry  $\text{CH}_2\text{Cl}_2$  (20 mL). The mixture was stirred over night at room temperature. The mixture was transferred into water then extracted with  $\text{CH}_2\text{Cl}_2$ . The organic layer was washed with water and brine, dried ( $\text{MgSO}_4$ ) and concentrated. The residue was recrystallized from ethyl acetate to give 2.54 g (50%) of the title compound:  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.82 (s, 6H), 5.07 (s, 1H), 6.90 (m, 4H), 7.25 (m, 4H).

**Intermediate-23**



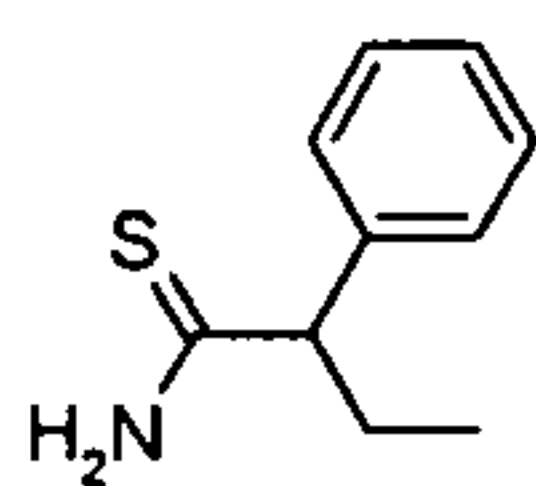
**(4-Methoxy-phenyl)-phenyl-acetonitrile.** (4-Methoxyphenyl)acetonitrile (5 mL, 37 mmol) was dissolved in dry benzene (10 mL) in a flamedried flask under nitrogen. The mixture was heated to reflux and bromine (1.9 mL, 37 mmol) was added in small portions over 2 h. The mixture was stirred at reflux for 30 min, then added to a refluxing mixture of  $\text{AlCl}_3$  (4.9 g, 37 mmol) in benzene (30 mL) over 80 min. The mixture was stirred at reflux for 1 h then cooled to room temperature. The mixture was transferred into 1N HCl and ice then extracted with diethylether. The organic layer was dried ( $\text{MgSO}_4$ ) and concentrated. The product was purified by flash chromatography on  $\text{SiO}_2$  to give 1.3 g (16%) of the title compound:  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.82 (s, 3H), 5.12 (s, 1H), 6.90 (m, 2H), 7.27 (m, 2H), 7.37 (m, 5H).

**Intermediate-24**

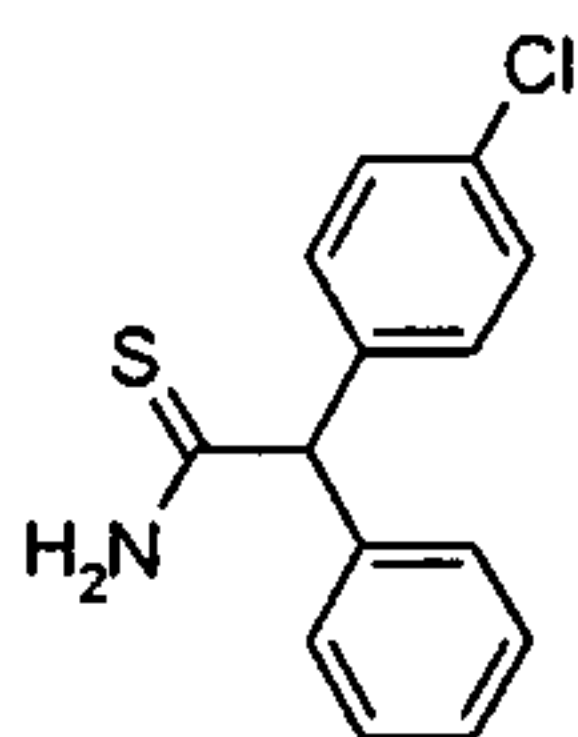
**2-(4-Chloro-phenyl)-3-phenyl-thiopropionamide – Representative Procedure 5**

**(RP5):** 2-(4-Chloro-phenyl)-3-phenyl-propionitrile (200 mg, 0.8 mmol) was dissolved in pyridine (5 mL) and triethylamine (1 mL). The mixture was saturated with hydrogen sulfide and stirred under an atmosphere of hydrogen sulfide room temperature for 3 days. The mixture was extracted with EtOAc. The extract was washed with brine, dried ( $\text{MgSO}_4$ ) and concentrated to give 250 mg of crude product, which was used directly in the next step.  $^1\text{H}$  NMR ( $\text{DMSO}-d_6$ ):  $\delta$  3.17 (dd,  $J = 8.1, 13.8$  Hz, 1H), 3.75 (dd,  $J = 7.0, 13.8$  Hz, 1H), 4.03 (t,  $J = 7.5$  Hz, 1H) and 7.20 (m, 9H).

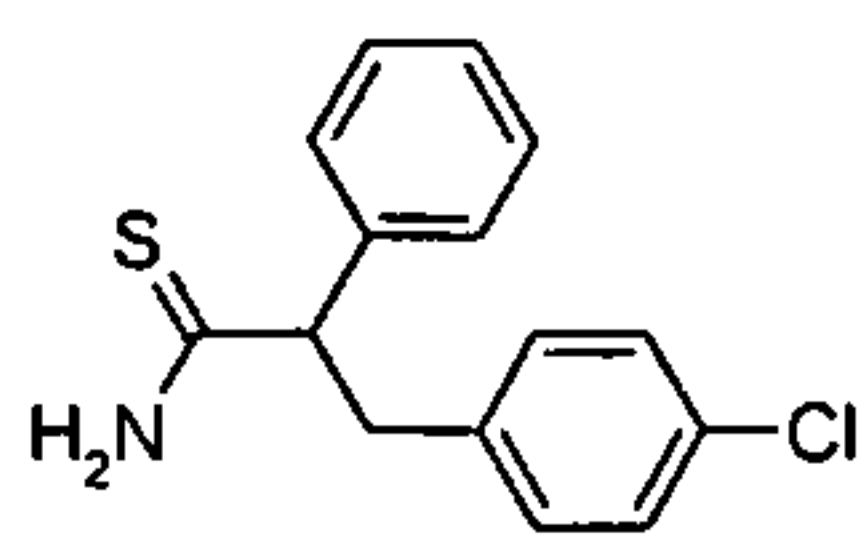
In an analogous way, the following compounds were made:

**Intermediate-25**

**2-Phenyl-thiobutylamide.** LC/MS (an10p8): Rt 2.9 min,  $m/z$  180 [ $M + 1$ ].  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  0.93 (t, 3H); 2.01 (m, 1H); 2.41 (m, 1H); 3.75 (dd, 1H); 6.75 (br s, 1H); 7.36 (m, 5H); 7.58 (br s, 1H).

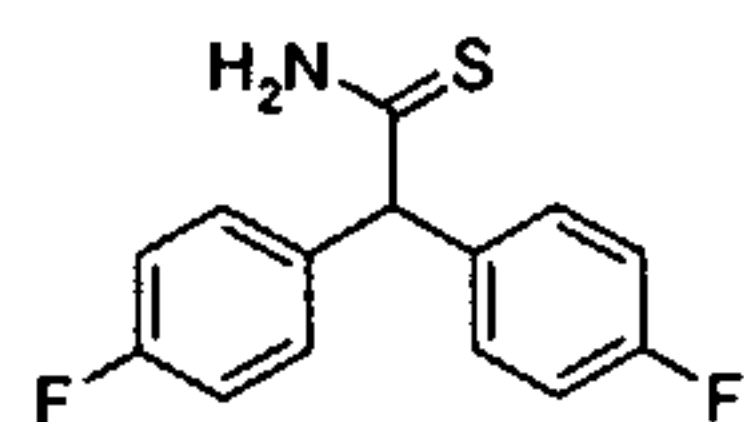
**Intermediate-26**

**2-(4-Chloro-phenyl)-2-phenyl-thioacetamide.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  5.59 (s, 1H).



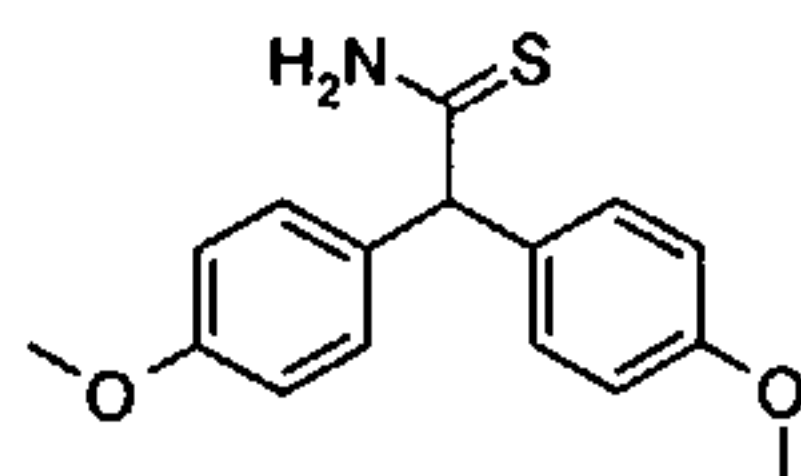
**Intermediate-27**

**3-(4-Chloro-phenyl)-2-phenyl-thiopropionamide.**  $^1\text{H}$  NMR ( $\text{DMSO-d}_6$ ):  $\delta$  3.14 (m, 1H), 3.77 (dd,  $J = 6.6, 13.9$  Hz, 1H), 4.00 (t,  $J = 7.73$  Hz, 1H).



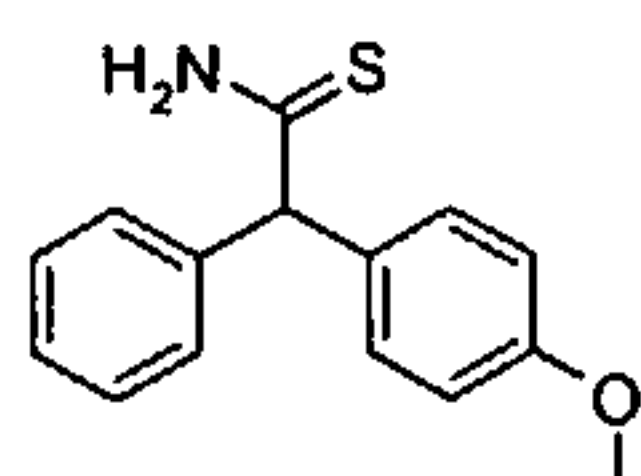
**Intermediate-28**

**2,2-Bis-(4-fluoro-phenyl)-thioacetamide.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  5.57 (s, 1H), 6.76 (br s, 1H (NH)), 7.08 (m, 4H) and 7.23 (m, 4H) and 7.68 (br s, 1H (NH)).



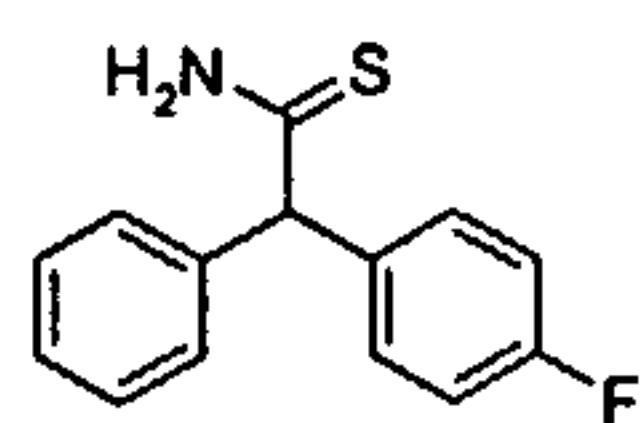
**Intermediate-29**

**2,2-Bis-(4-methoxy-phenyl)-thioacetamide.** LC/MS (an10p8): Rt 2.96 min,  $m/z$  288 [ $M + H$ ];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.81 (s, 6H), 5.54 (s, 1H), 6.83 (bs, 1H (NH)), 6.90 (m, 4H), 7.18 (m, 4H), 7.73 (br s, 1H (NH)).



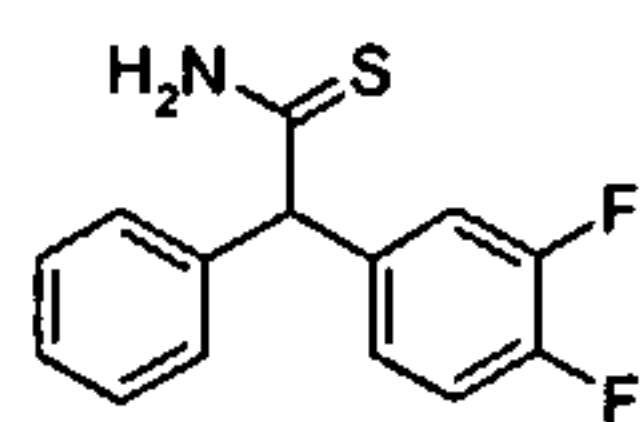
**Intermediate-30**

**2-(4-Methoxy-phenyl)-2-phenyl-thioacetamide.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.82 (s, 3H), 5.59 (s, 1H), 6.83 (bs, 1H (NH)), 6.90 (m, 2H), 7.18 (m, 2H), 7.35 (m, 5H), 7.76 (bs, 1H (NH)).



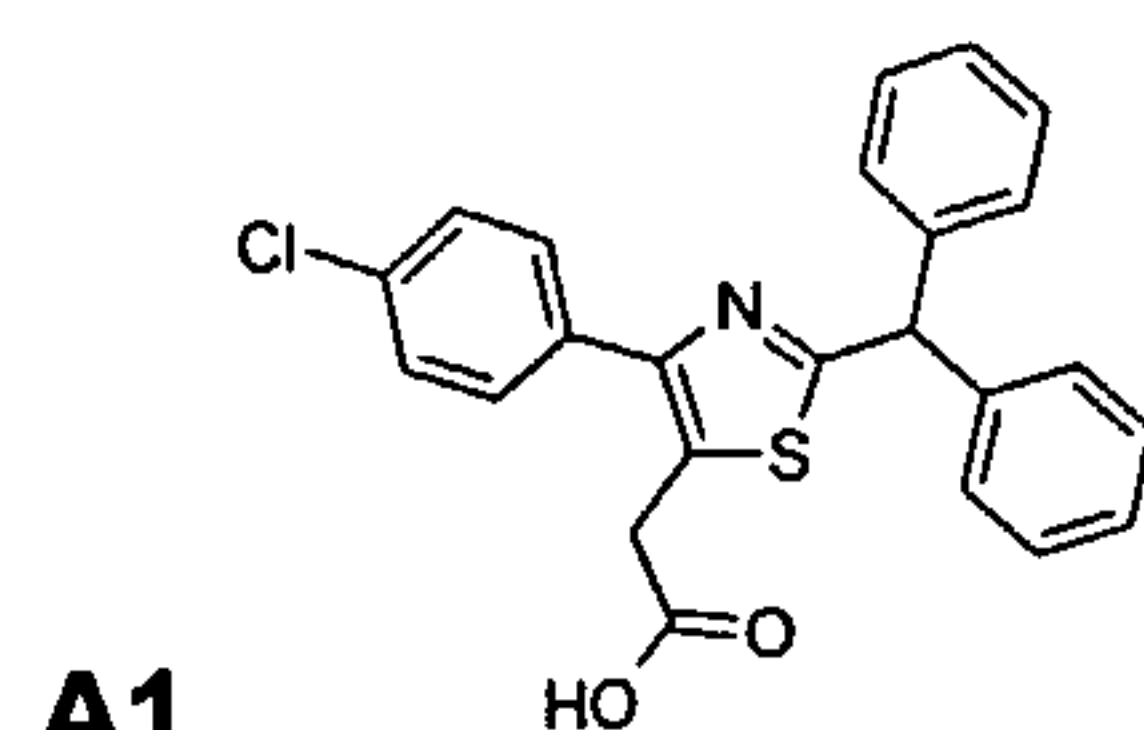
**Intermediate-31**

**2-(4-Fluoro-phenyl)-2-phenyl-thioacetamide.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  5.61 (s, 1H), 6.84 (br s, 1H (NH)), 7.06 (m, 2H), 7.26 (m, 2H), 7.37 (m, 5H), 7.86 (br s, 1H (NH)).



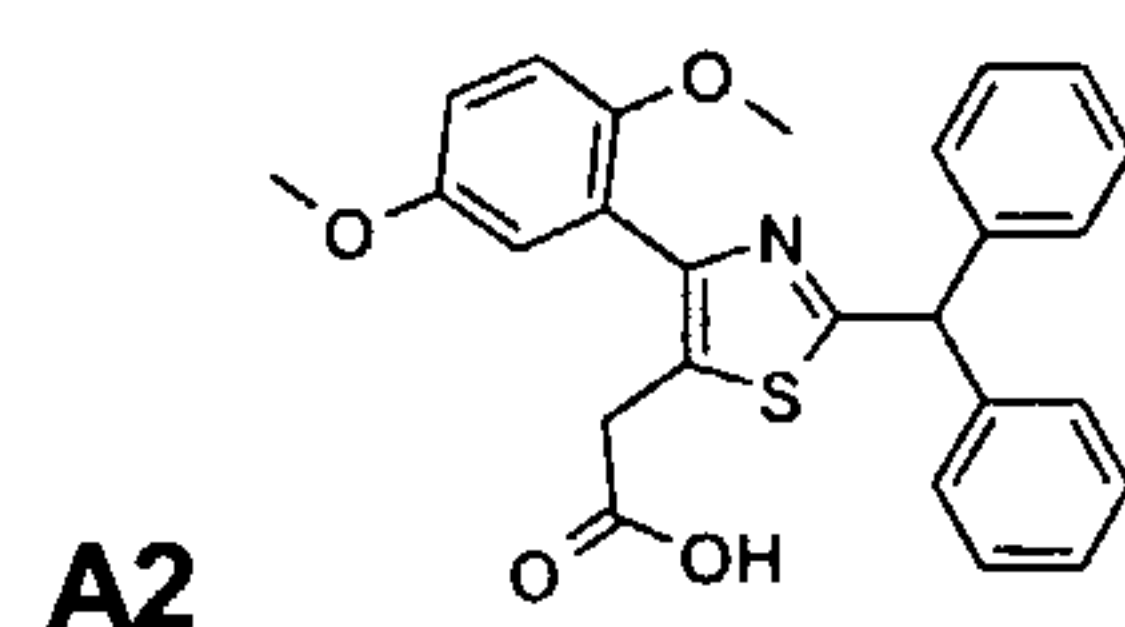
**Intermediate-32**

**2-(3,4-Difluoro-phenyl)-2-phenyl-thioacetamide.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  5.56 (s, 1H), 6.81 (br s, 1H (NH)), 7.04 (m, 1H), 7.14 (m, 2H), 7.25 (m, 2H), 7.38 (m, 3H), 7.92 (br s, 1H (NH)).

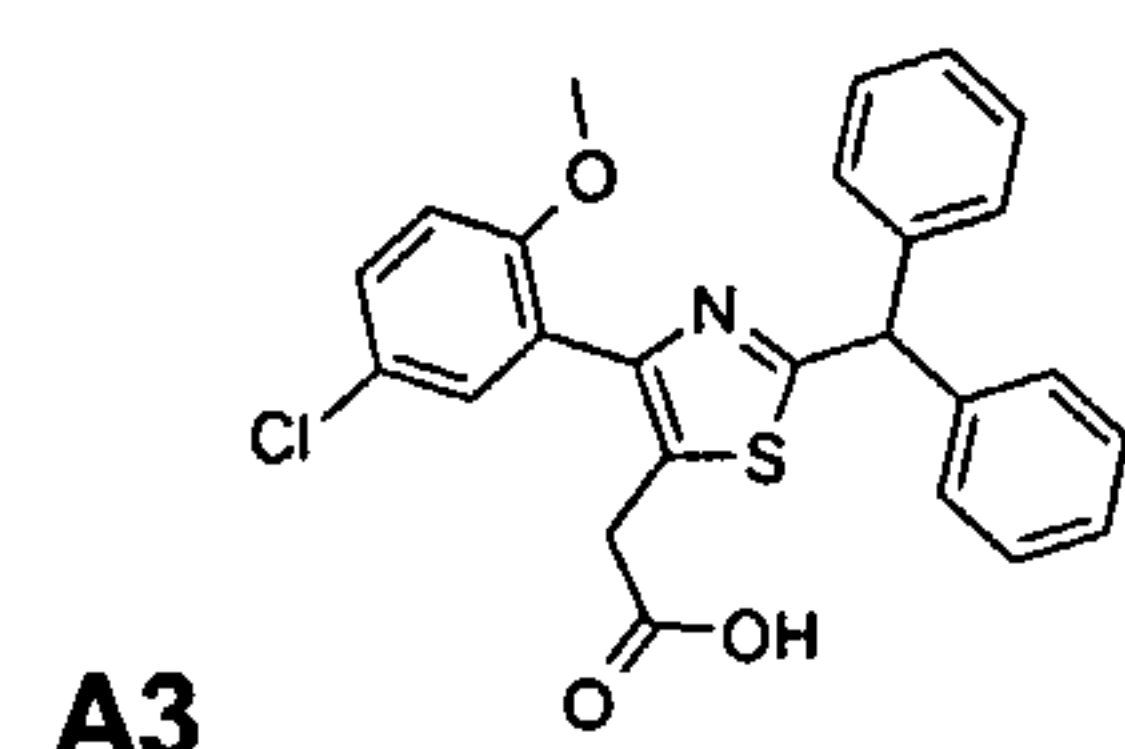


**[2-Benzhydryl-4-(4-chloro-phenyl)-thiazol-5-yl]-acetic acid – Representative Procedure 6 (RP6):** 3-Bromo-4-(4-chlorophenyl)-4-oxo-butyric acid (119 mg, 0.4 mmol) and 2,2-diphenyl-thioacetamide (91 mg, 0.4 mmol) was dissolved in DMF (1 mL) and heated to 100 °C for 10 minutes in a microwave oven. The reaction mixture was poured into water at 0 °C. The precipitation was filtered off and recrystallized from  $\text{CH}_2\text{Cl}_2$  to give 77 mg (54%) yellow powder:  $^1\text{H}$  NMR ( $\text{DMSO}-d_6$ ):  $\delta$  3.91 (s, 2H), 5.96 (s, 1H), 7.37 (m, 10H), 7.52 (d,  $J = 8.48$  Hz, 2H), 7.60 (d,  $J = 8.67$  Hz, 2H), 12.82 (br s, 1H (COOH)).

In an analogous way, the following compounds were made:

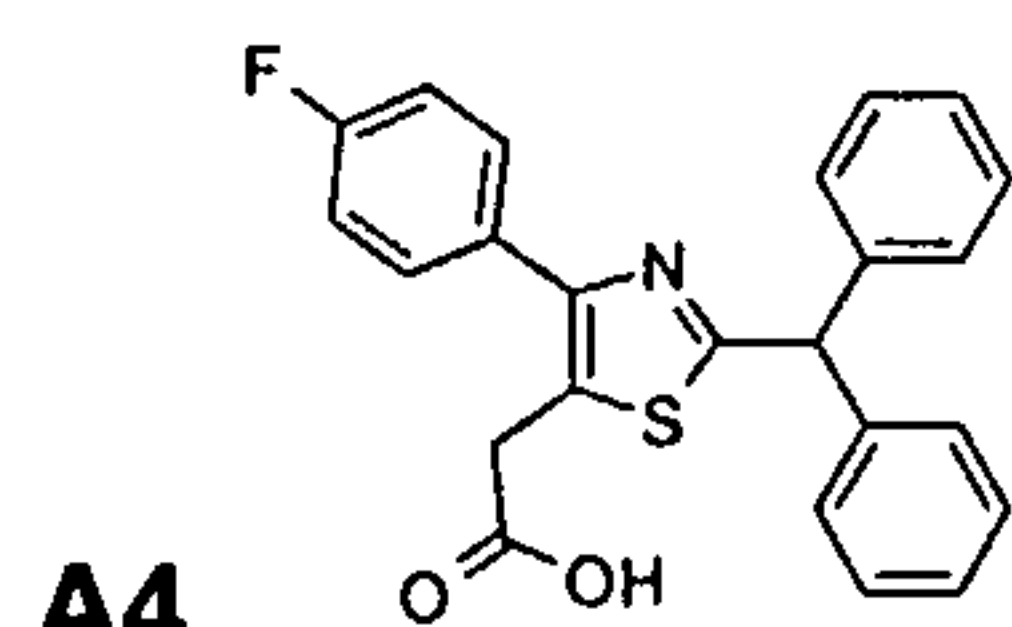


**[2-Benzhydryl-4-(2,5-dimethoxy-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 3.18 min,  $m/z$  446 [ $M + 1$ ];  $^1\text{H}$  NMR ( $\text{DMSO}-d_6$ ):  $\delta$  3.59 (s, 2H), 5.92 (s, 1H), 6.85 (d,  $J = 3.0$  Hz, 1H), 6.96 (dd,  $J = 8.9$  and 3.0 Hz), 7.04 (d,  $J = 8.5$  Hz), 7.22-7.45 (m, 10H).

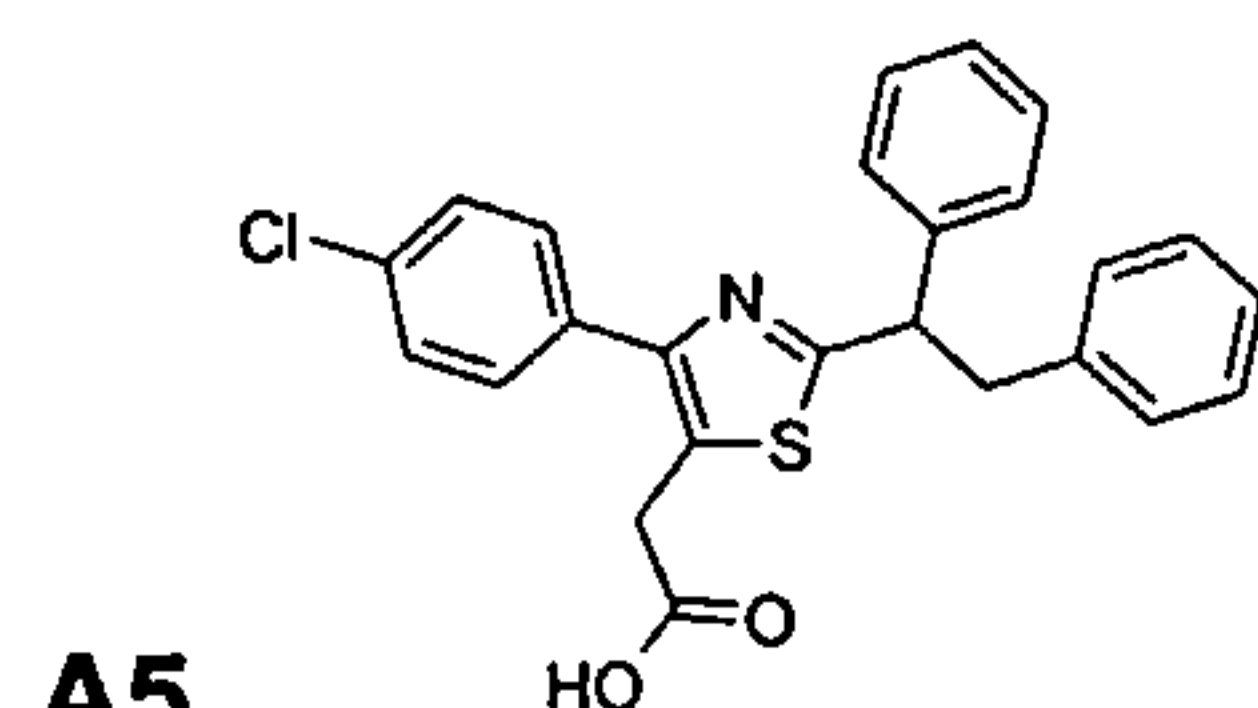


**[2-Benzhydryl-4-(5-chloro-2-methoxy-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 3.70 min,  $m/z$  450 [ $M + 1$ ];  $^1\text{H}$  NMR ( $\text{DMSO}-d_6$ ):  $\delta$  3.60 (s, 2H), 3.73 (s, 3H), 5.93 (s, 1H), 7.14 (d,  $J = \text{Hz}$ , 1H), 7.28 (m, 3H), 7.36 (m, 8H), 7.44 (m, 1H).

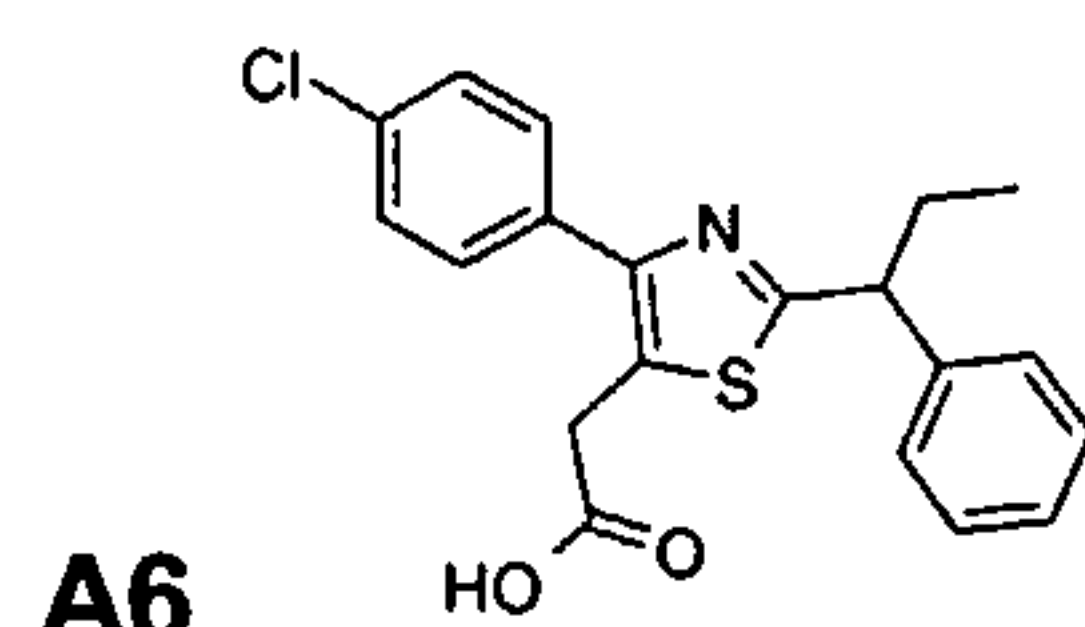




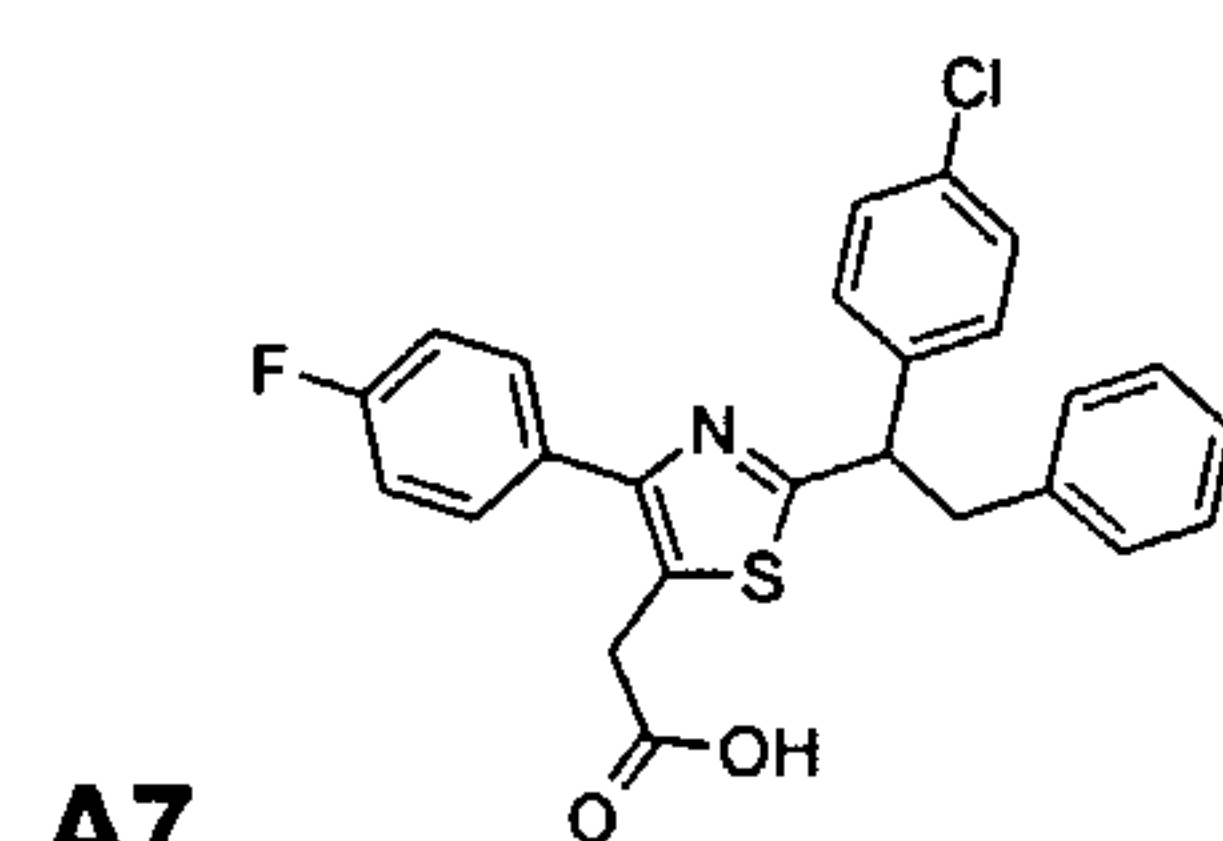
**[2-Benzhydryl-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 2.93 min,  $m/z$  404  $[M + 1]$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.85 (s, 2H), 5.88 (s, 1H), 7.12 (m, 2H), 7.25-7.38 (m, 10H), 7.58 (m, 2H).



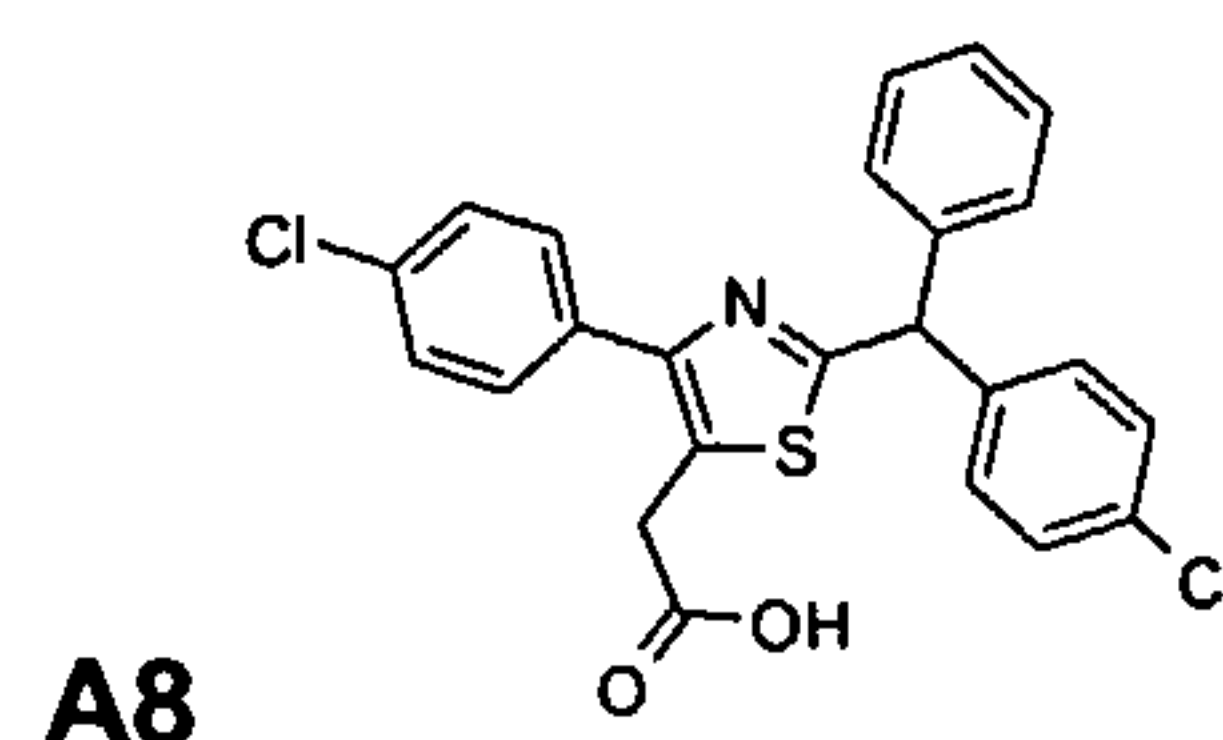
**[4-(4-Chloro-phenyl)-2-(1,2-diphenyl-ethyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 4.74 min,  $m/z$  434  $[M + 1]$ ;  $^1\text{H}$  NMR ( $\text{DMSO}-d_6$ ):  $\delta$  3.32 (m, 1H), 3.61 (m, 1H), 3.85 (s, 2H ( $\text{CH}_2$ )), 4.75 (m, 1H ( $\text{CH}$ )).



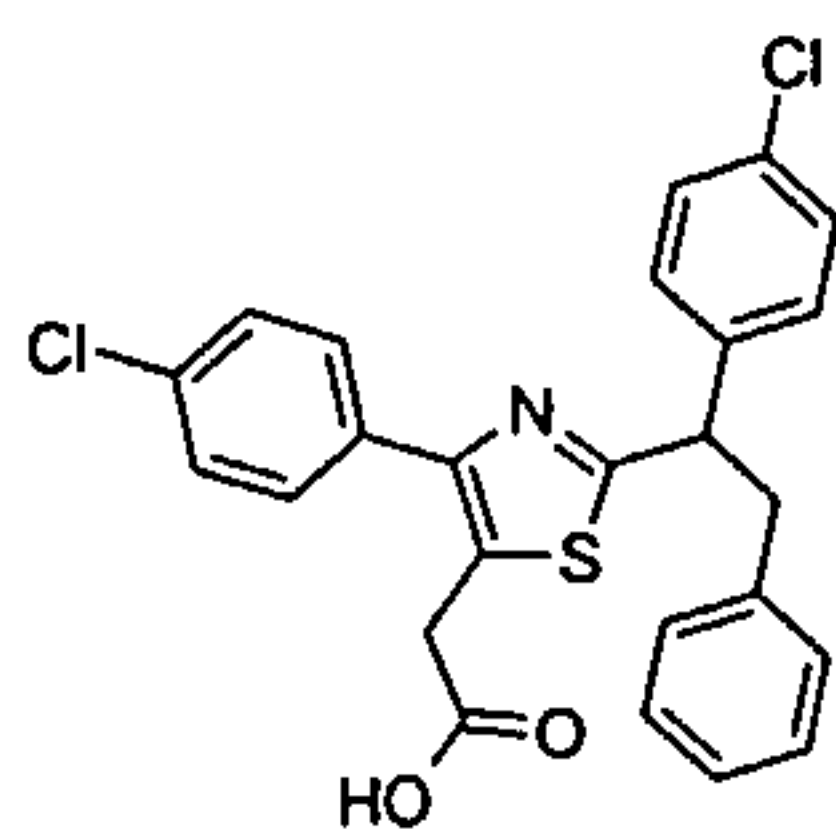
**[4-(4-Chloro-phenyl)-2-(1-phenyl-propyl)-thiazol-5-yl]-acetic acid:** LC/MS (an10p8): Rt 3.1 min,  $m/z$  372  $[M+1]$ .



**[2-[1-(4-Chloro-phenyl)-2-phenyl-ethyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.**  $^1\text{H}$  NMR ( $\text{DMSO}-d_6$ ):  $\delta$  3.32 (m, 1H), 3.61 (m, 1H), 3.84 (s, 2H ( $\text{CH}_2$ )), 4.80 (m, 1H ( $\text{CH}$ )).

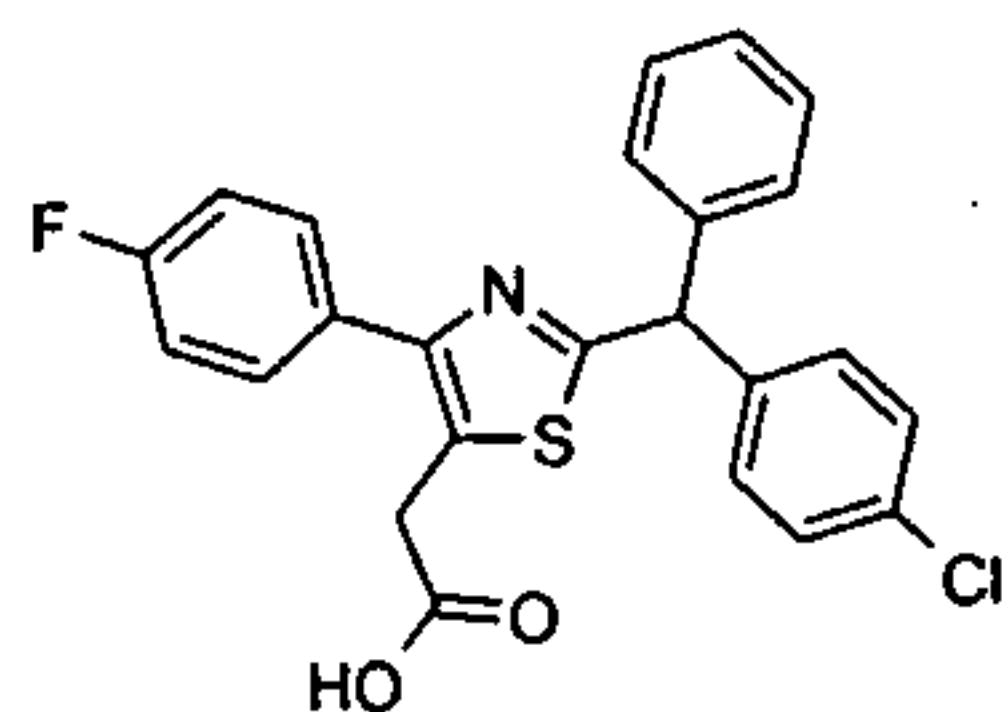


**{4-(4-Chloro-phenyl)-2-[(4-chloro-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid.**  $^1\text{H}$  NMR (DMSO- $d_6$ ):  $\delta$  3.91 (s, 2H), 6.01 (s, 1H), 7.37 (m, 9H), 7.50 (d,  $J$  = 8.10 Hz, 2H), 7.60 (d,  $J$  = 8.29 Hz, 2H).



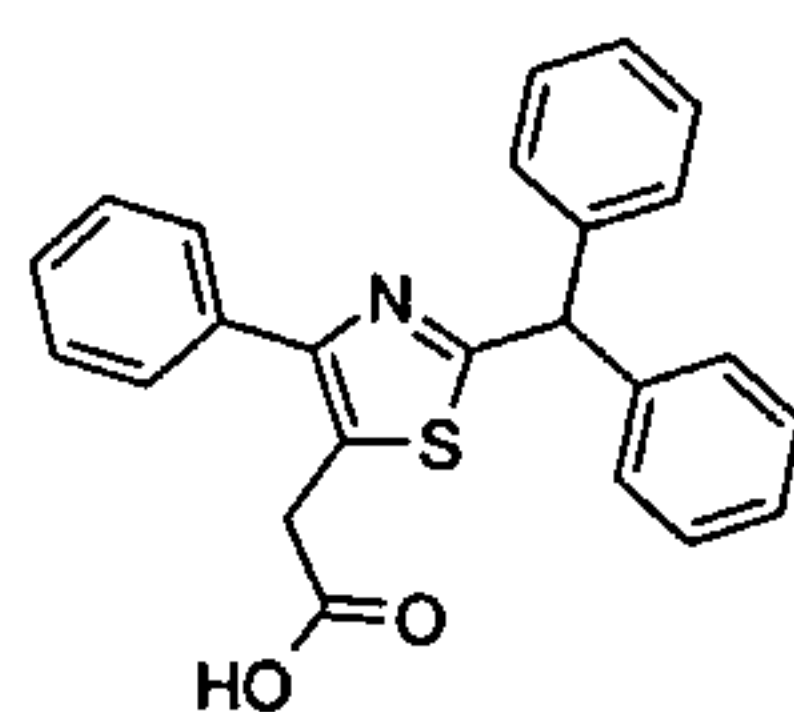
**A9**

**{4-(4-Chloro-phenyl)-2-[1-(4-chloro-phenyl)-2-phenyl-ethyl]-thiazol-5-yl}-acetic acid.** LC/MS (an10p8): Rt 5.17 min,  $m/z$  469 [ $M+1$ ];  $^1\text{H}$  NMR (DMSO- $d_6$ ):  $\delta$  3.32 (m, 1H), 3.61 (dd,  $J$  = 6.90 and 13.94, 1H), 3.86 (s, 2H ( $\text{CH}_2$ )) and 4.81 (t,  $J$  = 7.90, 1H (CH)).



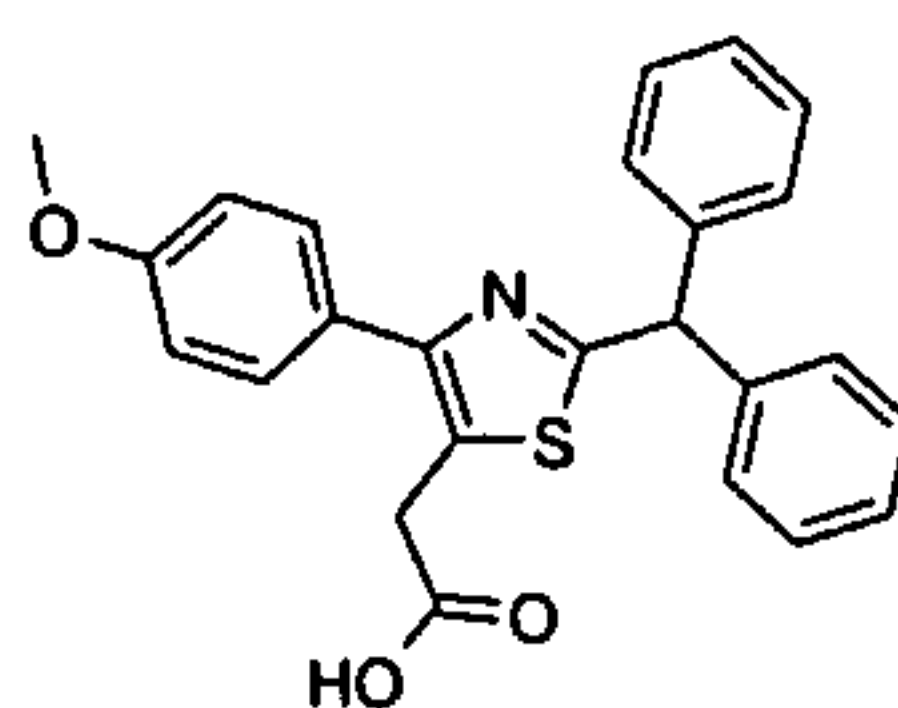
**A10**

**[2-[(4-Chloro-phenyl)-phenyl-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 5.04 min,  $m/z$  438 [ $M + 1$ ];  $^1\text{H}$  NMR (DMSO- $d_6$ ):  $\delta$  3.83 (s, 2H), 5.86 (s, 1H), 7.11 (m, 2H), 7.20-7.40 (m, 9H), 7.55 (m, 2H).



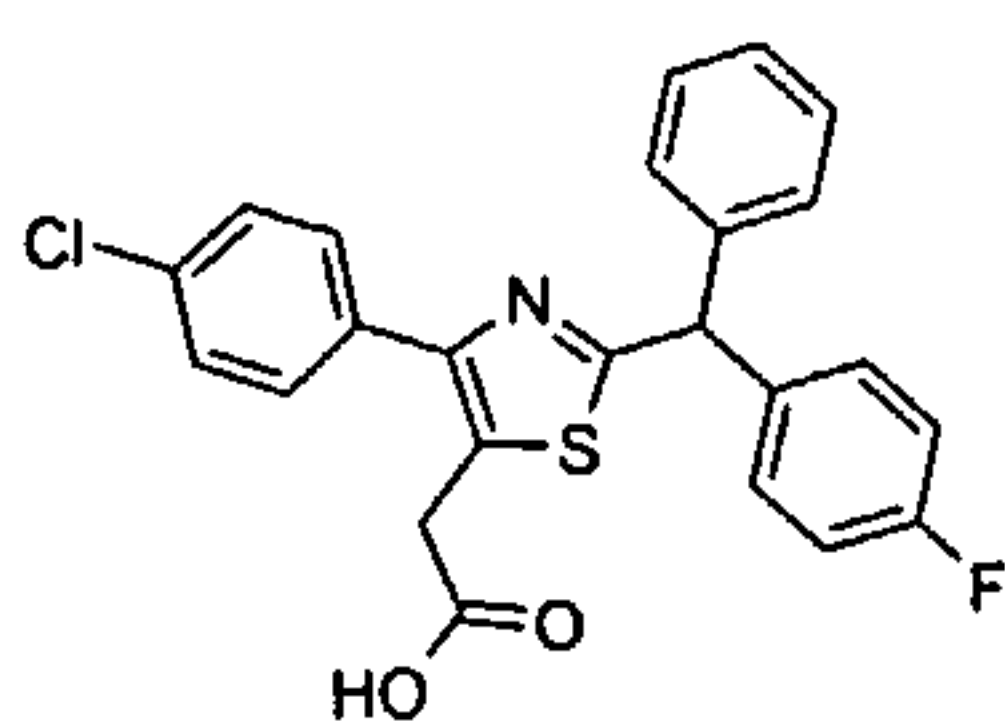
**A11**

**(2-Benzhydryl-4-phenyl-thiazol-5-yl)-acetic acid.** LC/MS (an10p8): Rt 3.95 min,  $m/z$  386 [ $M + H$ ];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.85 (s, 2H), 6.01 (s, 1H), 7.22-7.48 (m, 12H) and 7.60 (m, 2H).

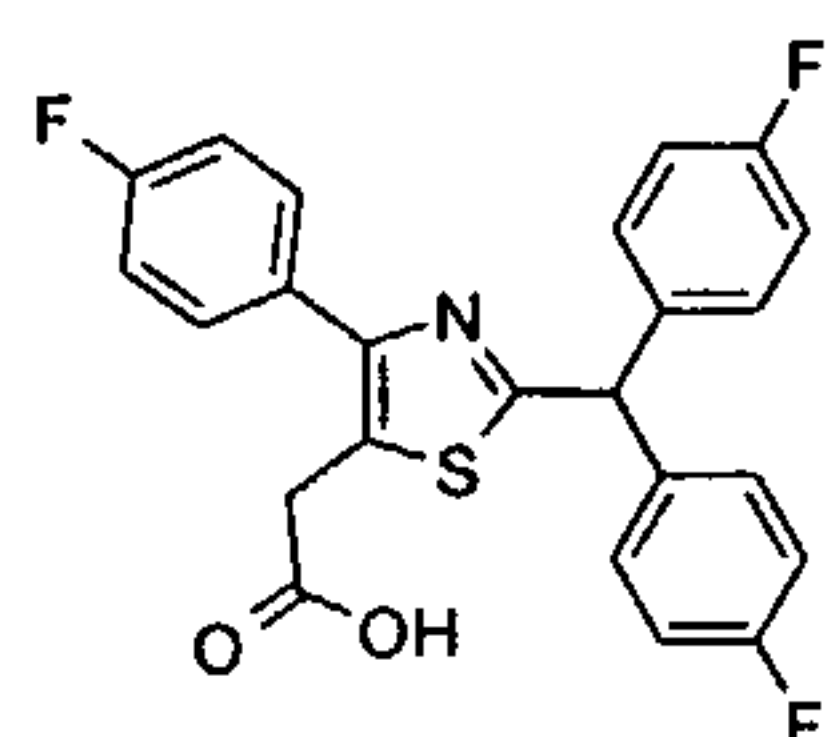


**A12**

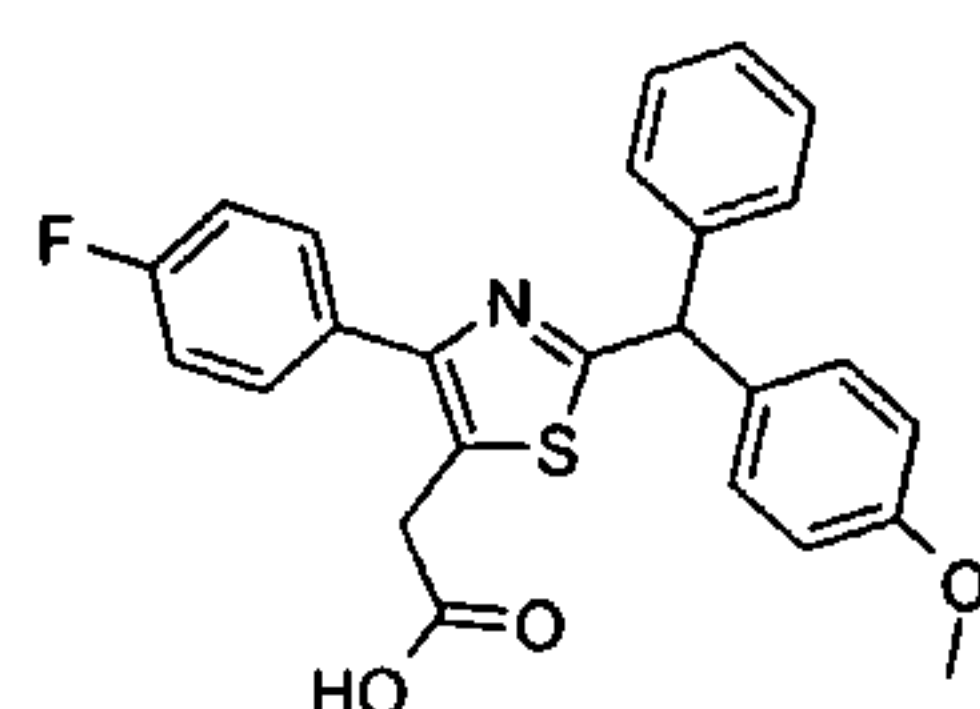
**[2-Benzhydryl-4-(4-methoxy-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 3.52 min,  $m/z$  416 [ $M + H$ ];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.84 (s, 3H), 3.85 (s, 2H), 5.86 (s, 1H), 6.97 (m, 2H), 7.26-7.37 (m, 10H) and 7.54 (m, 2H).

**A13**

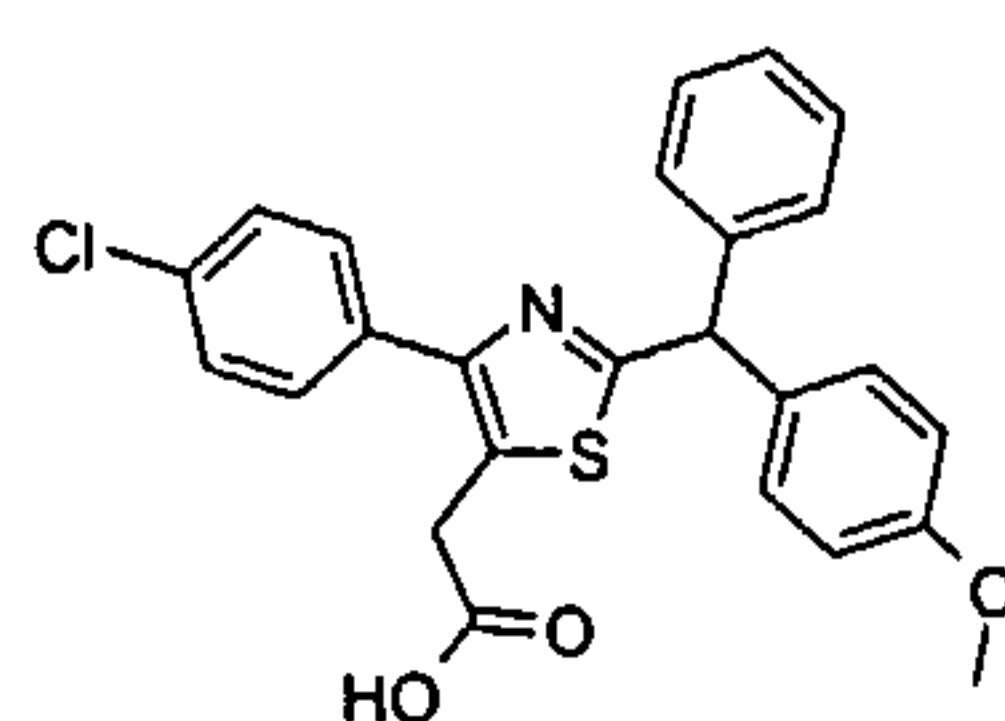
**{4-(4-Chloro-phenyl)-2-[(4-fluoro-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid.** LC/MS (an10p8): Rt 0.98 min,  $m/z$  438 [M + H];  $^1\text{H}$  NMR (DMSO- $d_6$ ):  $\delta$  3.91 (s, 2H), 6.00 (s, 1H), 7.19 (m, 2H), 7.29 (m, 1H), 7.36-7.43 (m, 6H), 7.54 (m, 2H), 7.59 (m, 2H), 12.87 (br s, 1H).

**A14**

**[2-[Bis-(4-fluoro-phenyl)-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 4.81 min,  $m/z$  440 [M + H];  $^1\text{H}$  NMR (DMSO- $d_6$ ):  $\delta$  3.89 (s, 2H), 6.03 (s, 1H), 7.19 (m, 4H), 7.30 (m, 2H), 7.41 (m, 4H), 7.62 (m, 2H).

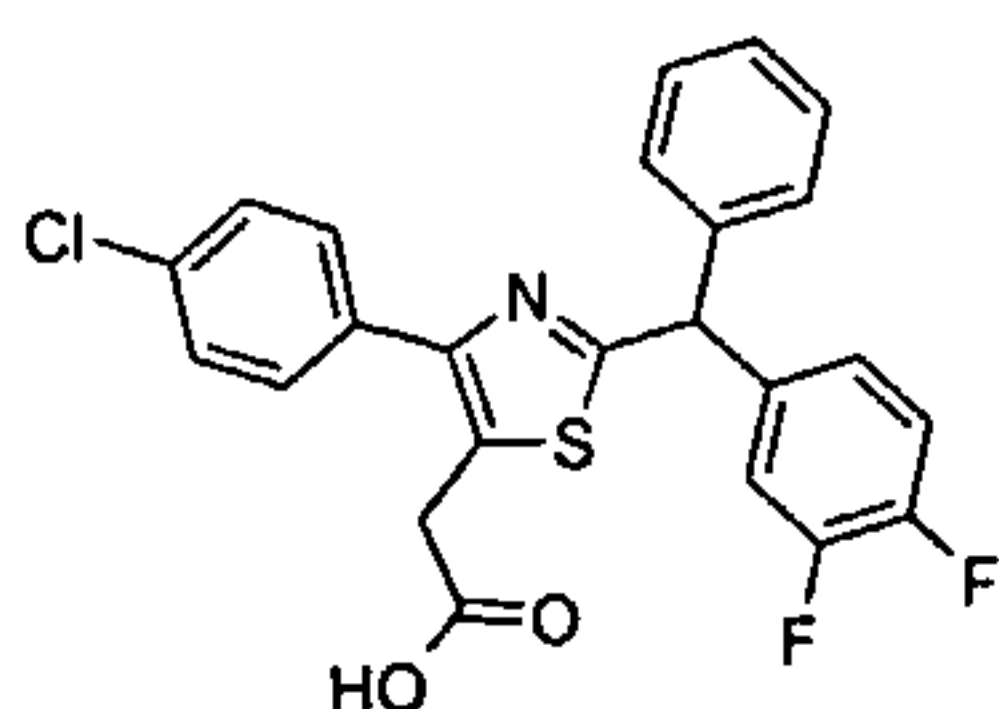
**A15**

**{4-(4-Fluoro-phenyl)-2-[(4-methoxy-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid.** LC/MS (an10p8): Rt 3.45 min,  $m/z$  434 [M + H];  $^1\text{H}$  NMR (CDCl $_3$ ):  $\delta$  3.81 (s, 3H), 3.84 (s, 2H), 5.81 (s, 1H), 6.89 (m, 2H), 7.12 (m, 2H), 7.24 (m, 2H), 7.28-7.38 (m, 5H), 7.58 (m, 2H).  $^{13}\text{C}$ -APT (CDCl $_3$ ):  $\delta$  32.79 (CH $_2$ ), 54.62, 55.65 (CH $_3$ /CH).

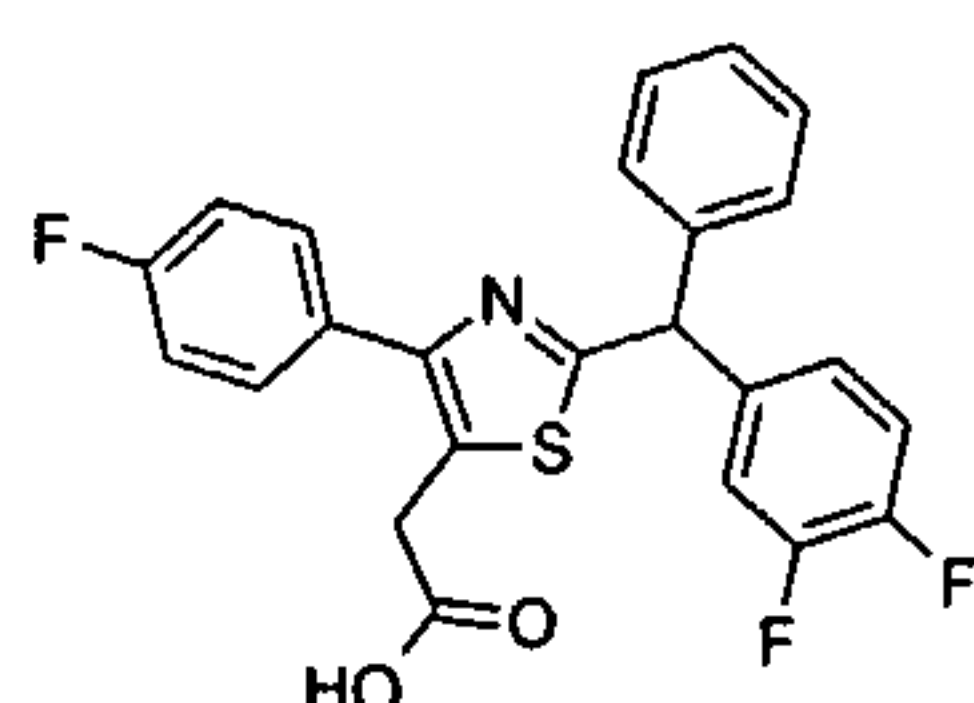
**A16**

**{4-(4-Chloro-phenyl)-2-[(4-methoxy-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid.** LC/MS (an10p8): Rt 3.71 min,  $m/z$  450 [M + H];  $^1\text{H}$  NMR (CDCl $_3$ ):  $\delta$  3.81 (s, 3H), 3.84 (s, 2H), 5.84 (s, 1H), 6.87 (m, 2H), 7.21 (m, 2H), 7.24-7.36 (m, 5H), 7.41 (m, 2H), 7.55 (m, 2H).  $^{13}\text{C}$ -APT (CDCl $_3$ ):  $\delta$  32.83 (CH $_2$ ), 54.57, 55.66 (CH $_3$  / CH).

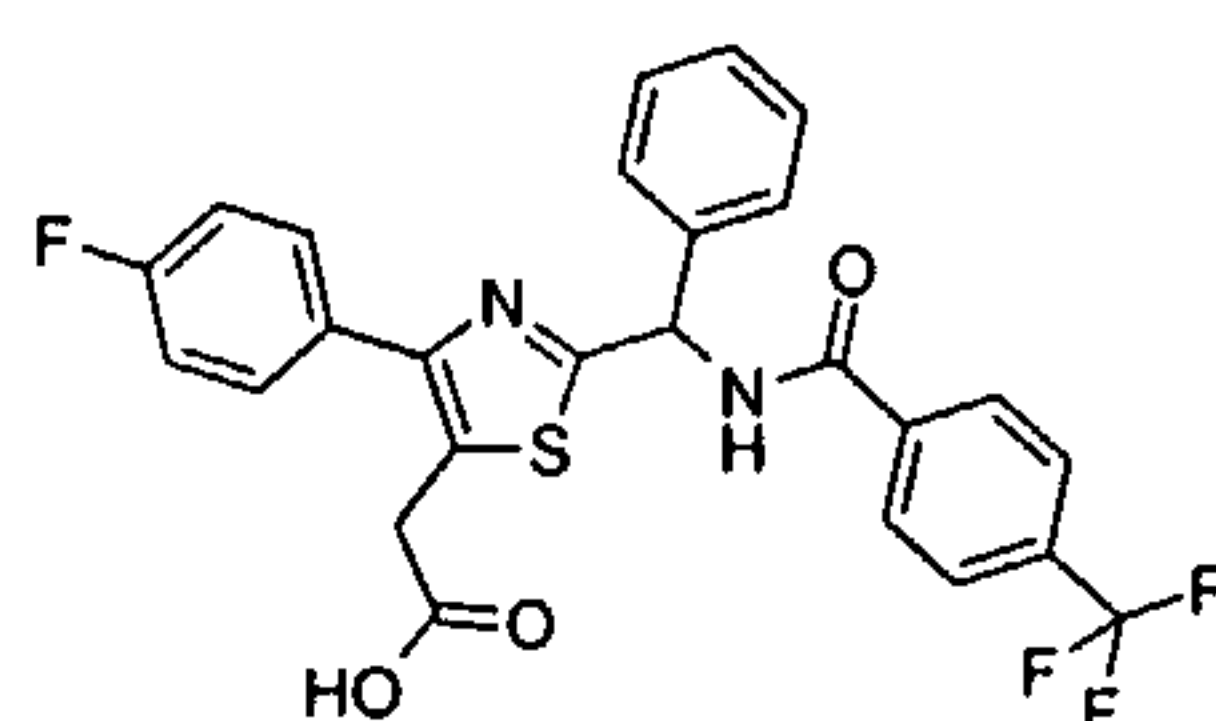


**A17**

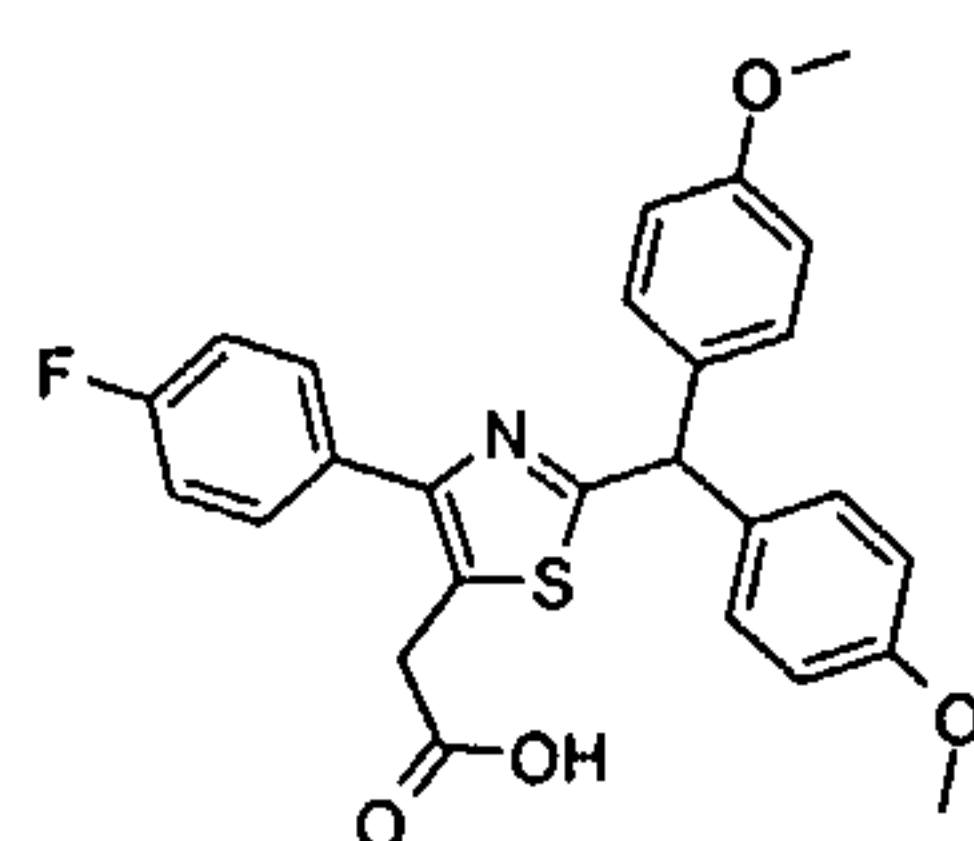
**{4-(4-Chloro-phenyl)-2-[(3,4-difluoro-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid.** LC/MS (an10p8): Rt 3.98 min,  $m/z$  456 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.89 (s, 2H), 5.79 (s, 1H), 7.04 (m, 1H), 7.15 (m, 2H), 7.25-7.40 (m, 5H), 7.44 (m, 2H), 7.53 (m, 2H).  $^{13}\text{C}$ -APT ( $\text{CDCl}_3$ ):  $\delta$  32.60 ( $\text{CH}_2$ ), 54.54 (CH).

**A18**

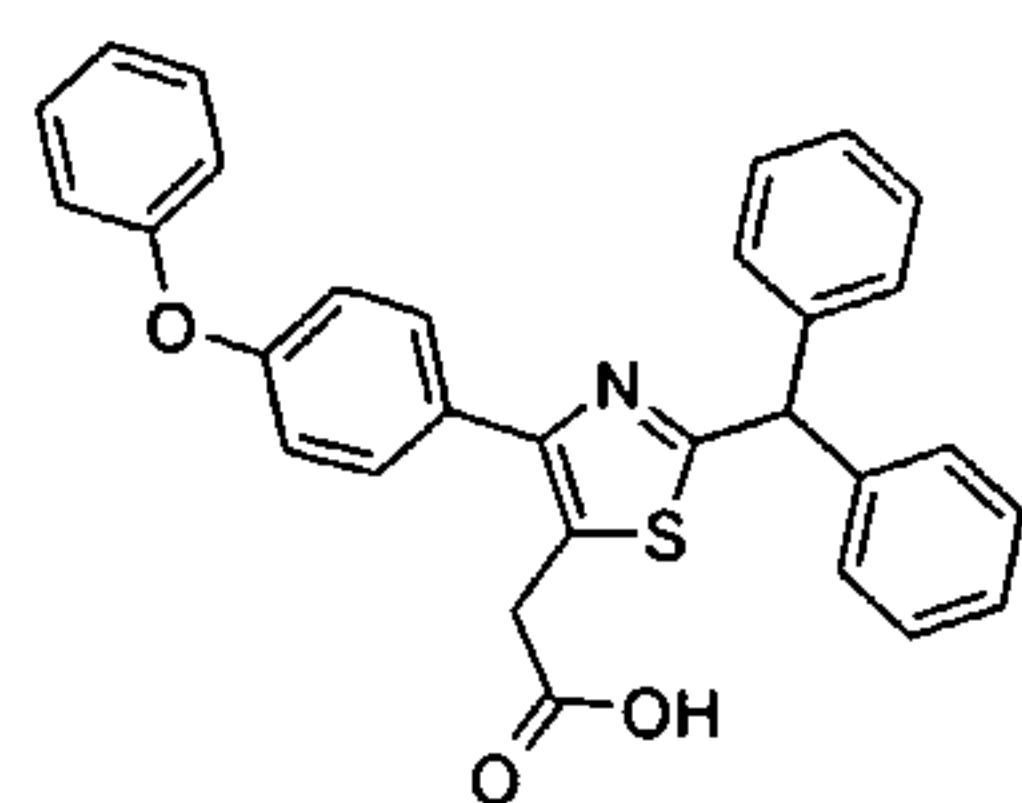
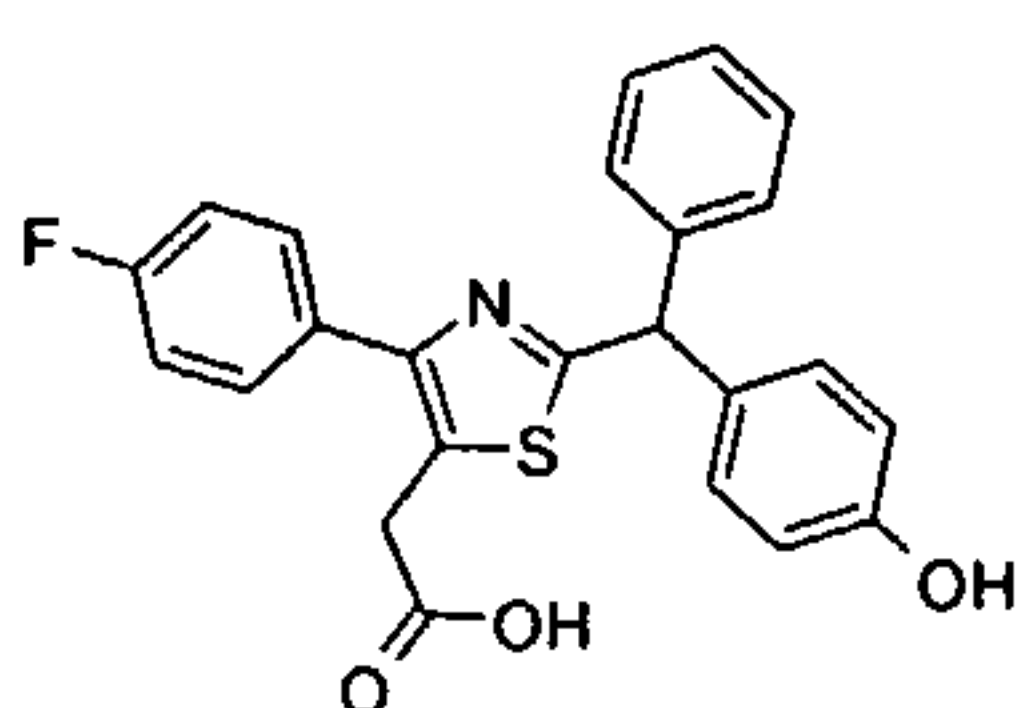
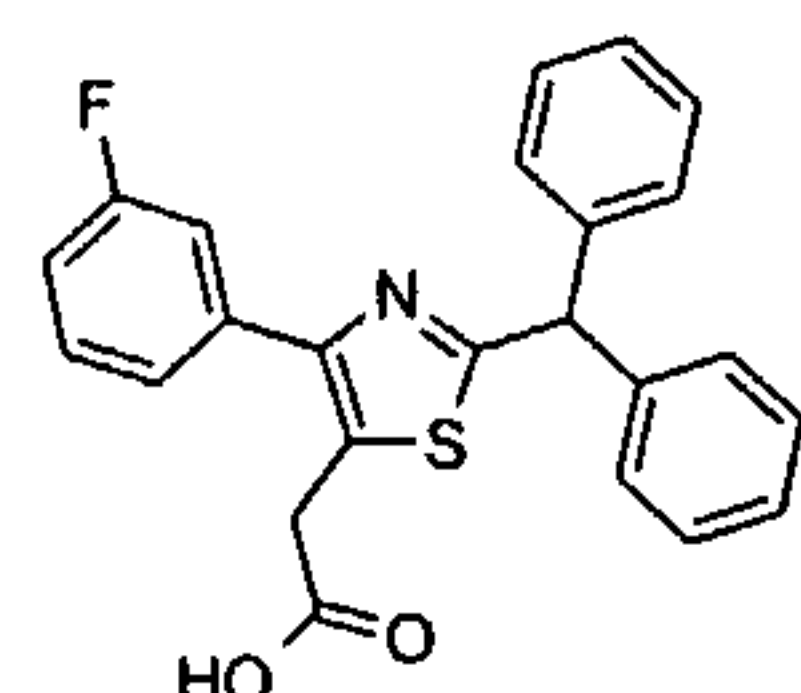
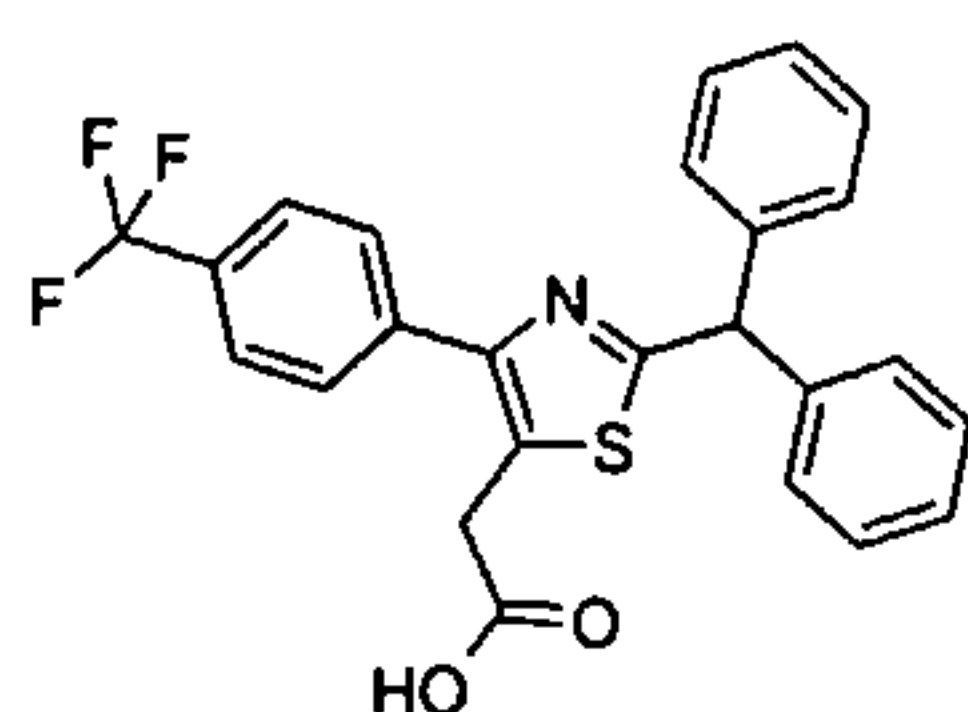
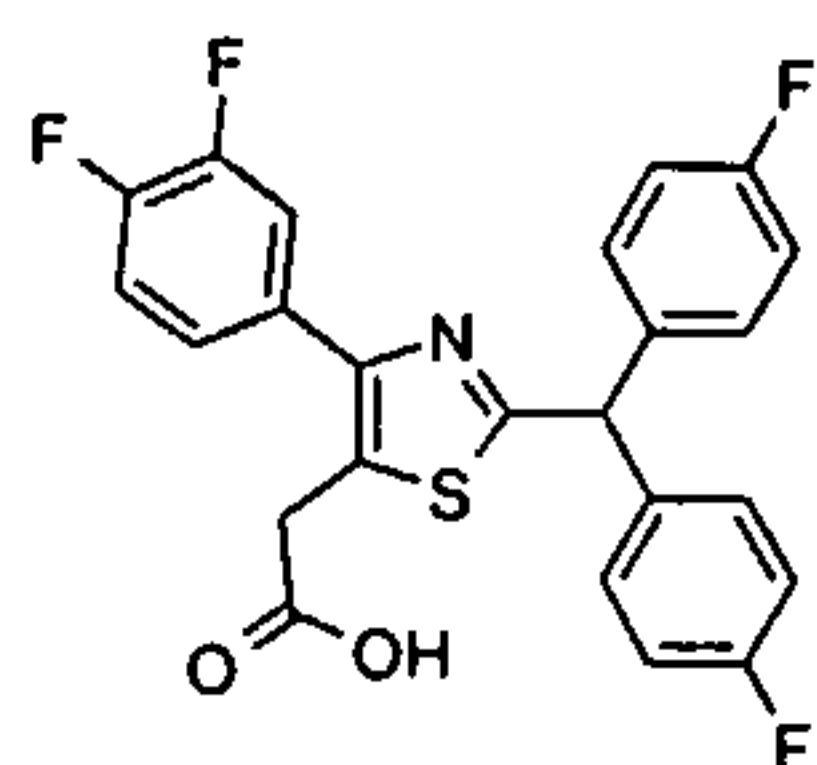
**[2-[(3,4-Difluoro-phenyl)-phenyl-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 3.76 min,  $m/z$  440 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.88 (s, 2H), 5.83 (s, 1H), 7.03 (m, 1H), 7.14 (m, 4H), 7.28-7.44 (m, 5H), 7.58 (m, 2H).  $^{13}\text{C}$ -APT ( $\text{CDCl}_3$ ):  $\delta$  32.65 ( $\text{CH}_2$ ), 54.46 (CH).

**A19**

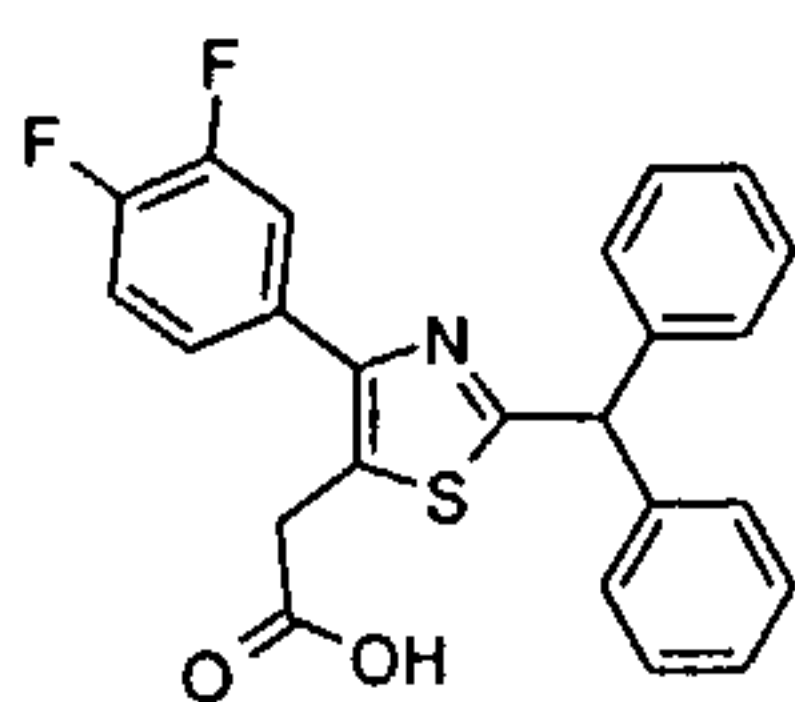
**{4-(4-Fluoro-phenyl)-2-[phenyl-(4-trifluoromethyl-benzoylamino)-methyl]-thiazol-5-yl}-acetic acid.** LC/MS (an10p8): Rt 2.88 min,  $m/z$  515 [M + H];  $^1\text{H}$  NMR ( $\text{DMSO}-d_6$ ):  $\delta$  3.90 (s, 2H), 6.64 (d,  $J = 8.2$  Hz, 1H), 7.30 (m, 2H), 7.36-7.45 (m, 3H), 7.54-7.65 (m, 4H), 7.87 (d,  $J = 8.2$  Hz, 2H), 8.16 (d,  $J = 8.2$  Hz, 2H), 9.87 (m, 1H (NH)) and 12.82 (s, 1H (OH)).

**A20**

**[2-[Bis-(4-methoxy-phenyl)-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 2.17 min,  $m/z$  464 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.81 (s, 6H), 3.83 (s, 2H), 5.77 (s, 1H), 6.89 (m, 4H), 7.11 (m, 2H), 7.22 (m, 4H), 7.56 (m, 2H).

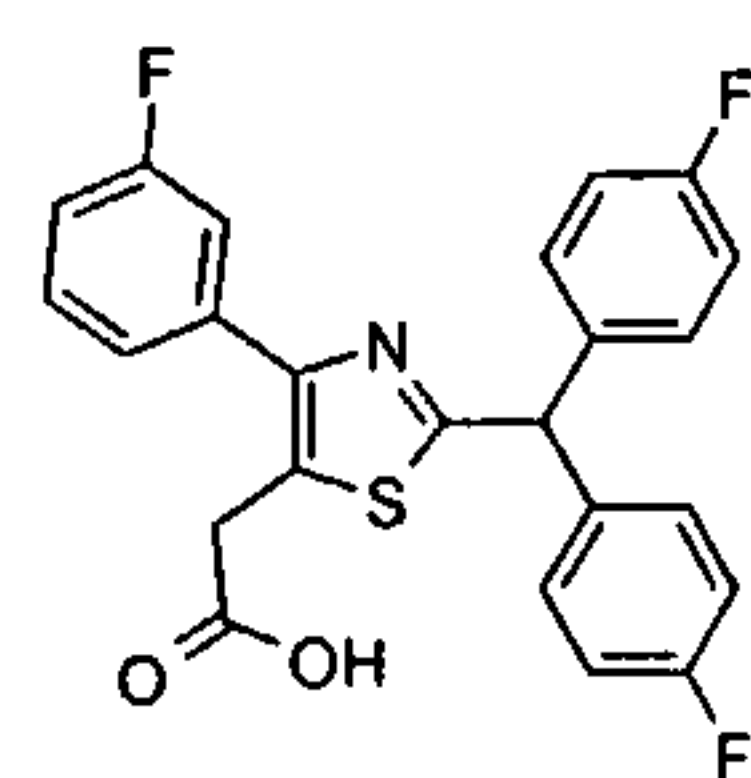
**A21****[2-Benzhydryl-4-(4-phenoxy-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8):Rt 4.04 min,  $m/z$  478 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.88 (s, 2H), 5.87 (s, 1H), 7.07 (m, 4H), 7.14 (m, 1H), 7.25-7.41 (m, 12H), 7.58 (m, 2H).**A22****{4-(4-Fluoro-phenyl)-2-[(4-hydroxy-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid.**  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.77 (s, 2H), 5.82 (s, 1H), 6.70 (m, 2H), 7.02-7.15 (m, 5H), 7.26-7.30 (m, 4H), 7.53 (m, 2H).**A23****[2-Benzhydryl-4-(3-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt2.69 min,  $m/z$  404 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.88 (s, 2H), 5.90 (s, 1H), 7.07 (m, 1H), 7.26-7.41 (m, 13H).**A24****[2-Benzhydryl-4-(4-trifluoromethyl-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS(an10p8): Rt 3.09 min,  $m/z$  455 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.91 (s, 2H), 5.91 (s, 1H), 7.34 (m, 10H), 7.72 (m, 4H).**A25**

**[2-[Bis-(4-fluoro-phenyl)-methyl]-4-(3,4-difluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 3.18 min,  $m/z$  458 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.88 (s, 2H), 5.81 (s, 1H), 7.04 (m, 4H), 7.18-7.36 (m, 6H), 7.46 (m, 1H).



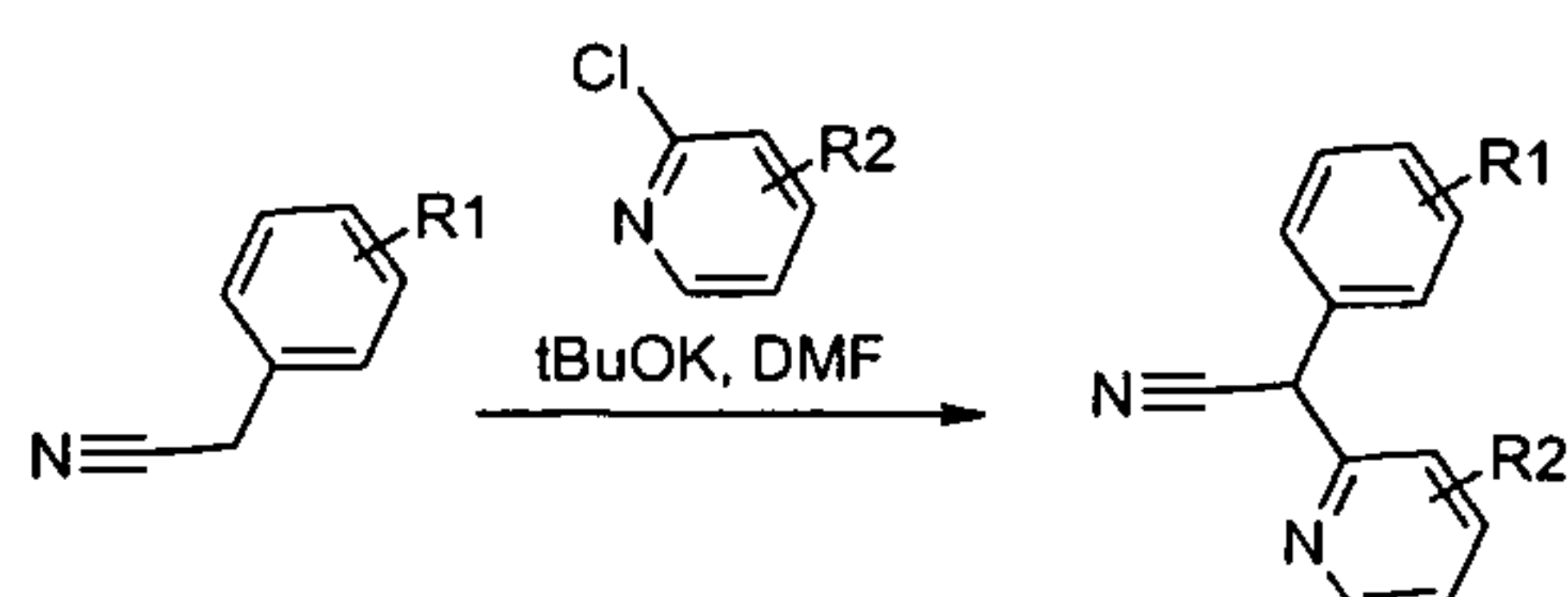
**A26**

**[2-Benzhydryl-4-(3,4-difluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 2.88 min,  $m/z$  422 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.88 (s, 2H), 5.81 (s, 1H), 7.20 (m, 1H), 7.26-7.37 (m, 9H), 7.48 (m, 1H).

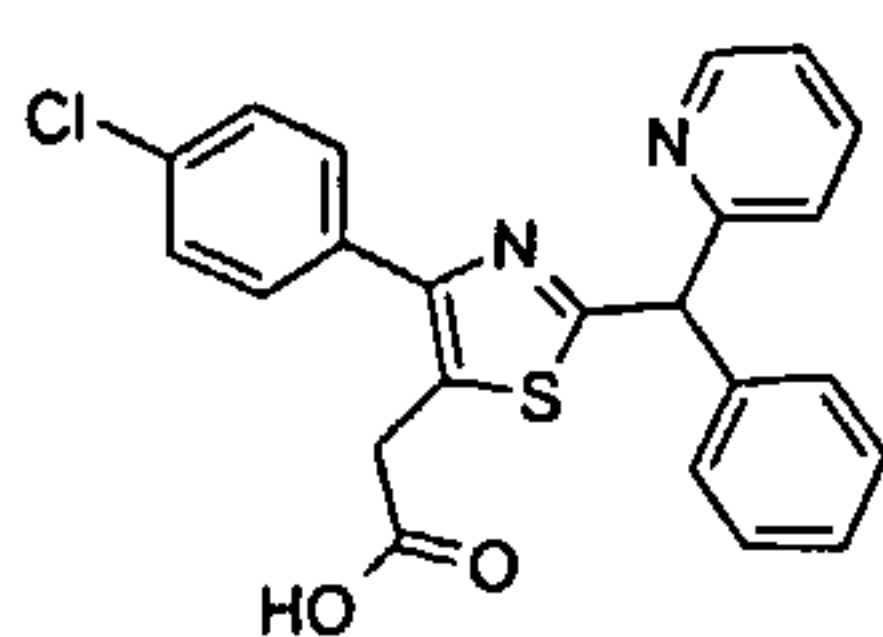


**A27**

**[2-[Bis-(4-fluoro-phenyl)-methyl]-4-(3-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** LC/MS (an10p8): Rt 3.08 min,  $m/z$  440 [M + H];  $^1\text{H}$  NMR ( $\text{CDCl}_3$ ):  $\delta$  3.92 (s, 2H), 5.82 (s, 1H), 7.04 (m, 4H), 7.24-7.29 (m, 6H) and 7.37 (m, 2H).



**Synthesis of nitrile intermediates – Representative Procedure 7 (RP7):** To a cooled (5 °C) solution of Potassium *tert*-butoxide (2.1 mmol) in dry DMF (0.6ml) was added a mixture of the benzonitrile (1 mmol) and the 2-Chloro-pyridine (1.1 mmol) in dry DMF (0.4ml). After O/N stirring at RT, aq.  $\text{NH}_4\text{Cl}$  and EtOAc were added. The organic phase was separated, dried over  $\text{MgSO}_4$  and concentrated *in vacuo*. The residue was purified over silica gel chromatography to give the desired product, which precipitated upon treatment with  $\text{Et}_2\text{O}$ .

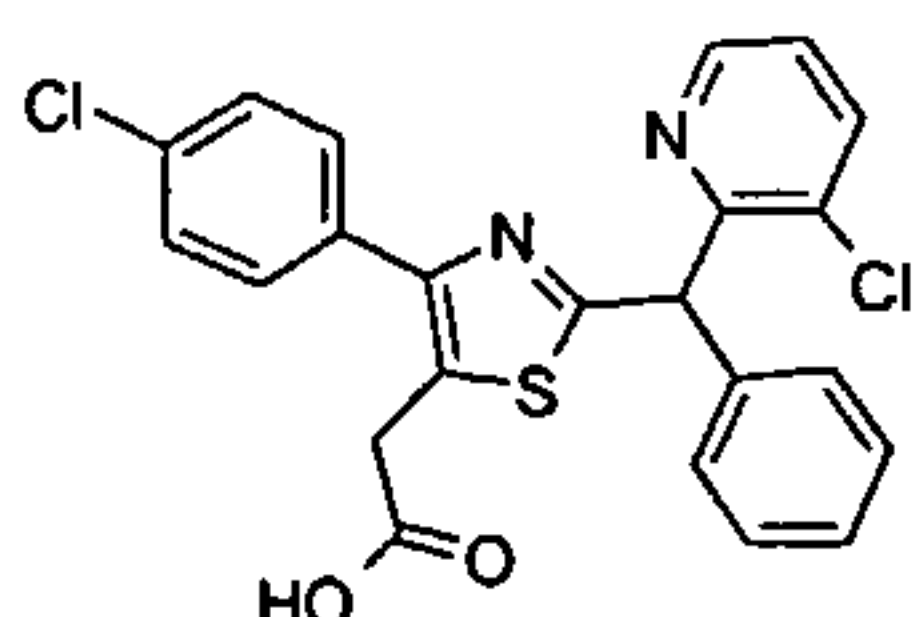


**A28**

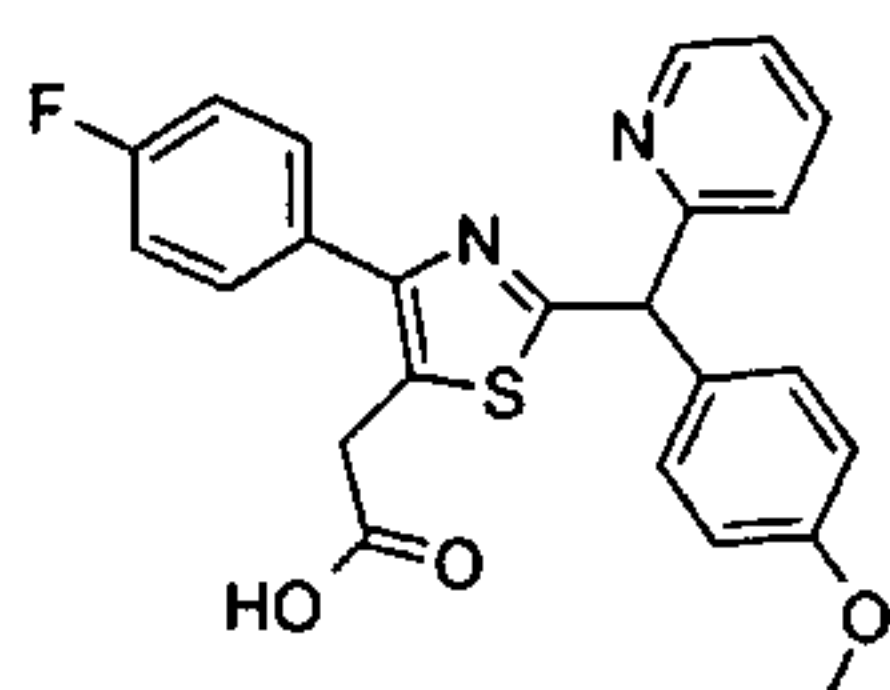


**[4-(4-Chloro-phenyl)-2-(phenyl-pyridin-2-yl-methyl)-thiazol-5-yl]-acetic acid.**

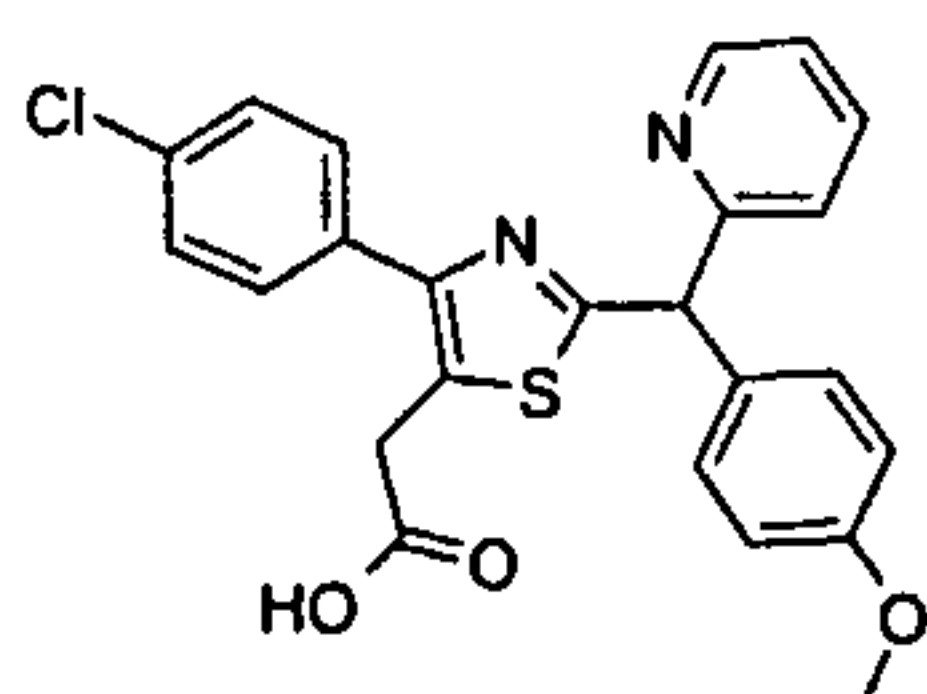
Title compound was prepared from 3-bromo-4-(4-chloro-phenyl)-4-oxo-butyric acid and 2-phenyl-2-pyridin-2-yl-thioacetamide according to RP6 and RP7: LC/MS (an10p8) Rt 3.00 min,  $m/z$  422  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.86 (s, 2H), 6.2 (s, 1H), 7.2-8.0 (m, 12H), 8.7 (d, 1H).

**A29****{4-(4-Chloro-phenyl)-2-[(3-chloro-pyridin-2-yl)-phenyl-methyl]-thiazol-5-yl}-**

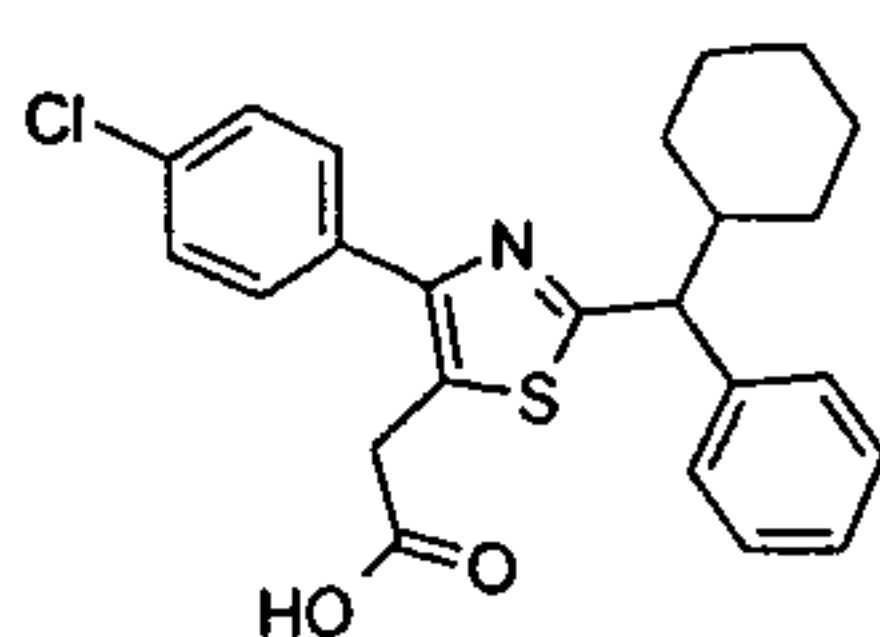
**acetic acid.** Title compound was prepared from 3-bromo-4-(4-chloro-phenyl)-4-oxo-butyric acid and 2-(3-Chloro-pyridin-2-yl)-2-phenyl-thioacetamide according to RP6 and RP7: LC/MS (an10p8) Rt 3.54 min,  $m/z$  454.5  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.83 (s, 2H), 6.66 (s, 1H), 7.2-7.3 (m, 1H), 7.3-7.4 (m, 5H), 7.5 (d, 4H), 7.7 (dd, 1H), 8.6 (dd, 1H).

**A30****{4-(4-Fluoro-phenyl)-2-[(4-methoxy-phenyl)-pyridin-2-yl-methyl]-thiazol-5-yl}-**

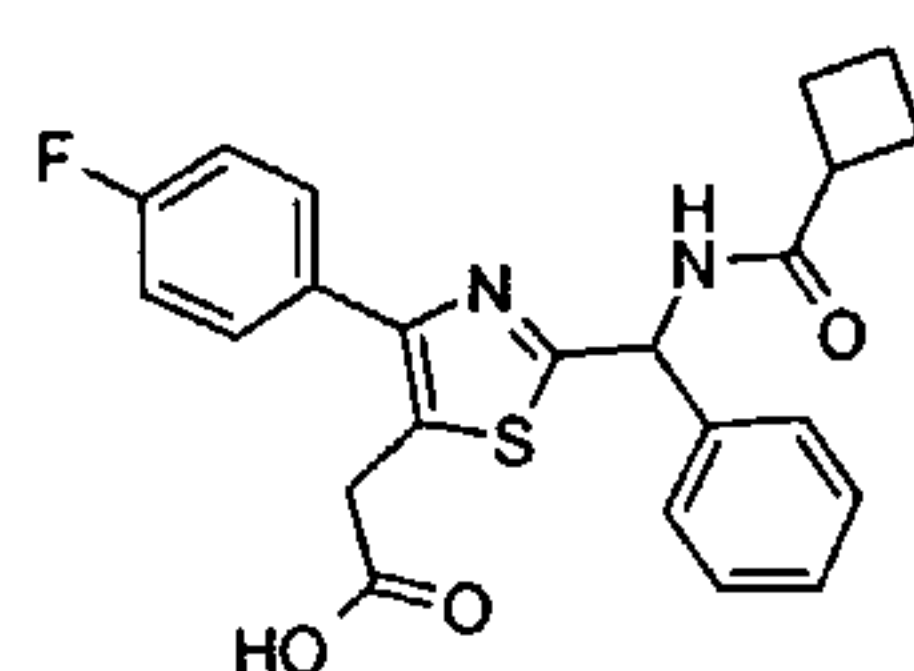
**acetic acid.** Title compound was prepared from 3-bromo-4-(4-fluoro-phenyl)-4-oxo-butyric acid and 2-(4-methoxy-phenyl)-2-pyridin-2-yl-thioacetamide according to RP6 and RP7: LC/MS (an10p8) Rt 2.20 min,  $m/z$  434  $[M + H]^+$ .

**A31****{4-(4-Chloro-phenyl)-2-[(4-methoxy-phenyl)-pyridin-2-yl-methyl]-thiazol-5-yl}-**

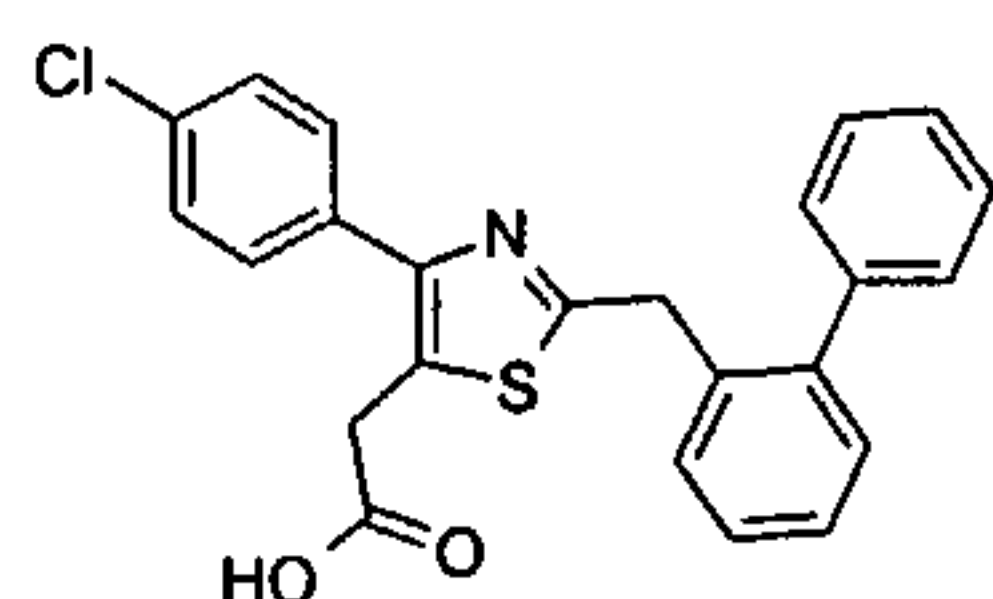
**acetic acid.** Title compound was prepared from 3-bromo-4-(4-chloro-phenyl)-4-oxo-butyric acid and 2-(4-methoxy-phenyl)-2-pyridin-2-yl-thioacetamide according to RP6 and RP7: LC/MS (an10p8) Rt 2.37 min,  $m/z$  450.5  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.75 (s, 3H), 3.78 (s, 2H) 6.0 (s, 1H), 6.9 (d, 2H), 7.2 (t, 1H), 7.3 (m, 4H), 7.4 (d, 1H), 7.5 (d, 2H), 7.6 (dt, 1H), 8.1 (d, 1H).

**A32**

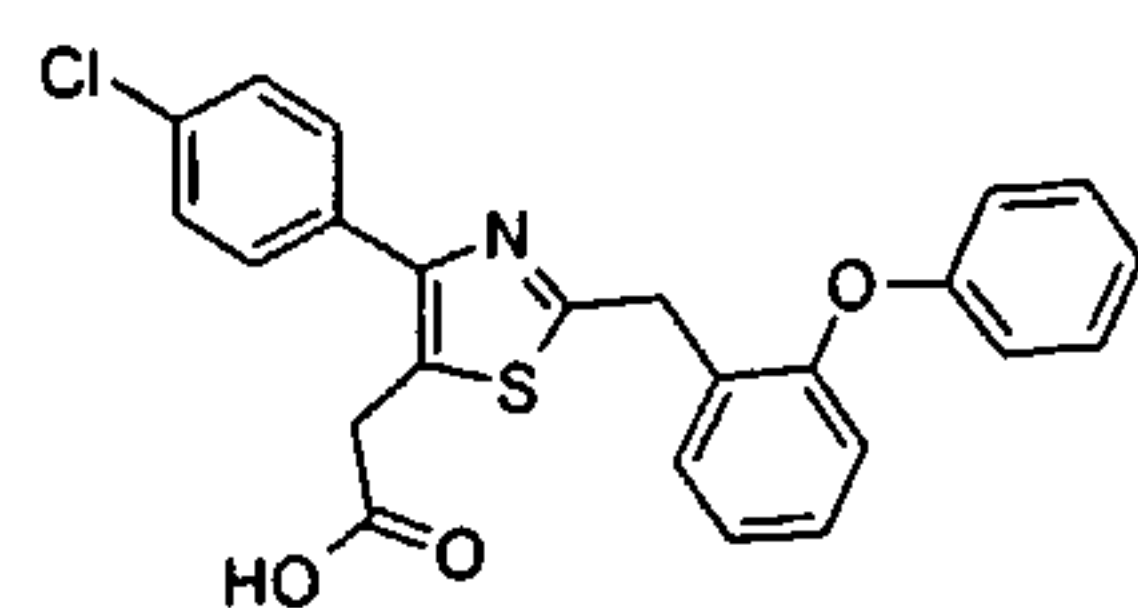
**[4-(4-Chloro-phenyl)-2-(cyclohexyl-phenyl-methyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from 3-bromo-4-(4-chloro-phenyl)-4-oxo-butyric acid and 2-cyclohexyl-2-phenyl-thioacetamide according to RP6: LC/MS (an10p8) Rt 3.20 min,  $m/z$  425.4  $[M + H]^+$ .

**A33**

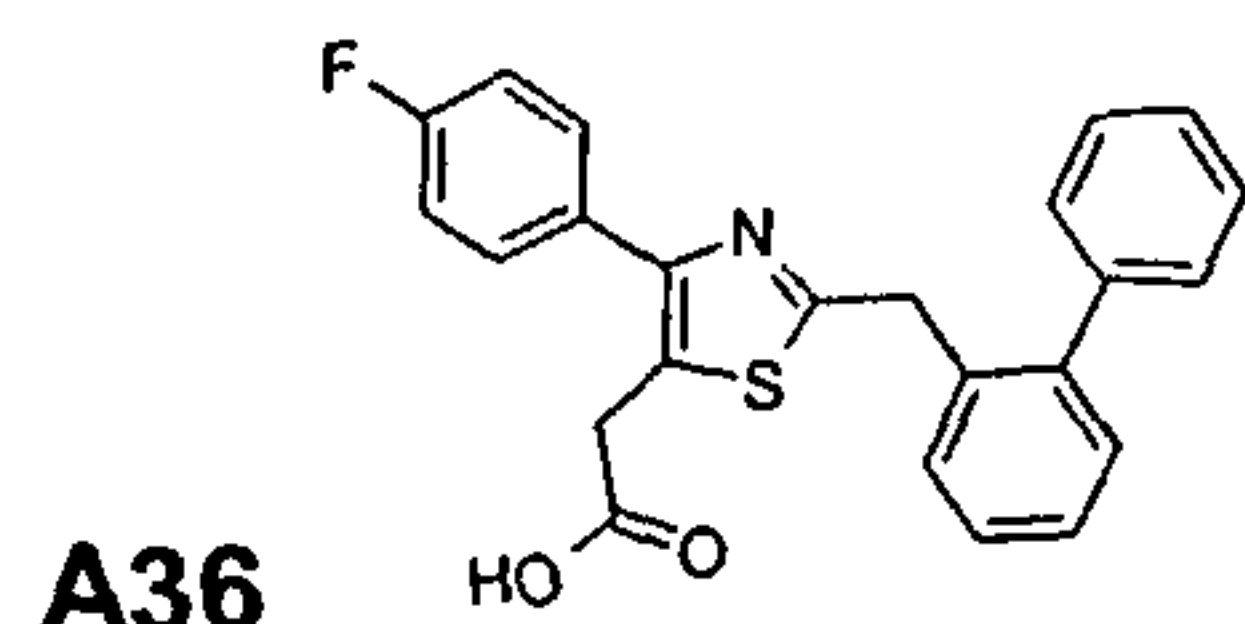
**[2-[(Cyclobutanecarbonyl-amino)-phenyl-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from 3-bromo-4-(4-fluoro-phenyl)-4-oxo-butyric acid and 2-cyclobutyl-2-phenyl-thioacetamide according to RP6: LC/MS (an10p8): Rt 2.01 min,  $m/z$  425  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  1.92 (m, 2H), 2.19 (m, 2H), 3.13 (p,  $J = 8.4$  Hz, 1H), 3.81(s, 2H), 6.49 (d,  $J = 7.5$ , 1H (NH)), 7.13 (m, 3H), 7.36 (m, 4H) and 7.54 (m, 2H).

**A34**

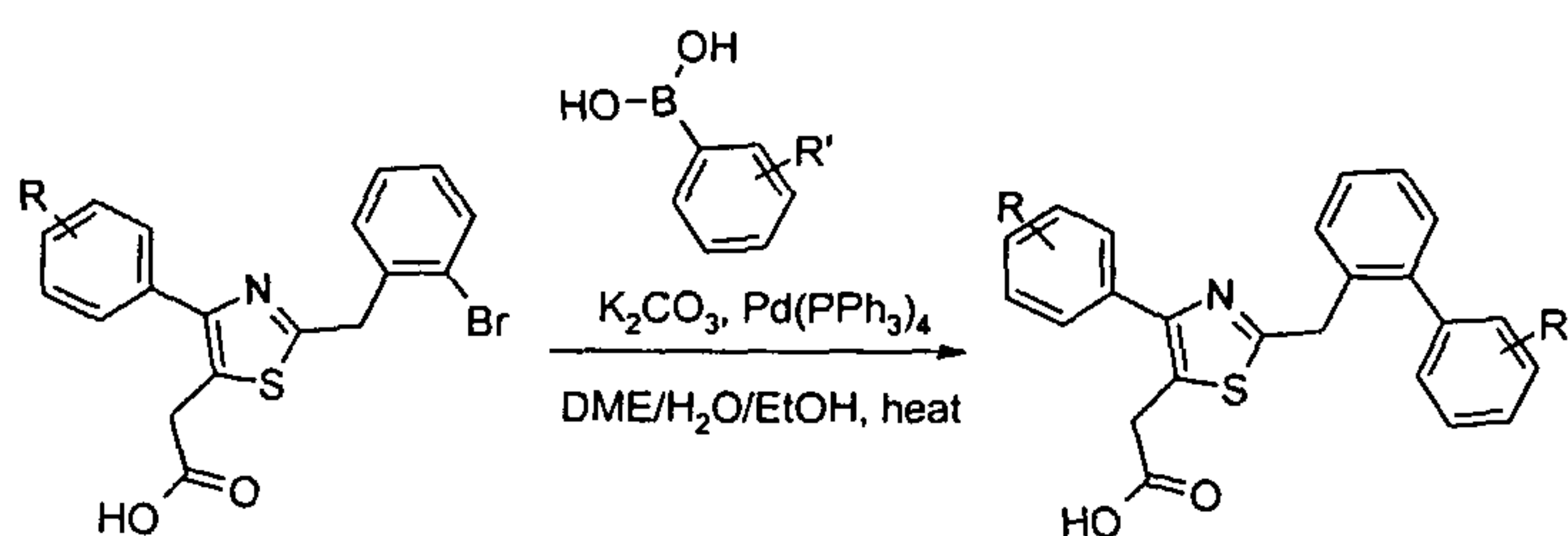
**[2-Biphenyl-2-ylmethyl-4-(4-chloro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from 3-bromo-4-(4-chloro-phenyl)-4-oxo-butyric acid and 2-biphenyl-2-yl-thioacetamide according to RP6: LC/MS (an10p8) Rt 4.94 min,  $m/z$  419.4  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.83 (s, 2H), 4.33 (s, 2H), 7.3-7.5 (m, 13H).

**A35**

**[4-(4-Chloro-phenyl)-2-(2-phenoxy-benzyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from 3-bromo-4-(4-chloro-phenyl)-4-oxo-butyric acid and 2-(2-phenoxy-phenyl)-thioacetamide according to RP6: LC/MS (an10p8) Rt 3.80 min,  $m/z$  435.4  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.82 (s, 2H), 4.39 (s, 2H), 6.9 (d, 1H), 7.0 (d, 2H), 7.1 (m, 2H), 7.2-7.3 (m, 3H), 7.4 (t, 3H), 7.5 (d, 2H).

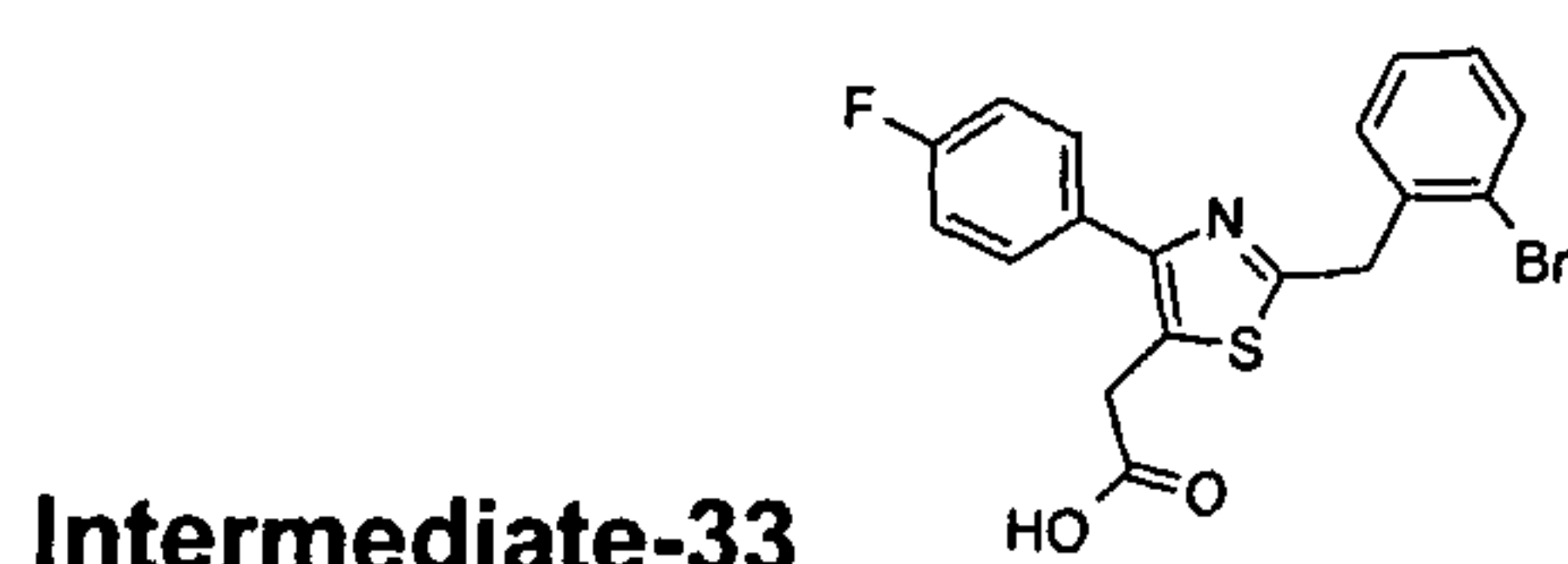


**[2-Biphenyl-2-ylmethyl-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from 3-bromo-4-(4-fluoro-phenyl)-4-oxo-butyric acid and 2-biphenyl-2-yl-thioacetamide according to RP6: LC/MS (an10p8) Rt 2.60 min,  $m/z$  403  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.78 (s, 2H), 4.31 (s, 2H), 7.1 (t, 2H), 7.3-7.5 (m, 11H).



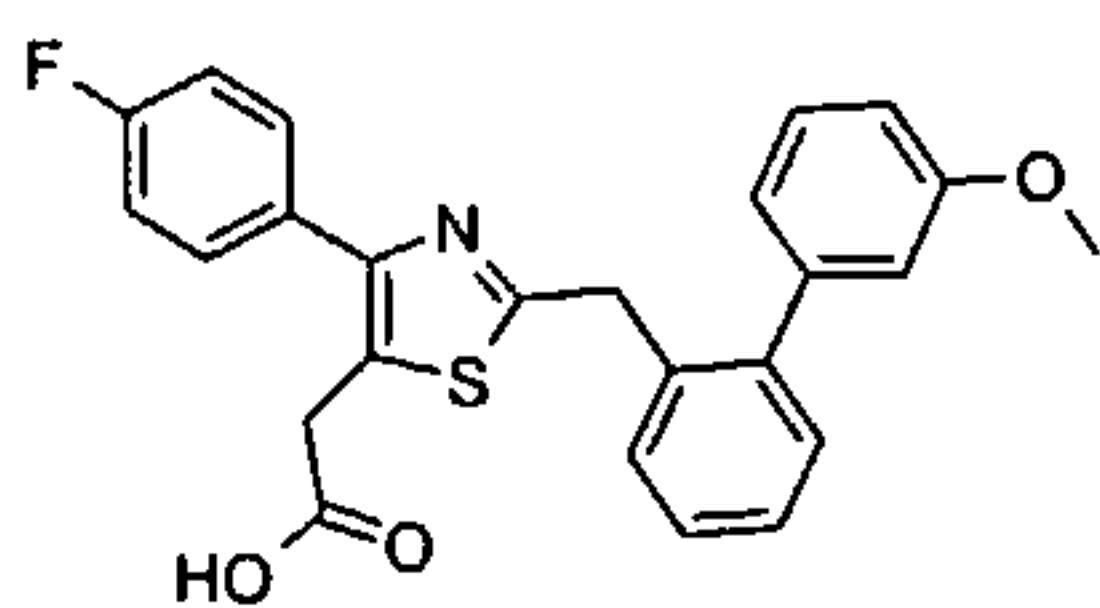
#### Representative procedure 8 (RP8)

A mixture of  $Pd(PPh_3)_4$  (~50mg),  $K_2CO_3$  (2 mmol), [2-(2-bromo-benzyl)-thiazol-5-yl]-acetic acid (1 mmol) and the corresponding phenyl boronic acid (1.3 mmol) in DME/H<sub>2</sub>O/EtOH (7/3/2, 20 mL) was heated at 150 °C for 10 minutes in a microwave. After cooling, water, acetic acid and EtOAc were added. The solid materials were filtered off and the filtrate was concentrated *in vacuo*. The residue was taken up in hot acetonitrile and solid particles were filtered off. The filtrate was allowed to cool to RT, upon which the desired compound precipitated. In some occasions, the crude material was purified by chromatography.

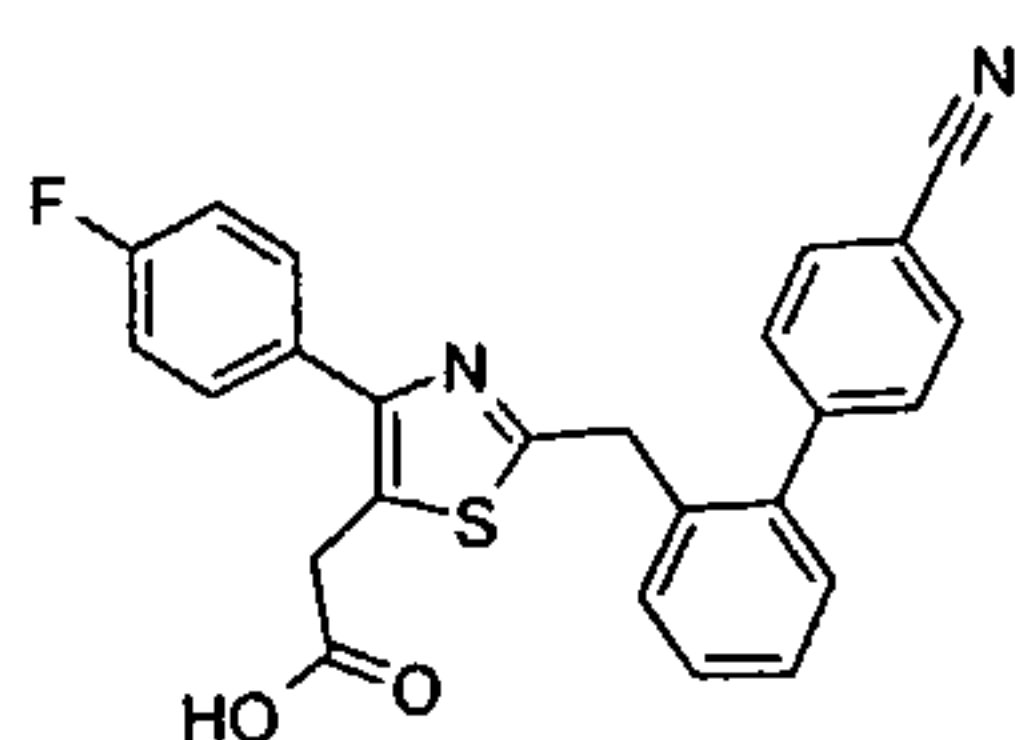


**[2-(2-Bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from 3-bromo-4-(4-fluoro-phenyl)-4-oxo-butyric acid and 2-(2-bromo-phenyl)-thioacetamide according to RP6: LC/MS (an10p8) Rt 2.22 min,  $m/z$  405.4  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.85 (s, 2H), 4.55 (s, 2H), 7.1 (m, 3H), 7.3 (t, 1H), 7.4 (d, 1H), 7.5-7.6 (m, 3H).

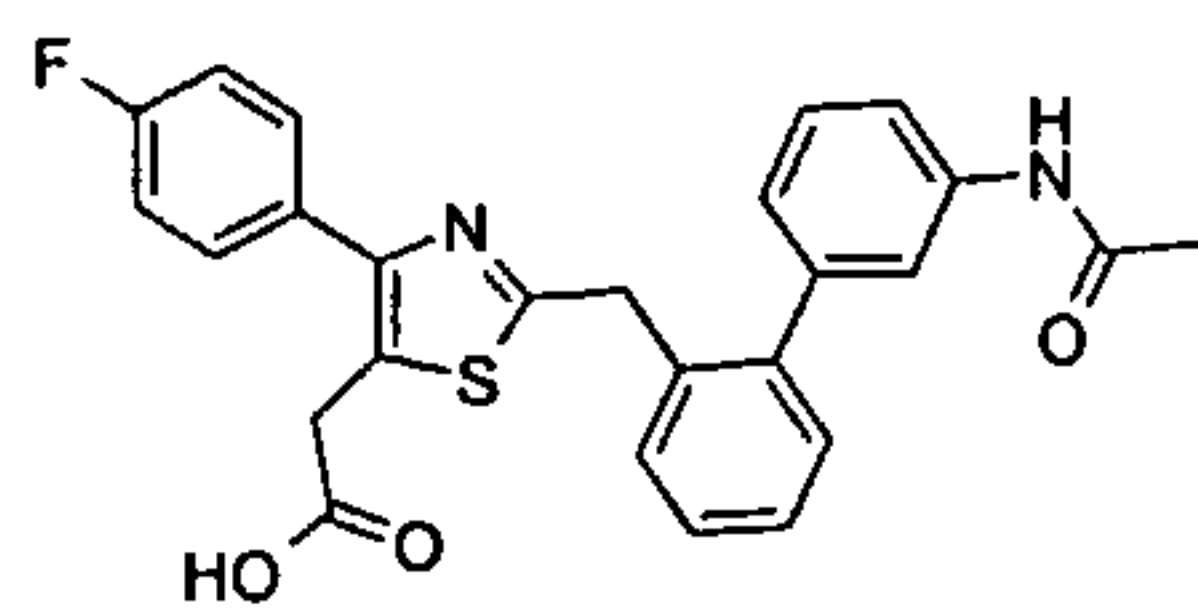


**A37**

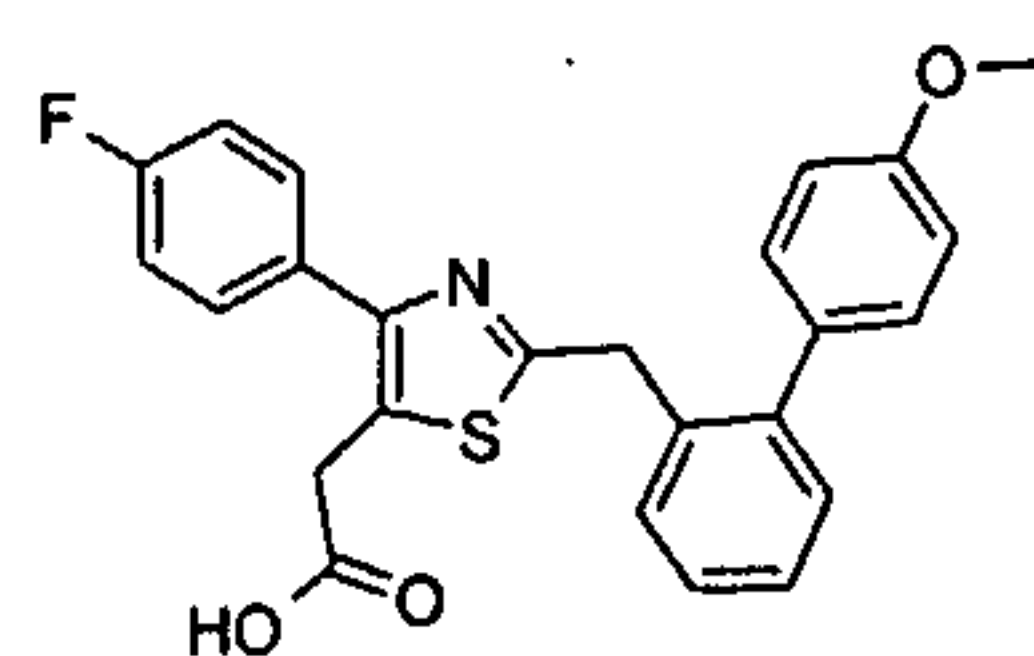
**[4-(4-Fluoro-phenyl)-2-(3'-methoxy-biphenyl-2-ylmethyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from [2-(2-bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid and 3-methoxyphenyl boronic acid according to RP8: LC/MS (an10p8) Rt 2.65 min,  $m/z$  433  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.76 (s, 3H), 3.81 (s, 2H), 4.43 (s, 2H), 6.8-6.9 (m, 2H), 7.1 (t, 1H), 7.3-7.5 (m, 7H), 7.7 (m, 2H).

**A38**

**[2-(4'-Cyano-biphenyl-2-ylmethyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from [2-(2-bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid and 4-cyanophenyl boronic acid according to RP8: LC/MS (an10p8) Rt 2.47 min,  $m/z$  428  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.84 (s, 2H), 4.36 (s, 2H), 7.1 (t, 2H), 7.3-7.5 (m, 8H), 7.7 (d, 2H).

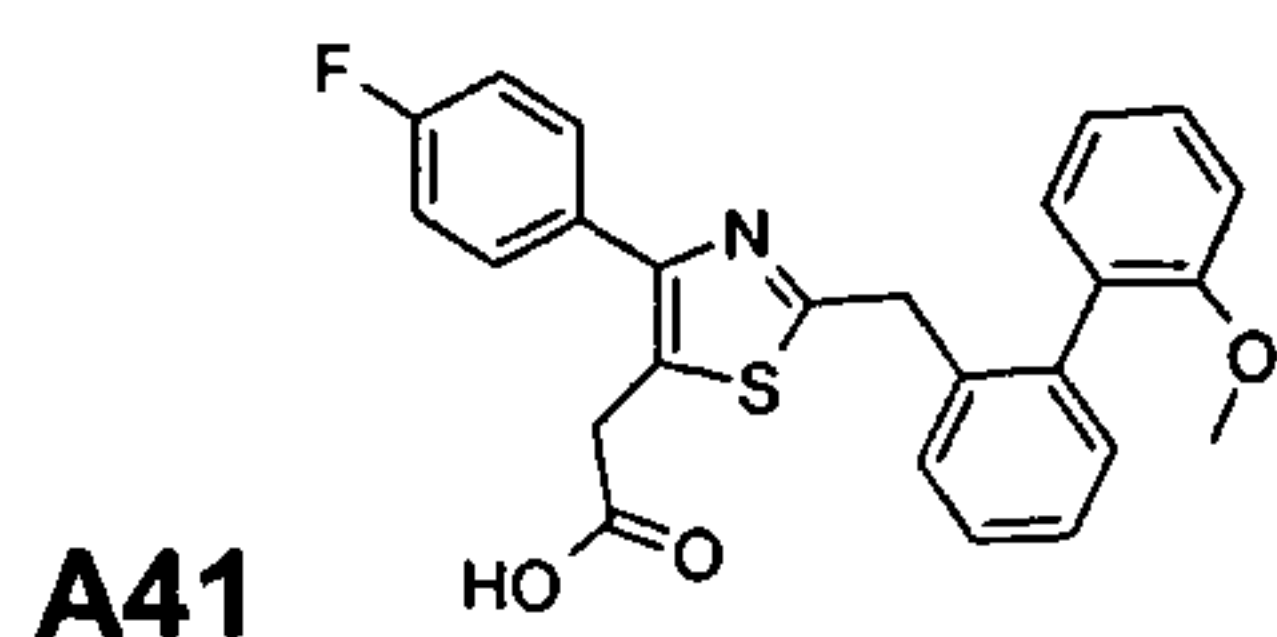
**A39**

**[2-(3'-Acetylamino-biphenyl-2-ylmethyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from [2-(2-bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid and 3-acetamidobenzene boronic acid according to RP8: LC/MS (an10p8) Rt 2.18 min,  $m/z$  460  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  1.98 (s, 3H), 3.78 (s, 2H), 4.3 (s, 2H), 7.0-7.1 (m, 4H), 7.2-7.4 (m, 2H), 7.4 (m, 4H), 7.6 (m, 2H).

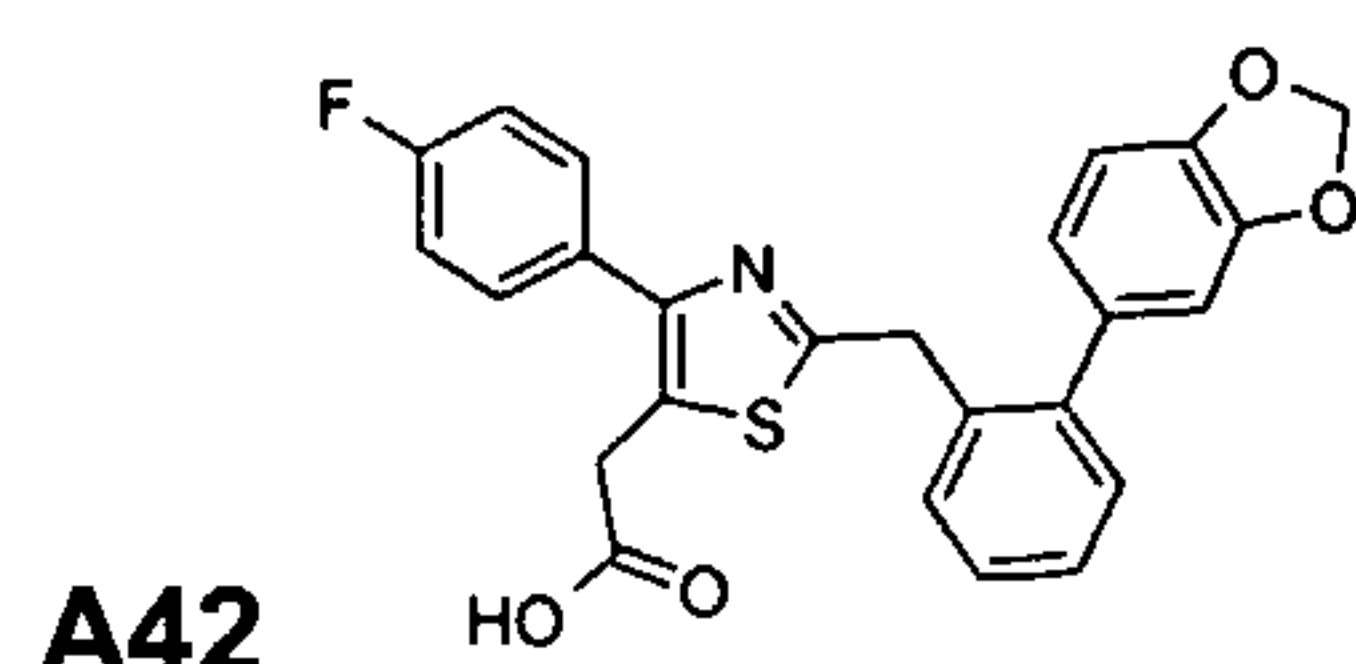
**A40**

**[4-(4-Fluoro-phenyl)-2-(4'-methoxy-biphenyl-2-ylmethyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from [2-(2-bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid and 4-methoxyphenyl boronic acid according to RP8: LC/MS

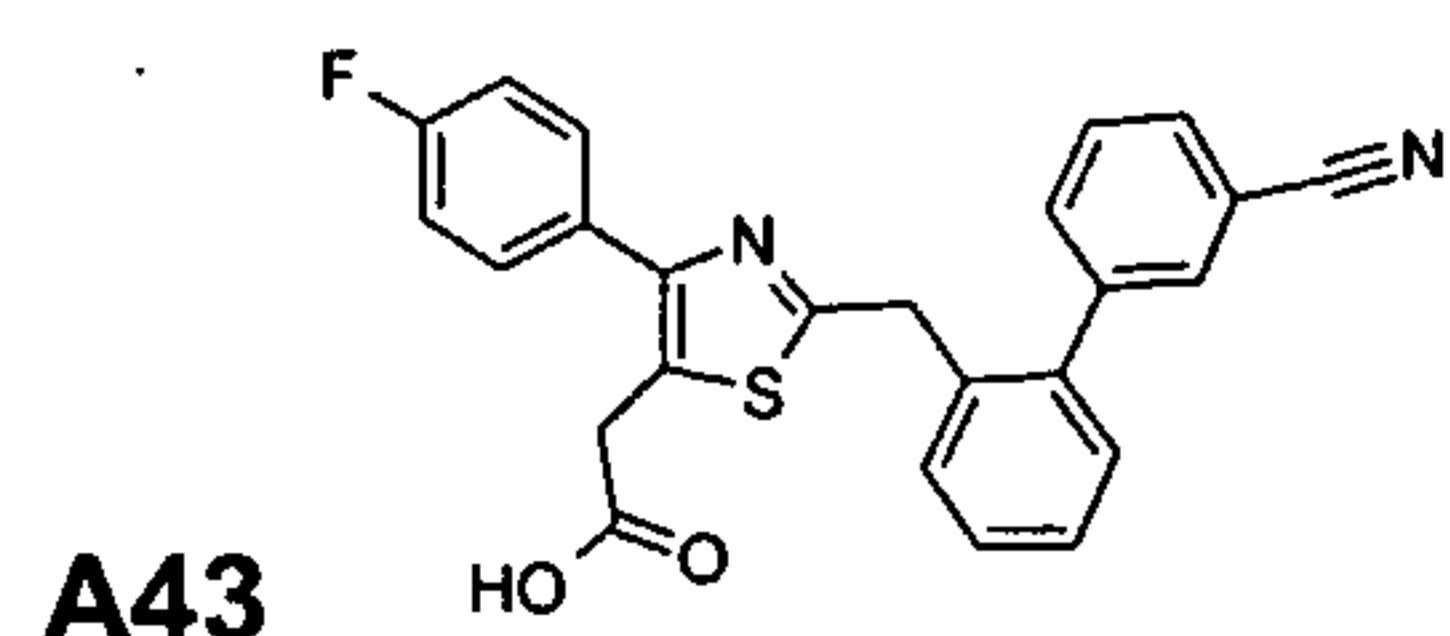
(an10p8) Rt 2.60 min,  $m/z$  433  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.82 (s, 2H), 3.84(s, 3H), 4.37 (s, 2H), 6.9 (d, 2H), 7.1 (t, 2H), 7.2-7.3 (m, 5H), 7.4 (m, 1H), 7.5 (m, 2H).



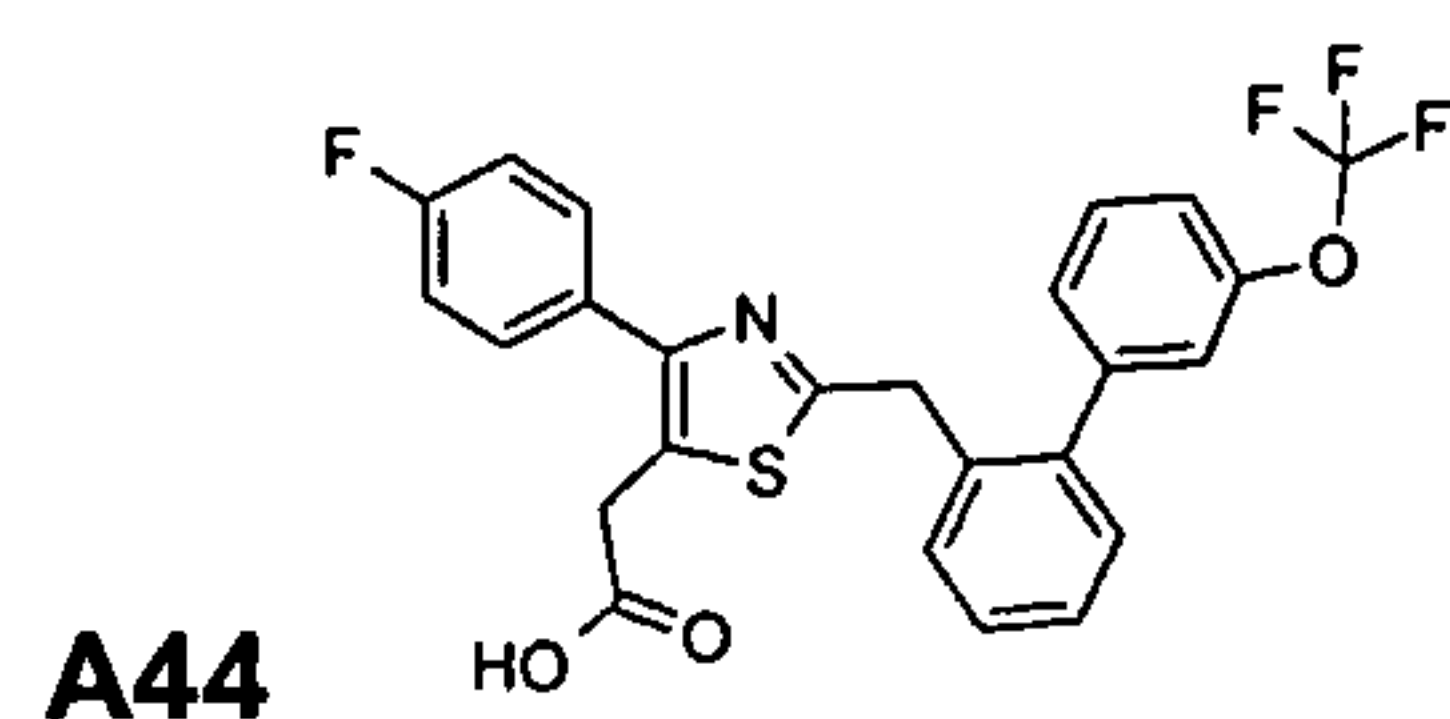
**[4-(4-Fluoro-phenyl)-2-(2'-methoxy-biphenyl-2-ylmethyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from [2-(2-bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid and 2-methoxyphenyl boronic acid according to RP8: LC/MS (an10p8) Rt 2.55 min,  $m/z$  433  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.71 (s, 3H), 3.81 (s, 2H), 4.3 (s, 2H), 6.9-7.0 (m, 2H), 7.1 (m, 3H), 7.2-7.4 (m, 4H), 7.4-7.5 (m, 3H).



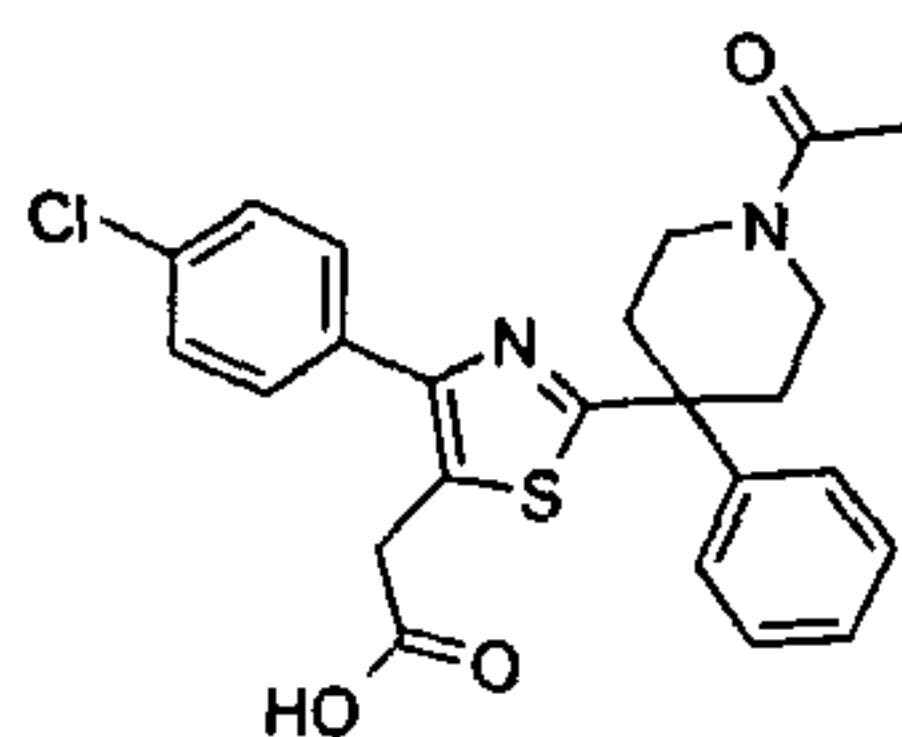
**[2-(2-Benzo[1,3]dioxol-5-yl-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from [2-(2-Bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid and 3,4-methylenedioxobenzene boronic acid according to RP8: LC/MS (an10p8) Rt 3.35 min,  $m/z$  447  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.78 (s, 2H), 4.34 (s, 2H) 5.96 (s, 2H), 6.7 (m, 3H), 7.1 (t, 2H), 7.2-7.3 (m, 3H), 7.3 (d, 1H), 7.5 (t, 2H).



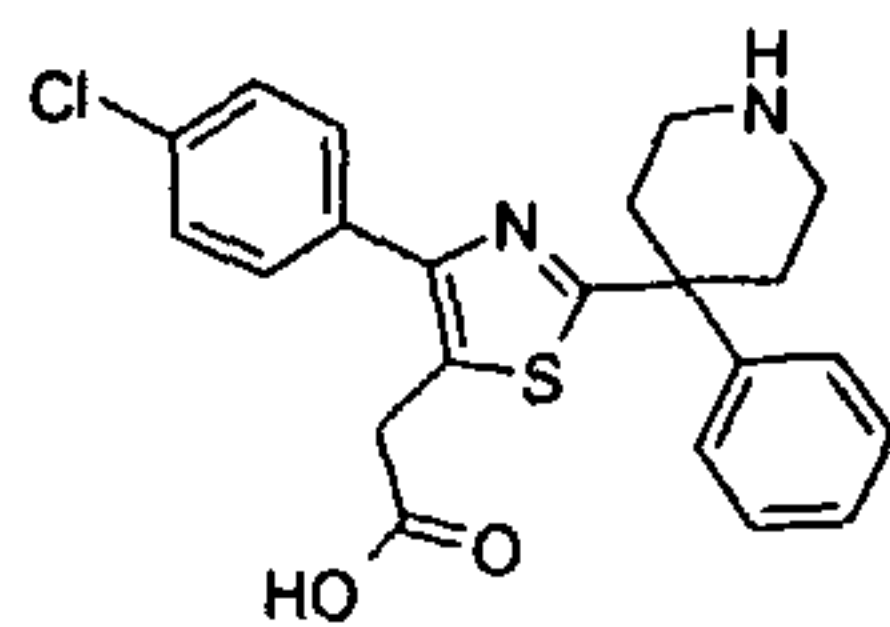
**[2-(3'-Cyano-biphenyl-2-ylmethyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from [2-(2-bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid and 3-cyanophenyl boronic acid according to RP8: LC/MS (an10p8) Rt 3.157 min,  $m/z$  428  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.55 (s, 2H), 3.9 (s, 2H), 6.8 (m, 2H), 7.0 (m, 4H), 7.2-7.4 (m, 6H).



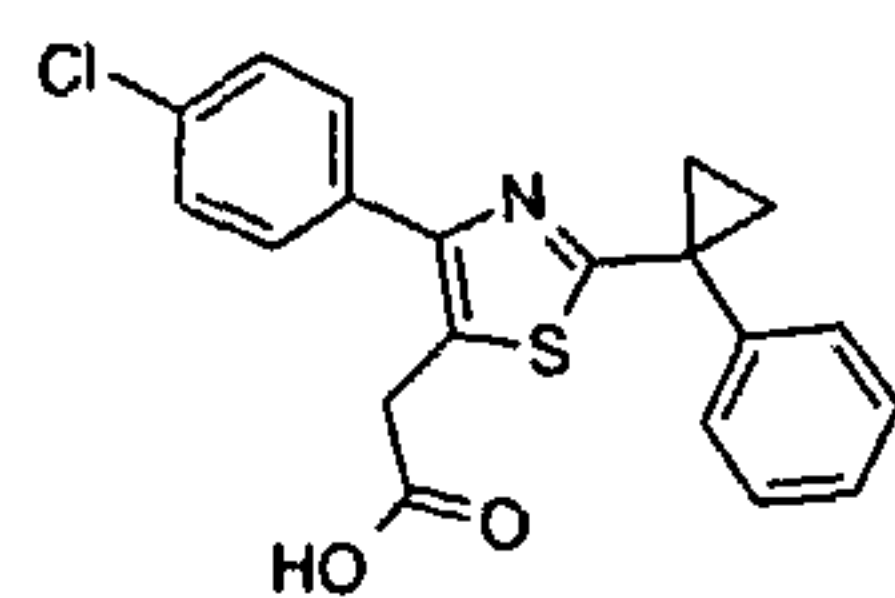
**[4-(4-Fluoro-phenyl)-2-(3'-trifluoromethoxy-biphenyl-2-ylmethyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from [2-(2-bromo-benzyl)-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid and 3-trifluoromethoxyphenyl boronic acid according to RP8: LC/MS (an10p8) Rt 3.91 min,  $m/z$  487  $[M + H]^+$ ;  $^1H$  NMR ( $CDCl_3$ ):  $\delta$  3.78 (s, 2H), 4.3 (s, 2H), 7.1 (t, 2H), 7.3 (m, 1H), 7.3 (t, 2H), 7.4-7.5 (m, 7H).

**A45**

**[2-[(1-Acetyl-piperidin-4-yl)-phenyl-methyl]-4-(4-chloro-phenyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from 3-bromo-4-(4-chloro-phenyl)-4-oxo-butyrac acid and 1-acetyl-4-phenyl-piperidine-4-carbothioic acid amide 2-(1-acetyl-piperidin-4-yl)-2-phenyl-thioacetamide according to RP6: LC/MS (an10p8) Rt 2.32 min,  $m/z$  454.5  $[M + H]^+$ .

**A46**

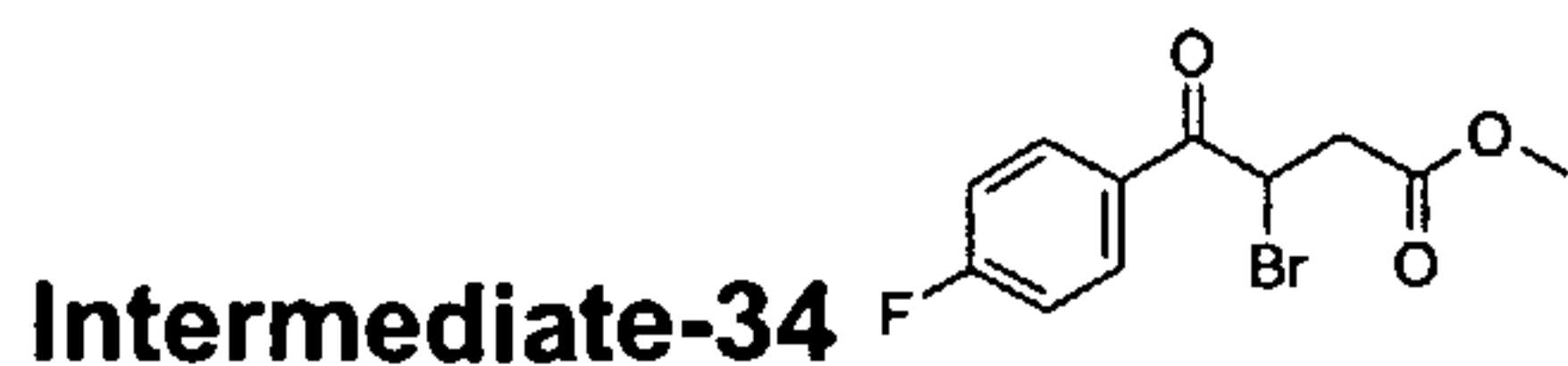
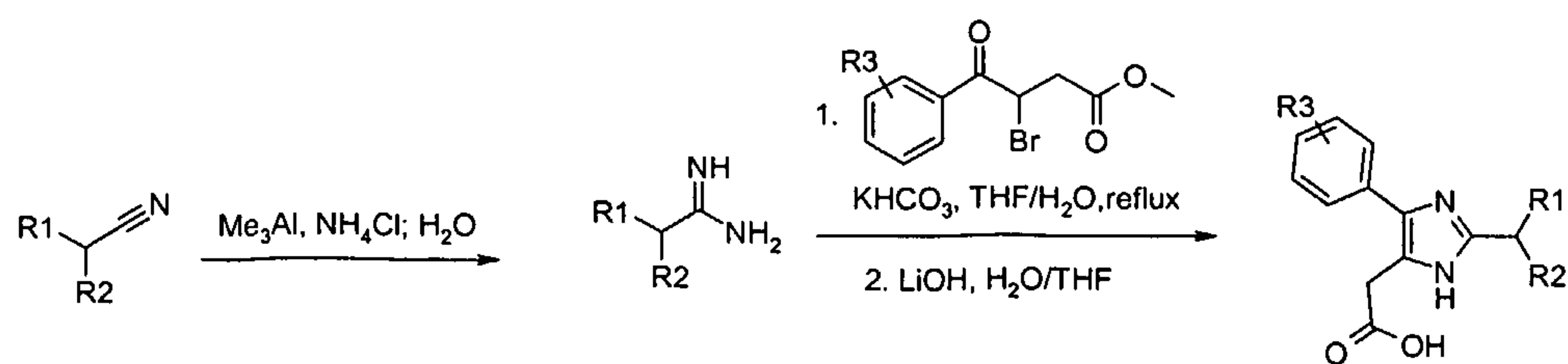
**[4-(4-Chloro-phenyl)-2-(4-phenyl-piperidin-4-yl)-thiazol-5-yl]-acetic acid.** Title compound, isolated as its HCl salt, was prepared by reacting [2-[(1-acetyl-piperidin-4-yl)-phenyl-methyl]-4-(4-chloro-phenyl)-thiazol-5-yl]-acetic acid with 4N aq. HCl at 95°C for 18 hours, followed by evaporation of solvent: LC/MS (an10p8) Rt 2.07 min,  $m/z$  412.4  $[M + H]^+$ .

**A46**

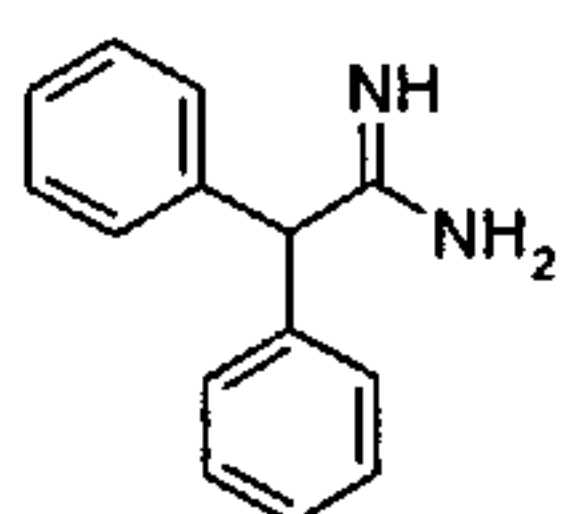
**[4-(4-Chloro-phenyl)-2-(1-phenyl-cyclopropyl)-thiazol-5-yl]-acetic acid.** Title compound was prepared from 3-bromo-4-(4-chloro-phenyl)-4-oxo-butyrac acid and 1-phenyl-cyclopropanecarbothioic acid amide according to RP6: LC/MS (an10p8) Rt 3.57 min,  $m/z$  369.8  $[M + H]^+$ .

#### General synthetic route to imidazole analogs

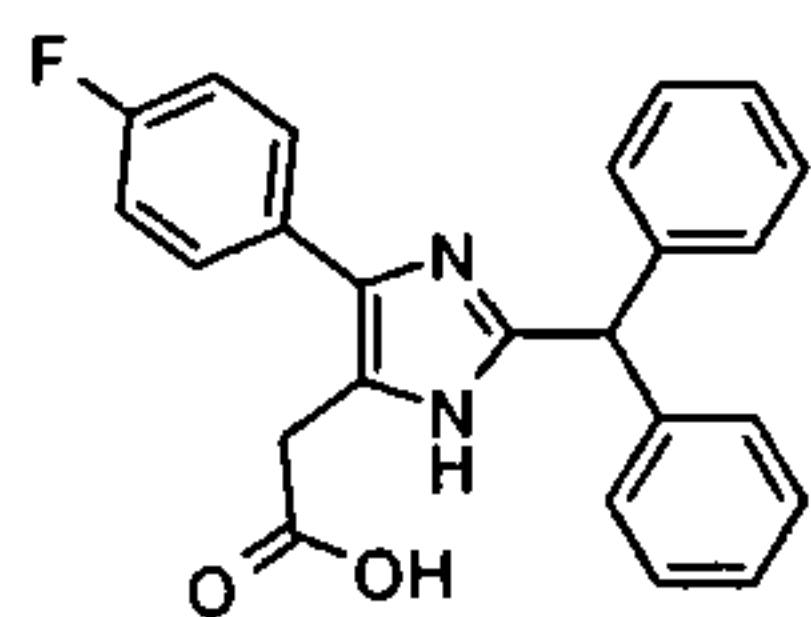


**Intermediate-34**

**3-Bromo-4-(4-fluorophenyl)-4-oxo-butiric acid methyl ester.** 3-Bromo-4-(4-fluorophenyl)-4-oxobutyric acid (15 mmol) was dissolved in methanol (60 ml) and thionyl chloride (17 mmol) was added at 0 °C. After stirring at 80 °C for 2 h the solvent was evaporated. The residue was stripped with diethylether. The product was used directly in the next step: <sup>1</sup>H NMR (CDCl<sub>3</sub>): δ 3.00 (m, 1H), 3.33 (m, 1H), 3.67 (s, 3H), 5.44 (t, 1H), 7.15 (t, 2H), 8.06 (t, 2H).

**Intermediate-35**

**2,2-Diphenylacetamidine.** Prepared from diphenylacetoneitrile according to R. A. Moss, W. Ma, D. C. Merrer, and S. Xue (*Tetrahedron Lett.* **1995**, 36, 8761-8764): LC/MS (an10p8): Rt 1.57 min, *m/z* 211 [M+H]<sup>+</sup>.

**A48**

**[2-Benzhydryl-5-(4-fluoro-phenyl)-3H-imidazol-4-yl]-acetic acid.** A suspension of 2,2-diphenylacetamidine (10 mmol) and potassium carbonate (38 mmol) in THF/H<sub>2</sub>O (150 mL/50 mL) was heated to reflux. 3-Bromo-4-(4-fluorophenyl)-4-oxo-butiric acid methyl ester (10 mmol) in THF (50 mL) was added slowly. The reaction mixture was refluxed for 16 h, and then concentrated. The residue was dissolved in water (10 mL) and extracted with CH<sub>2</sub>Cl<sub>2</sub> (10 mL). The organic phase was dried (MgSO<sub>4</sub>) and concentrated to produce [2-benzhydryl-5-(4-fluoro-phenyl)-3H-imidazol-4-yl]-acetic acid methyl ester: LC/MS (an10p8): Rt 3.64 min, *m/z* 401 [M+H]<sup>+</sup>. The methyl ester in THF was added excess LiOH·H<sub>2</sub>O in water. The reaction was stirred at room temperature over night, 3% HCl was added until pH <1, and the mixture was extracted with CH<sub>2</sub>Cl<sub>2</sub>. The organic phase was dried (MgSO<sub>4</sub>) and concentrated to

give the product was subject to hydrolysis with LiOH in water/THF.: LC/MS (an10n8):  
Rt 1.43 min,  $m/z$  387  $[M - H]^-$ .

## **Biological Assays**

### **Materials and Methods**

**Generation/origin of the cDNA Constructs.** The coding sequence of the human CRTH2 receptor (genbank accession no NM\_004778) was amplified by PCR from a human hippocampus cDNA library and inserted into the pcDNA3.1(+) expression vector (invitrogen) via 5' HindIII and 3' EcoRI. To generate a CRTH2-Renilla luciferase (CRTH2-Rluc) fusion protein, the CRTH2 coding sequence without a STOP codon and Rluc were amplified, fused in frame by PCR and subcloned into the pcDNA3.1(+)Zeo expression vector (invitrogen). Human  $\beta$ -arrestin2 ( $\beta$ -arr2) N-terminally tagged with GFP<sup>2</sup> ( $\beta$ arr2-GFP<sup>2</sup>) and Renilla luciferase were purchased from BioSignal Packard Inc, (Montreal, Canada). The sequence identity of the construct was verified by restriction endonuclease digests and sequencing in both directions on an ABI Prism (Applied Biosystems, Foster City, CA).

### **Sequence ID CRTH2 (protein sequence):**

MSANATLKPLCPILEQMSRLQSHSNTSIRYIDHAAVLLHGLASLLGLVEN  
GVILFVVGCRMRQTVVTTWVLHLALS~~DL~~LASASLPFFTYFLAVGHSWELG  
TTF~~C~~KLHSSIFFLNMFASGFLLSAISLDRCLQVVRPVWAQNHRTVAAAHK  
VCLVL~~W~~ALAVLNTVPYFVFRDTISRLDGRIMCYYNVLLLNPDPDRDATCN  
SRQAALAVSKFLLAFLVPLAIIASSHAAVSLRLQHRGRRRPGRFVRLVAA  
VVAAAFALCWGPYHVFSLL~~E~~ARAHANPGLRPLVWRGLPFVTS~~L~~AFFNSVAN  
PVLYVLTCPDMLRKLRRSLRTVLESVLVDDSELGGAGSSRRRRRTSSTARS  
ASPLALCSRPEEPRGPARLLGWLLGSCAASPQTGPLNRALSSTSS

### **Sequence ID CRTH2 (nucleotide sequence):**

atgtcggc  
caacgccaca ctgaagccac tctgccccat cctggagcag atgagccgtc  
tccagagcca  
cagcaacacc agcatccgct acatcgacca cgcggccgtg ctgctgcacg  
ggctggcctc  
gctgctgggc ctggtggaga atggagtcac cctcttcgtg gtgggctgcc  
gcatgcgcca  
gaccgtggtc accacctggg tgctgcacct ggcgctgtcc gacctgttgg  
cctctgcttc  
cctgcccttc ttcacctact tcttggccgt gggccactcg tgggagctgg  
gcaccacctt  
ctgcaaactg cactcctcca tcttctttct caacatgttc gccagcggct  
tcttgctcag  
cgccatcagc ctggaccgct gcctgcaggt ggtgcggccg gtgtgggccc  
agaaccaccg



```

caccgtggcc gcggcgcaca aagtctgcct ggtgctttgg gcactagcgg
tgctcaacac
ggtgccctat ttcgtgttcc gggacaccat ctgcgaggctg gacgggcgca
ttatgtgcta
ctacaatgtg ctgctcctga acccggggcc tgaccgcgat gccacgtgca
actcgcgcca
ggcggccctg gccgtcagca agttcctgct ggccttcctg gtgccgctgg
cgatcatcgc
ctcgagccac gcggccgtga gcctgcggtt gcagcaccgc ggccgcccgc
ggccaggccg
cttcgtgcgc ctggtggcag ccgtcgtggc cgccttcgcg ctctgctggg
ggccctacca
cgtgttcagc ctgctggagg cgcgggcgca cgcaaaccgc gggctgcggc
cgctcgtgtg
gcgcgggctg cccttcgtca ccagcctggc cttcttcaac agcgtggcca
accggtgct
ctacgtgctc acctgccccg acatgctgcg caagctgcgg cgctcgtgc
gcacggtgct
ggagagcgtg ctggtggacg acagcgagct gggtaggcgc ggaagcagcc
gccgccgccc
cacctcctcc accgcccgtc cggcctcccc ttagctctc tgcagccgcc
cggaggaacc
gcggggcccc gcgcgtctcc tcggctggct gctgggcagc tgcgcagcgt
ccccgcagac
gggccccctg aaccgggcgc tgagcagcac ctcgagttag

```

**Cell Culture and Transfection.** COS-7 cells were grown in Dulbecco's modified Eagle's medium (DMEM) 1885 supplemented with 10% fetal bovine serum, 100 units/ml penicillin, 1000 µg/ml streptomycin, and kept at 37°C in a 10% CO<sub>2</sub> atmosphere. HEK293 cells were maintained in Minimum Essential medium (MEM) supplemented with 10% (v/v) heat inactivated fetal calf serum (HIFCS), 2mM Glutamax™-I, 1% non essential amino acids (NEAA), 1% sodium pyruvate and 10 µg/ml gentamicin. For binding experiments, COS7 cells were transiently transfected with the CRTH2 receptor using a calcium phosphate-DNA coprecipitation method with the addition of chloroquine (as described by Holst et al., 2001\*). To perform the functional Bioluminescence Resonance Energy Transfer (BRET) assays, a HEK293 cell clone stably expressing βarr2-GFP<sup>2</sup> and CRTH2-Rluc was generated (CRTH2-HEK293 cells).

**Binding assay.** 24h after transfection COS-7 cells were seeded into 96well plates at a density of 30.000 cells/well. Competition binding experiments on whole cells were then performed about 18-24 h later using 0.1 nM [<sup>3</sup>H]PGD<sub>2</sub> (NEN, 172 Ci/mmol) in a binding buffer consisting of HBSS (GIBCO) and 10 mM HEPES. Competing ligands were diluted in DMSO which was kept constant at 1% (v/v) of the final incubation volume. Total and nonspecific binding were determined in the absence and presence



of 10  $\mu$ M PGD2. Binding reactions were routinely conducted for 3 h at 4°C and terminated by 2 washes (100  $\mu$ l each) with ice cold binding buffer. Radioactivity was determined by liquid scintillation counting in a TOPCOUNTER (Packard) following over night incubation in Microscint 20. Stable HEK293 cells were seeded at a density of 30.000 cells/well 18-24 h prior to the binding assay which was performed essentially as described for COS7 cells above. Determinations were made in duplicates.

**BRET assay.** Functional BRET assays were performed on HEK293 cells stably expressing human CRTH2-Rluc and GFP<sup>2</sup>- $\beta$ -arr2. Prior to their use in the BRET assay cells were detached and re-suspended in D-PBS with 1000 mg/L L-Glucose at a density of  $2 \times 10^6$  cells/mL. DeepBlueC™ was diluted to 50  $\mu$ M in D-PBS with 1000 mg/L L-Glucose (light sensitive). 100  $\mu$ L of cell suspension was transferred to wells in a 96-well microplate (white OptiPlate) and placed in the Mithras LB 940 instrument (BERTHOLD TECHNOLOGIES, Bad Wildbad, Germany). 12  $\mu$ L/well agonist was then injected by injector 1 and 10  $\mu$ L/well DeepBlueC™ was injected simultaneously by injector 2. Five seconds after the injections the light output from the well was measured sequentially at 400 nm and 515 nm, and the BRET signal (mBRET ratio) was calculated by the ratio of the fluorescence emitted by GFP<sup>2</sup>- $\beta$ -arr2 (515 nm) over the light emitted by the receptor-Rluc (400 nm). Antagonists were added before placing the microplates into the Mithras LB 940 and allowed to incubate for 15 minutes prior to the addition of agonist and DeepBlueC™. Compounds were dissolved in DMSO and the final DMSO concentration was kept constant at 1% in the assay.

**Human eosinophil shape change assay.** Blood was sampled from healthy volunteers according to a protocol approved by the Ethics Committee of the University of Graz and processed as described previously (Bohm et al., 2004). Preparations of polymorphonuclear leukocytes (containing eosinophils and neutrophils) were prepared by dextran sedimentation of citrated whole blood and Histopaque gradients. The resulting cells were washed and resuspended in assay buffer (comprising PBS with Ca<sup>2+</sup>/Mg<sup>2+</sup> supplemented with 0.1% BSA, 10 mM HEPES and 10 mM glucose, pH 7.4) at  $5 \times 10^6$  cells/mL. Cells were incubated with the antagonists or vehicle (PBS or DMSO) for 10 min at 37°C and then stimulated with various concentration of the agonists (PGD2 or eotaxin) for 4 min at 37°C. To stop the reaction, samples were transferred to ice and fixed with 250  $\mu$ L of fixative

solution. Samples were immediately analyzed on a FACSCalibur flow cytometer (Becton Dickinson) and eosinophils were identified according to their autofluorescence in the FL-1 and FL-2 channels. Shape change responses were quantified as percentage of the maximal response to PGD<sub>2</sub> or eotaxin in the absence of an antagonist.

### Materials

Tissue culture media and reagents were purchased from the Gibco invitrogen corporation (Breda, Netherlands). PGD<sub>2</sub> was obtained from Cayman and [<sup>3</sup>H]PGD<sub>2</sub> from NEN.

### Data analysis

Curve analysis was performed with the GraphPadPrism software 3.0 (Graphpad Prism Inc., San Diego, USA) and IC<sub>50</sub> values were calculated as a measure of the antagonistic potencies.

### References

Holst B, Hastrup H, Raffetseder U, Martini L, Schwartz TW. Two active molecular phenotypes of the tachykinin NK1 receptor revealed by G-protein fusions and mutagenesis. J Biol Chem. 2001 Jun 8;276(23):19793-9. Epub 2001 Feb 22.

### Biological data:

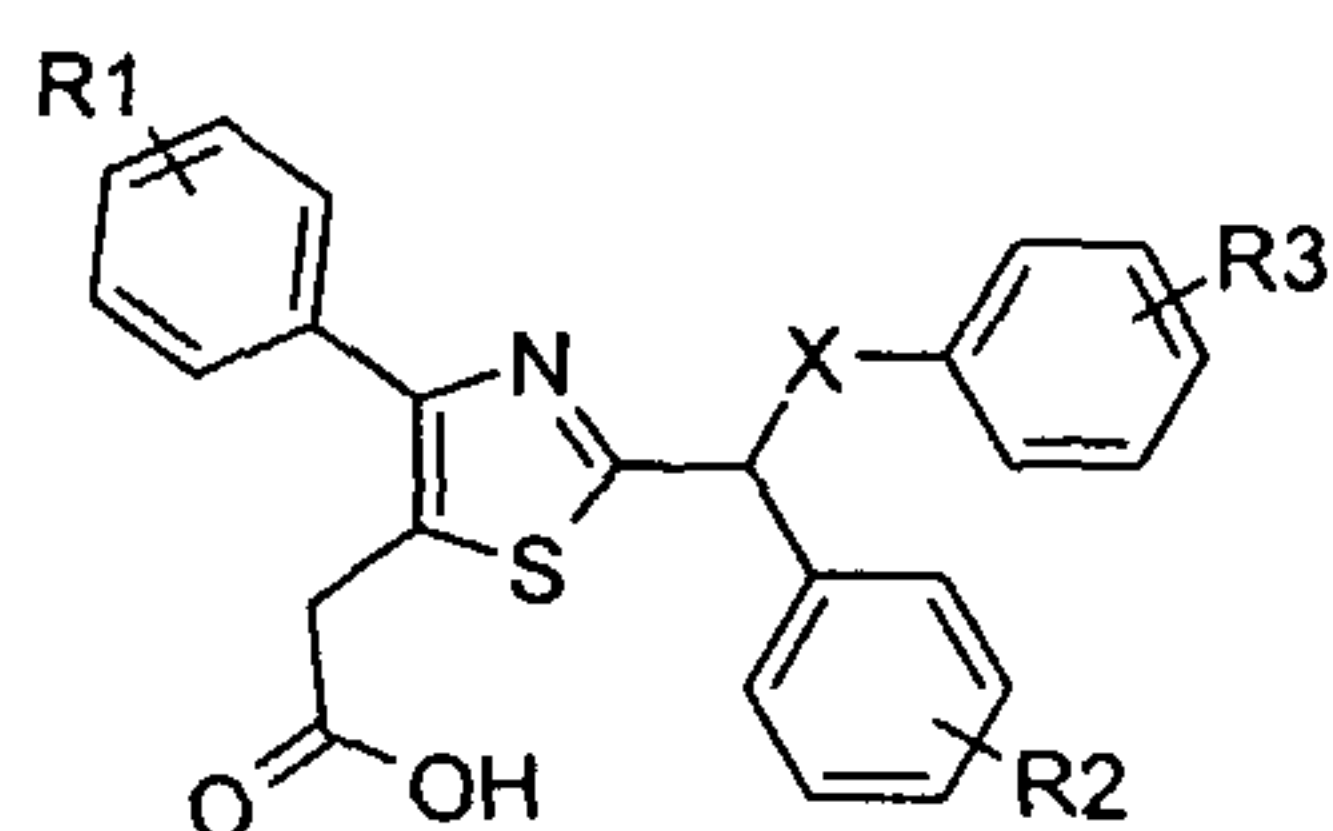
Compounds were tested in the receptor binding assay and the functional antagonist assay described below, and their IC<sub>50</sub> values were assessed. The compounds are grouped in three classes:

- A: IC<sub>50</sub> value lower than 0.5  $\mu$ M
- B: IC<sub>50</sub> value between 0.5  $\mu$ M and 5  $\mu$ M
- C: IC<sub>50</sub> value higher than 5  $\mu$ M

Tables 1 to 4 give the biological test results for the compounds synthesised above and for some additional compounds acquired from commercial sources.

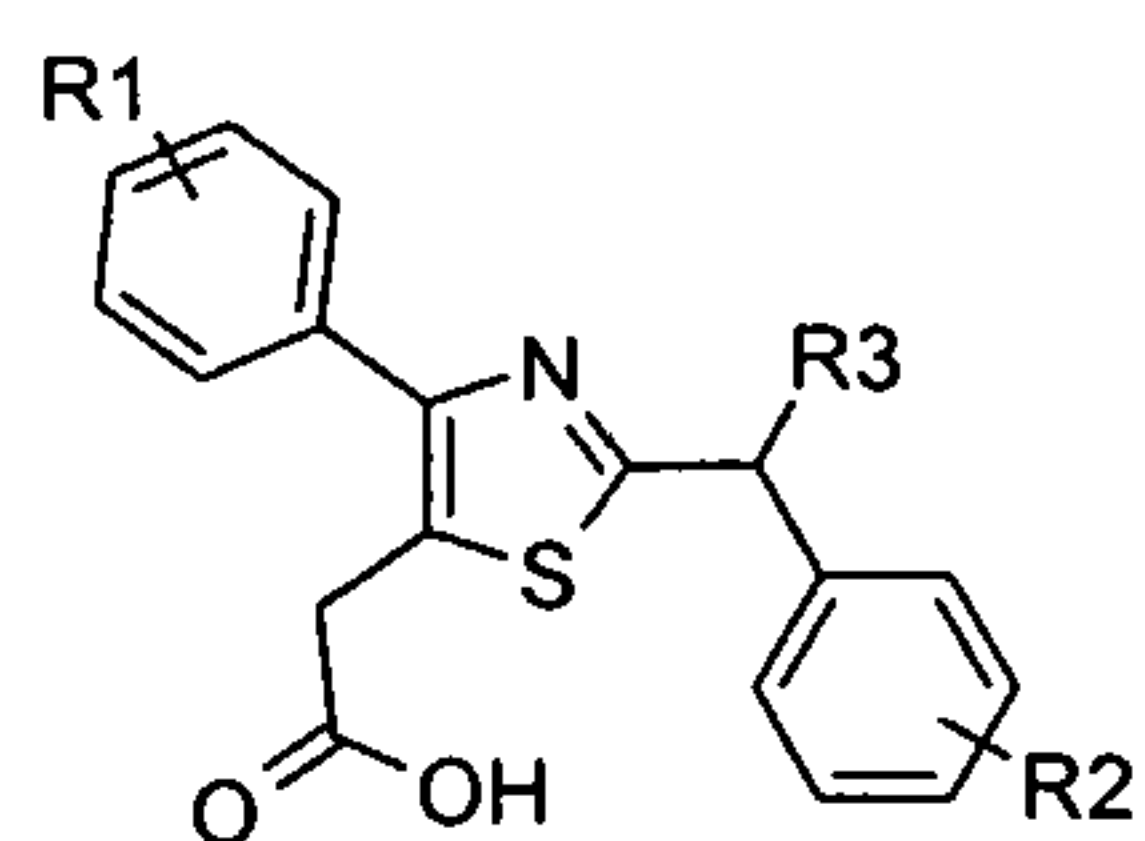
The ability of the compounds above to inhibit prostaglandin D<sub>2</sub> induced eosinophil shape change is demonstrated by the examples in Figure 1

Table 1



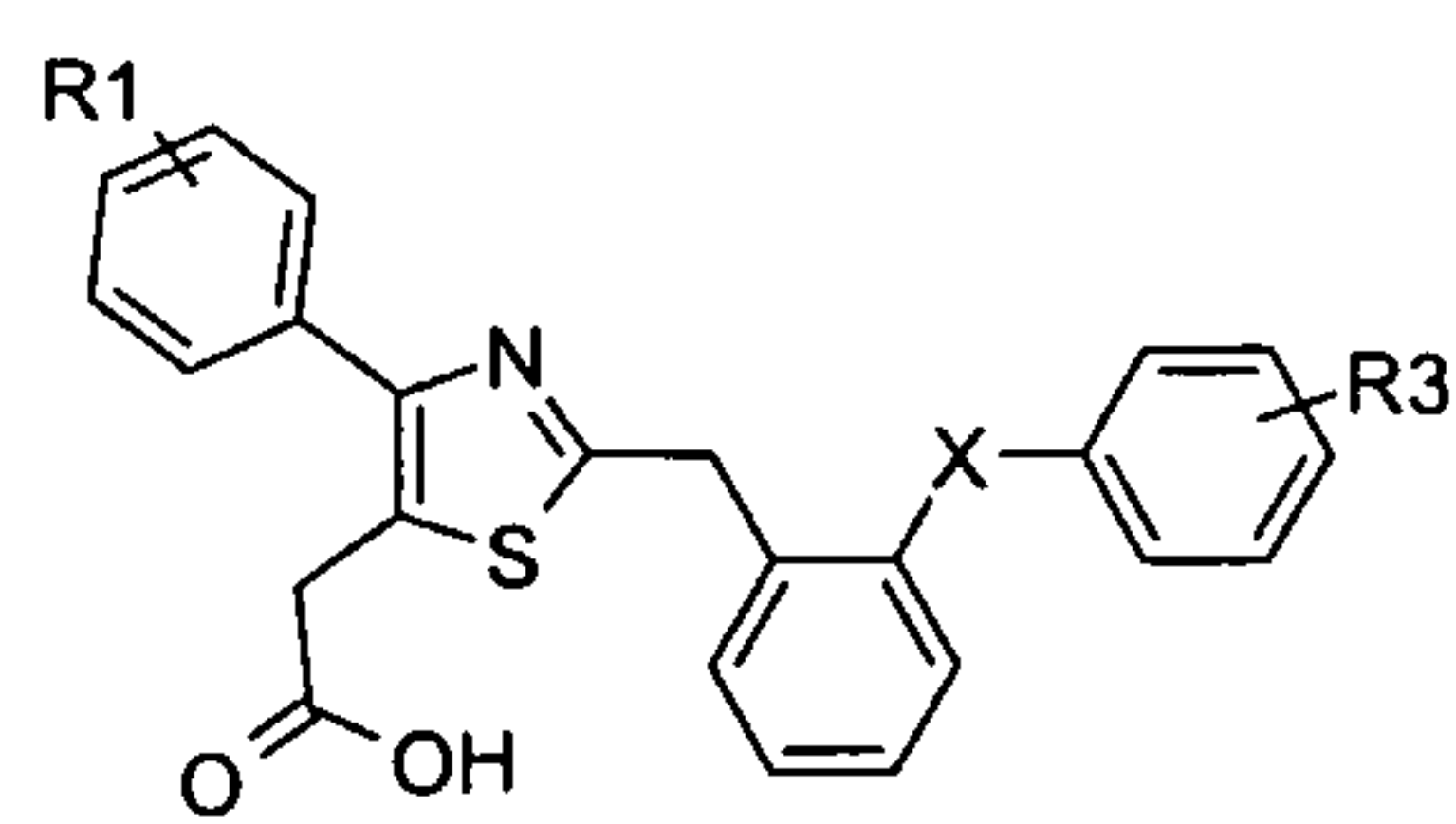
	X	R1	R2	R3	Binding IC <sub>50</sub>	Antag. IC <sub>50</sub>
A1	Bond	4-Cl	H	H	A	A
A4	Bond	4-F	H	H	A	A
A5	CH <sub>2</sub>	4-Cl	H	H	A	B
A7	CH <sub>2</sub>	4-F	4-Cl	H	A	A
A8	Bond	4-Cl	4-Cl	H	A	A
A9	CH <sub>2</sub>	4-Cl	4-Cl	H	A	B
A10	Bond	4-F	4-Cl	H	A	A
A11	Bond	H	H	H	B	A
A12	Bond	4-MeO	H	H	A	B
A13	Bond	4-Cl	4-F	H	A	A
A14	Bond	4-F	4-F	4-F	A	A
A15	Bond	4-F	4-MeO	H	A	A
A16	Bond	4-Cl	4-MeO	H	A	A
A17	Bond	4-Cl	3,4-DiF	H	A	C
A18	Bond	4-F	3,4-DiF	H	A	A
A19	NHCO	4-F	H	4-CF <sub>3</sub>	A	C
A20	Bond	4-F	4-MeO	4-MeO	A	A
A21	Bond	4-PhO	H	H	A	B
A22	Bond	4-F	4-OH	H	A	A
A23	Bond	3-F	H	H	A	A
A24	Bond	4-CF <sub>3</sub>	H	H	B	C
A25	Bond	3,4-DiF	4-F	4-F	A	A
A26	Bond	3,4-DiF	H	Ph	A	A
A27	Bond	3-F	4-F	4-F	A	A



**Table 2**

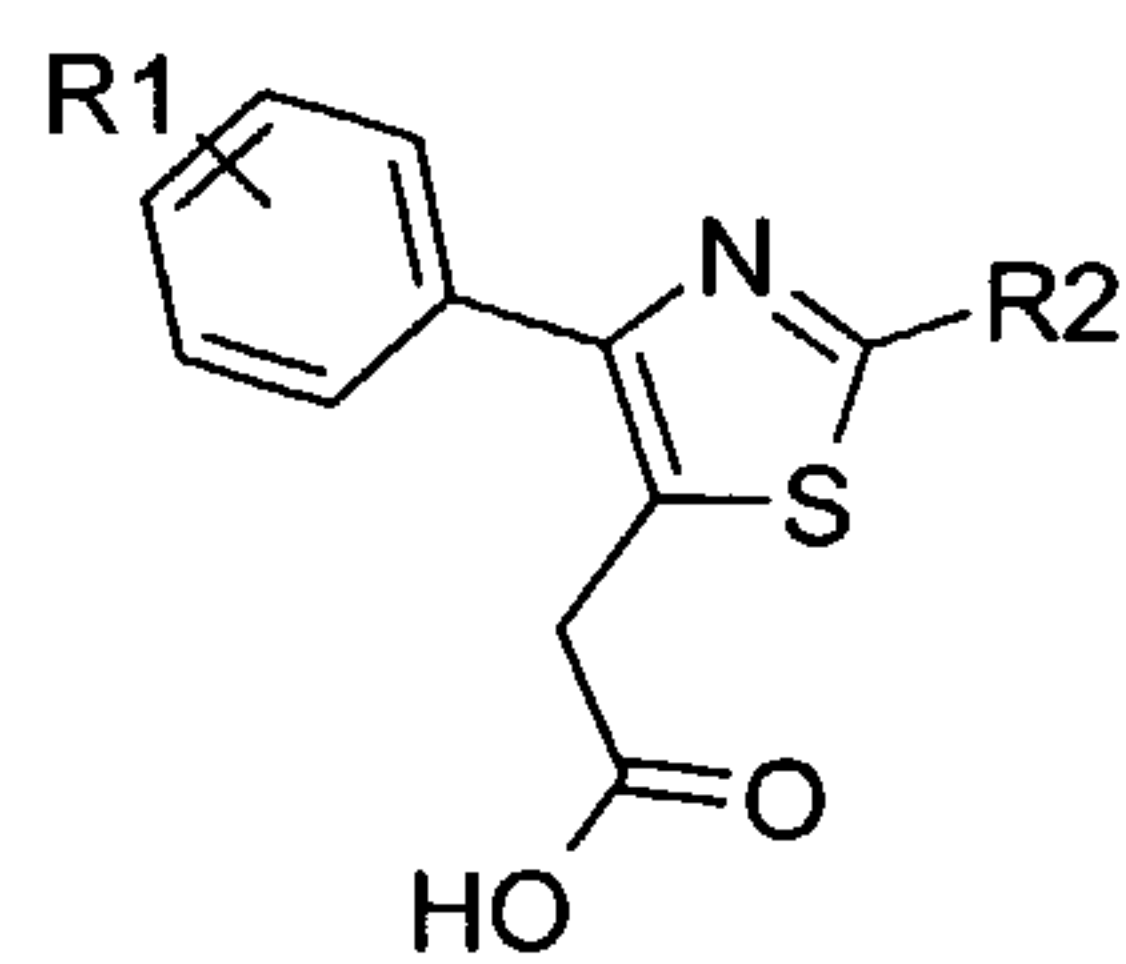
	R1	R2	R3	Binding IC <sub>50</sub>	Antag. IC <sub>50</sub>
<b>A28</b>	4-Cl	H		A	B
<b>A29</b>	4-Cl	H		A	
<b>A30</b>	4-F	4-MeO		A	
<b>A31</b>	4-Cl	4-MeO		A	A
<b>A32</b>	4-Cl	H		B	
<b>A6</b>	4-Cl	H	Et	A	

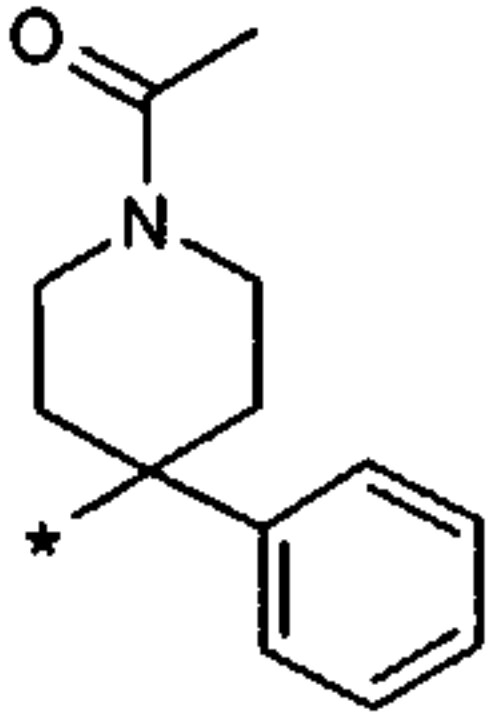
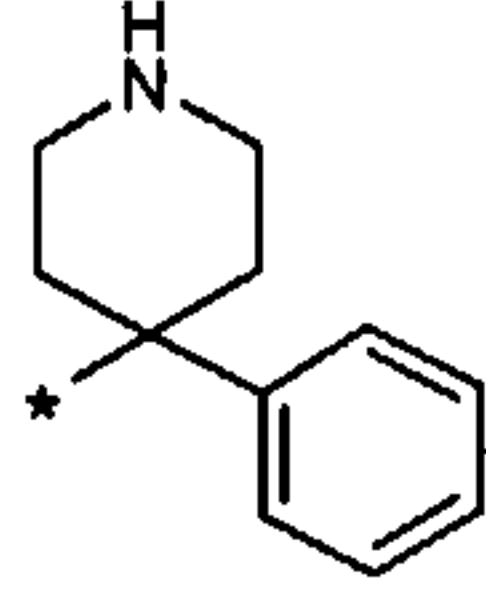
Table 3



	X	R1	R2	Binding IC <sub>50</sub>	Antag. IC <sub>50</sub>
A34	Bond	4-Cl	H	A	A
A35	O	4-Cl	H	B	
A36	Bond	4-F	H	A	A
A37	Bond	4-F	3-MeO	A	A
A38	Bond	4-F	4-CN	A	A
A39	Bond	4-F	3-NHAc	B	
A40	Bond	4-F	4-MeO	A	A
A41	Bond	4-F	2-MeO	A	
A42	Bond	4-F	3,4-OCH <sub>2</sub> O	A	A
A43	Bond	4-F	3-CN	A	
A44	Bond	4-F	3-OCF <sub>3</sub>	A	

Table 4

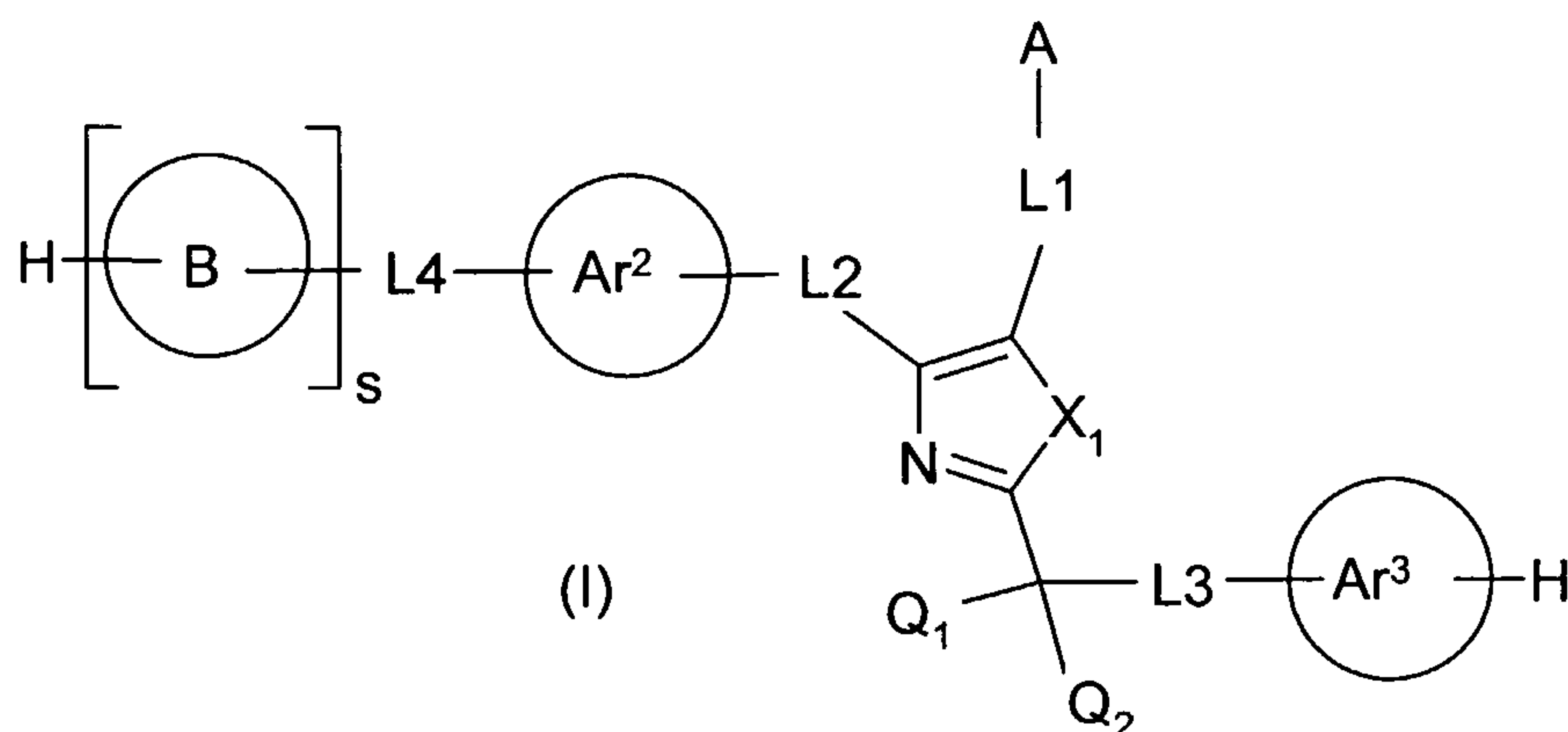


	R1	R2	Binding IC <sub>50</sub>	Antag. IC <sub>50</sub>
A45	4-Cl		A	B
A46	4-Cl		B	C



## Claims:

1. A compound of formula (I) or a salt, hydrate or solvate thereof:



wherein

$X_1$  is -S-, -O-, -N=N-, -NR<sub>7</sub>-, -CR<sub>7</sub>=CR<sub>8</sub>-, -CR<sub>7</sub>=N-, wherein R<sub>7</sub> and R<sub>8</sub> are independently hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl;

**A** is a carboxyl group -COOH, or a carboxyl bioisostere;

rings **Ar**<sup>2</sup> and **Ar**<sup>3</sup> each independently represent a phenyl or 5- or 6-membered monocyclic heteroaryl ring, or a bicyclic ring system consisting of a 5- or 6-membered carbocyclic or heterocyclic ring which is benz-fused or fused to a 5- or 6-membered monocyclic heteroaryl ring, said ring or ring system being optionally substituted;

ring **B** is as defined for **Ar**<sup>2</sup> and **Ar**<sup>3</sup>, or an optionally substituted N-pyrrolidinyl, N-piperidinyl or N-azepinyl ring;

**s** is 0 or 1;

**L1** represents a divalent radical of formula -(Alk<sup>1</sup>)<sub>m</sub>- and **L2** and **L4** each independently represents a divalent radical of formula -(Alk<sup>1</sup>)<sub>m</sub>-(Z)<sub>n</sub>-(Alk<sup>2</sup>)<sub>p</sub>- wherein

**m**, **n** and **p** are independently 0 or 1,

**Alk**<sup>1</sup> and **Alk**<sup>2</sup> are independently optionally substituted straight or branched chain C<sub>1</sub>-C<sub>3</sub> alkylene or C<sub>2</sub>-C<sub>3</sub> alkenylene radicals which may contain a compatible -O-, -S- or -NR- link wherein R is hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl, and

**Z** is  $-O-$ ;  $-S-$ ;  $-C(=O)-$ ;  $-SO_2-$ ;  $-SO-$ ;  $-NR-$ ,  $-NRSO_2-$ ,  $-C(=O)NR-$ ,  $-NRCONH-$ ,  $NRC(=NR)NH-$ , or  $=N-NR-$  wherein R is hydrogen or  $C_1$ - $C_3$  alkyl; or a divalent 5- or 6-membered monocyclic carbocyclic or heterocyclic radical;

**L3** represents a divalent radical of formula  $-(Alk^3)_m-(Z)_n-(Alk^2)_p-$  wherein m, n, p,  $Alk^2$  and Z are as defined in relation to L2 and L4, and  $Alk^3$  is an optionally substituted straight or branched chain  $C_1$ - $C_2$  alkylene or  $C_1$ - $C_2$  alkenylene radical which may contain a compatible  $-O-$ ,  $-S-$  or  $-NR-$  link wherein R is hydrogen or  $C_1$ - $C_3$  alkyl;

**Q<sub>1</sub>** represents hydrogen or  $(C_1-C_6)$ alkyl;

**Q<sub>2</sub>** represents

(i)  $(C_1-C_6)$ alkyl,  $(C_1-C_6)$ alkoxy, hydroxy, hydroxy $(C_1-C_6)$ alkyl, nitrile ( $-CN$ ), phenyl, phenoxy, monocyclic heteroaryl or heteroaryloxy with 5 or 6 ring atoms,  $-CONR^A R^B$ ,  $-NR^B COR^A$ ,  $-NR^B SO_2 R^A$  or  $-NR^A CONR^A R^B$  wherein  $R^A$  and  $R^B$  are independently hydrogen or a  $(C_1-C_6)$ alkyl group, or  $R^A$  and  $R^B$  are linked to the same N atom to form a cyclic amino ring, and when Q is phenyl, phenoxy or monocyclic heteroaryl or heteroaryloxy with 5 or 6 ring atoms the phenyl or heteroaryl ring is optionally substituted by any of  $(C_1-C_6)$ alkyl,  $(C_1-C_6)$ alkoxy, hydroxy, hydroxy $(C_1-C_6)$ alkyl,  $(C_1-C_3)$ alkylthio, halo, fully or partially fluorinated  $(C_1-C_3)$ alkyl,  $(C_1-C_3)$ alkoxy or  $(C_1-C_3)$ alkylthio, trifluoromethylthio, nitro, nitrile ( $-CN$ ),  $-COOR^A$ ,  $-COR^A$ ,  $-OCOR^A$ ,  $-SO_2 R^A$ ,  $-CONR^A R^B$ ,  $-SO_2 NR^A R^B$ ,  $-NR^A R^B$ ,  $-NR^B COR^A$ ,  $-NR^B COOR^A$ ,  $-NR^B SO_2 R^A$  or  $-NR^A CONR^A R^B$  wherein  $R^A$  and  $R^B$  are independently hydrogen or a  $(C_1-C_6)$ alkyl group, or  $R^A$  and  $R^B$  are linked to the same N atom to form a cyclic amino ring, or

(ii) hydrogen, but only when, in L3, Z represents an optionally substituted divalent 5- or 6-membered monocyclic carbocyclic or heterocyclic radical;

or **Q<sub>1</sub>** and **Q<sub>2</sub>** taken together with the carbon atom to which they are attached form a  $C_3$ - $C_6$  cycloalkyl ring or a monocyclic non-aromatic heterocyclic ring with 4-6 ring atoms;

and wherein the total length of L2 and L3 does not exceed that of an unbranched saturated chain of 10 carbon atoms.

2. A compound as claimed in claim 1 wherein (i) the length of each of L2, L3 and L4 does not exceed that of an unbranched saturated chain of 5 atoms and (ii) the total length of L2, L3 and L4 does not exceed that of an unbranched saturated chain of 7 atoms, and (iii) none of L1, L2, L3 and L4 includes more than two R substituents different from hydrogen.

3. A compound as claimed in claim 1 or claim 2 wherein L3 is a bond,  $Q_1$  is hydrogen, and  $Q_2$  is phenyl or monocyclic heteroaryl with 5 or 6 ring atoms optionally substituted by any of (C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>6</sub>)alkoxy, hydroxy, hydroxy(C<sub>1</sub>-C<sub>6</sub>)alkyl, (C<sub>1</sub>-C<sub>3</sub>)alkylthio, halo, fully or partially fluorinated (C<sub>1</sub>-C<sub>3</sub>)alkyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy or (C<sub>1</sub>-C<sub>3</sub>)alkylthio, trifluoromethylthio, nitro, nitrile (-CN), -COOR<sup>A</sup>, -COR<sup>A</sup>, -OCOR<sup>A</sup>, -SO<sub>2</sub>R<sup>A</sup>, -CONR<sup>A</sup>R<sup>B</sup>, -SO<sub>2</sub>NR<sup>A</sup>R<sup>B</sup>, -NR<sup>A</sup>R<sup>B</sup>, -NR<sup>B</sup>COR<sup>A</sup>, -NR<sup>B</sup>COOR<sup>A</sup>, -NR<sup>B</sup>SO<sub>2</sub>OR<sup>A</sup> or -NR<sup>A</sup>CONR<sup>A</sup>R<sup>B</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring.

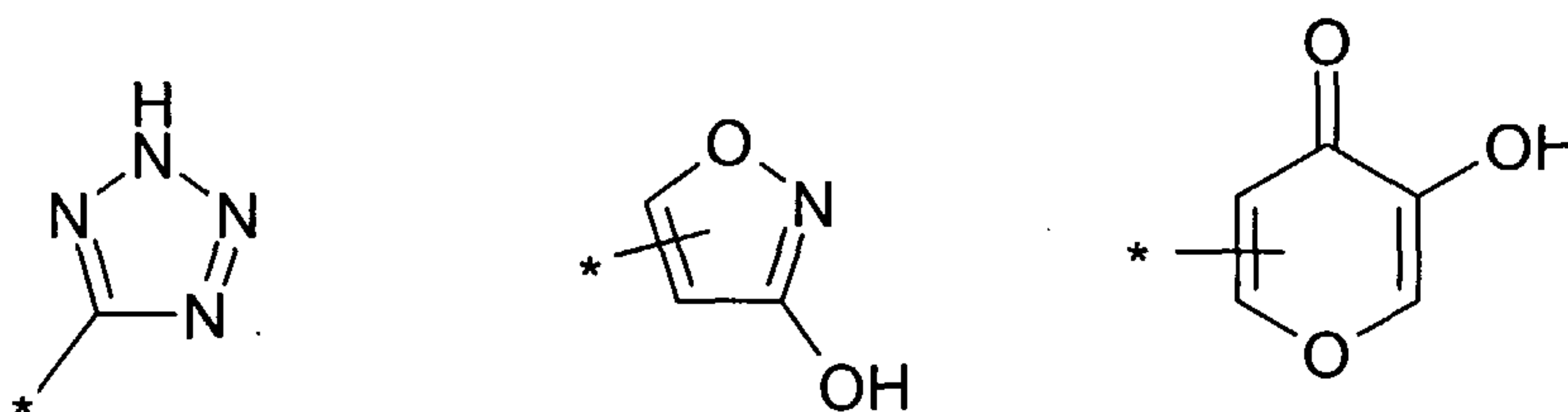
4. A compound as claimed in claim 1 or claim 2 wherein L3 is a bond,  $Q_1$  is hydrogen, and  $Q_2$  is phenyl, optionally substituted by any of fluoro, chloro, bromo, (C<sub>1</sub>-C<sub>3</sub>)alkyl, trifluoromethyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano, (C<sub>1</sub>-C<sub>3</sub>alkyl)SO<sub>2</sub><sup>-</sup>, NH<sub>2</sub>SO<sub>2</sub><sup>-</sup>, (C<sub>1</sub>-C<sub>3</sub>alkyl)NHSO<sub>2</sub><sup>-</sup>, (C<sub>1</sub>-C<sub>3</sub>alkyl)<sub>2</sub>NSO<sub>2</sub><sup>-</sup>, -CONR<sup>A</sup>R<sup>B</sup>, and -NR<sup>B</sup>COR<sup>A</sup>. wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring.

5. A compound as claimed in claim 1 or claim 2 wherein L3 is -CH<sub>2</sub>-, -O-, -S-, -SO<sub>2</sub>-, -NHC(=O)-, -CH=CH-, -NR<sub>11</sub>-, or -NR<sub>11</sub>CH<sub>2</sub>-, wherein R<sub>11</sub> is hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl.

6. A compound as claimed in claim 1 or claim 2 wherein  $Q_2$  is hydrogen and L3 represents a divalent radical of formula  $-(Alk^3)_m-(Z)_n-(Alk^2)_p-$  wherein m is 0, n is 1, and Z is a phenylene radical optionally substituted by one or more of fluoro, chloro, bromo, (C<sub>1</sub>-C<sub>3</sub>)alkyl, trifluoromethyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano, (C<sub>1</sub>-C<sub>3</sub>alkyl)SO<sub>2</sub><sup>-</sup>, NH<sub>2</sub>SO<sub>2</sub><sup>-</sup>, (C<sub>1</sub>-C<sub>3</sub>alkyl)NHSO<sub>2</sub><sup>-</sup>, (C<sub>1</sub>-C<sub>3</sub>alkyl)<sub>2</sub>NSO<sub>2</sub><sup>-</sup>, -CONR<sup>A</sup>R<sup>B</sup>, and -NR<sup>B</sup>COR<sup>A</sup>. wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring.



- 7 A compound as claimed in claim 6 wherein Z is a 1, 2-phenylene radical optionally substituted by one or more of fluoro, chloro, bromo, (C<sub>1</sub>-C<sub>3</sub>)alkyl, trifluoromethyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano, (C<sub>1</sub>-C<sub>3</sub>alkyl)SO<sub>2</sub><sup>-</sup>, NH<sub>2</sub>SO<sub>2</sub><sup>-</sup>, (C<sub>1</sub>-C<sub>3</sub>alkyl)NHSO<sub>2</sub><sup>-</sup>, (C<sub>1</sub>-C<sub>3</sub>alkyl)<sub>2</sub>NSO<sub>2</sub><sup>-</sup>, -CONR<sup>A</sup>R<sup>B</sup>, and -NR<sup>B</sup>COR<sup>A</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring..
8. A compound as claimed in claim 6 or claim 7 wherein Q<sub>1</sub> is hydrogen.
9. A compound as claimed in any of the preceding claims wherein X<sub>1</sub> is -S-.
10. A compound as claimed in any of the preceding claims wherein A is a carboxyl group -COOH.
11. A compound as claimed in any of claims 1 to 9 wherein A is a carboxyl bioisostere selected from -SO<sub>2</sub>NHR and -P(=O)(OH)(OR) wherein R is hydrogen methyl or ethyl, -SO<sub>2</sub>OH, -P(=O)(OH)(NH<sub>2</sub>), -C(=O)NHCN and groups of formulae:



12. A compound as claimed in any of the preceding claims wherein L1 represents a bond, -CR<sub>11</sub>R<sub>12</sub><sup>-</sup>, \*-CH<sub>2</sub>CR<sub>11</sub>R<sub>12</sub><sup>-</sup>, \*-OCR<sub>11</sub>R<sub>12</sub><sup>-</sup>, \*-SCR<sub>11</sub>R<sub>12</sub><sup>-</sup>, \*-NR<sub>11</sub>CH<sub>2</sub><sup>-</sup> or -NR<sub>11</sub><sup>-</sup> wherein R<sub>11</sub> and R<sub>12</sub> are independently hydrogen or C<sub>1</sub>-C<sub>3</sub> alkyl, the bond marked with an asterisk being the one connected to the ring containing X<sup>1</sup>.
13. A compound as claimed in any of claims 1 to 11 wherein L1 represents -CH<sub>2</sub>- or -CH(CH<sub>3</sub>)<sup>-</sup>.
14. A compound as claimed in any of the preceding claims wherein Ar<sup>3</sup> is phenyl, thienyl, naphthyl or 2-, 3- or 4-pyridyl, any of which is optionally substituted.
15. A compound as claimed in claim 14 wherein optional substituents in Ar<sup>3</sup> are selected from fluoro, chloro, bromo, (C<sub>1</sub>-C<sub>3</sub>)alkyl, trifluoromethyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy,

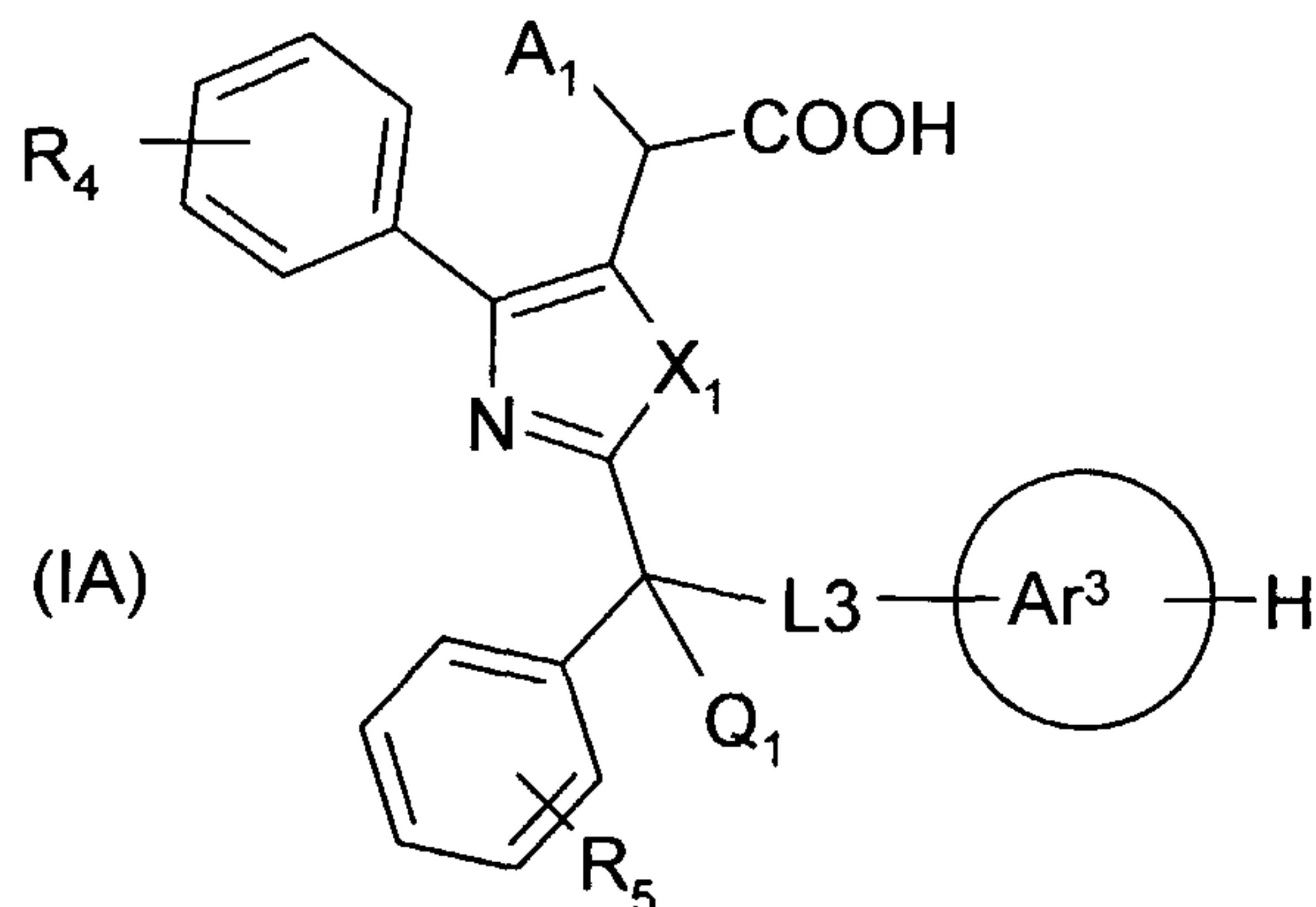
trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano, (C<sub>1</sub>-C<sub>3</sub>alkyl)SO<sub>2</sub>-, NH<sub>2</sub>SO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)NHSO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)<sub>2</sub>NSO<sub>2</sub>-, -CONR<sup>A</sup>R<sup>B</sup>, and -NR<sup>B</sup>COR<sup>A</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring.

16. A compound as claimed in any of the preceding claims wherein L2 is a bond and Ar<sup>2</sup> is an optionally substituted phenyl, thienyl, furanyl, pyrrolyl or pyridyl ring.

17. A compound as claimed in claim 16 wherein optional substituents in Ar<sup>2</sup> are selected from fluoro, chloro, bromo, (C<sub>1</sub>-C<sub>3</sub>)alkyl, trifluoromethyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano, (C<sub>1</sub>-C<sub>3</sub>alkyl)SO<sub>2</sub>-, NH<sub>2</sub>SO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)NHSO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)<sub>2</sub>NSO<sub>2</sub>-, -CONR<sup>A</sup>R<sup>B</sup>, and -NR<sup>B</sup>COR<sup>A</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring.

18. A compound as claimed in any of the preceding claims wherein s is 0.

19. A compound of formula (IA), or a salt, hydrate or solvate thereof:



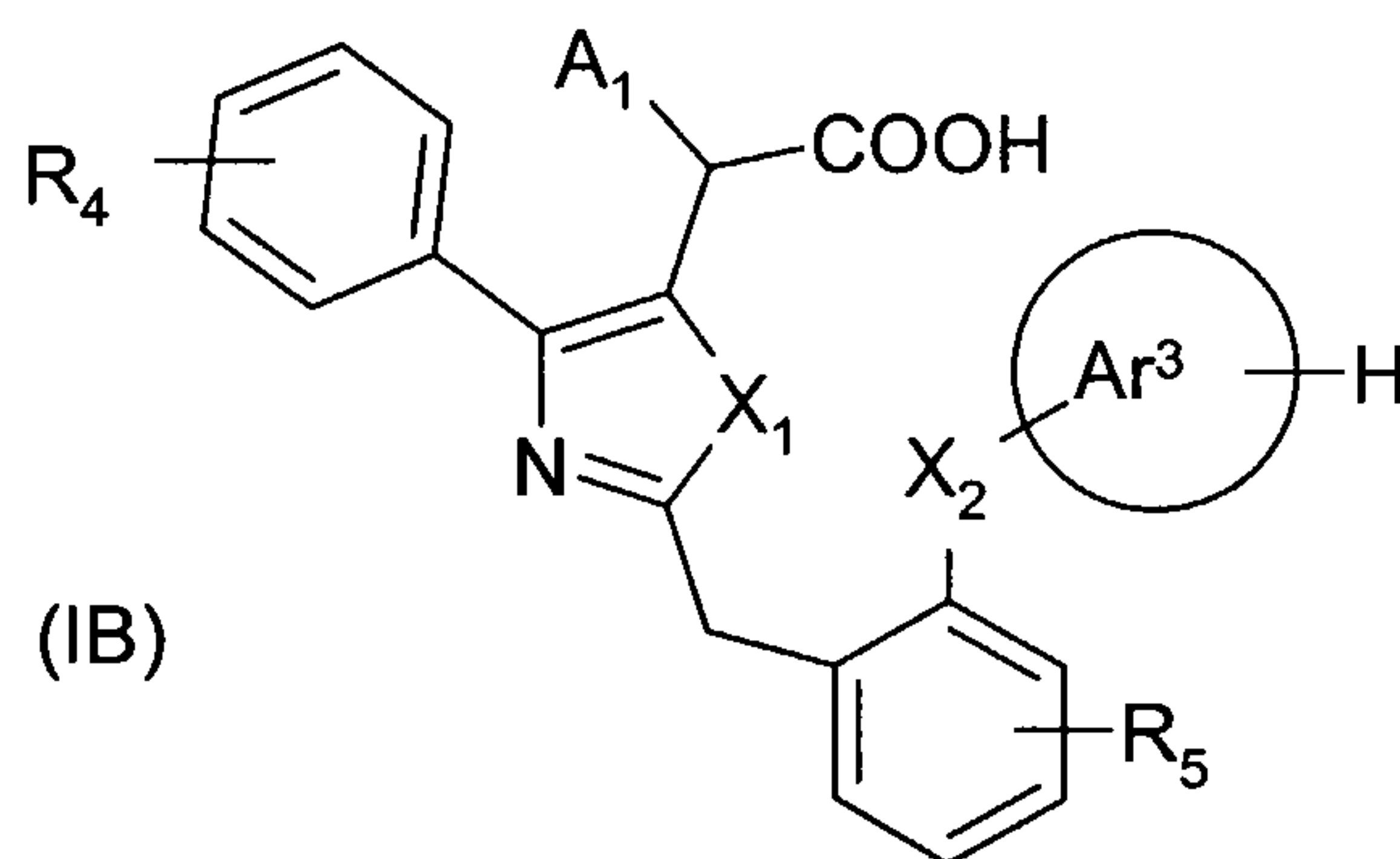
wherein A<sub>1</sub> is hydrogen or methyl, X<sub>1</sub>, Q<sub>1</sub>, Ar<sup>3</sup> and L3 are as defined in claim 1, and R<sub>4</sub> and R<sub>5</sub> independently represent hydrogen or one or more optional substituents.

20. A compound as claimed in claim 19 wherein A<sub>1</sub> is hydrogen.

21. A compound as claimed in claim 19 or claim 20 wherein Q<sub>1</sub> is hydrogen.

22. A compound as claimed in any of claims 19 to 21 wherein X<sub>1</sub> is -S-.

23. A compound as claimed in any of claims 19 to 22 wherein  $\text{Ar}^3$  is optionally substituted phenyl.
24. A compound as claimed in any of claims 19 to 23 wherein  $\text{L}_3$  is a bond,  $-\text{O}-$ ,  $-\text{S}-$ , or  $-\text{NR}-$  wherein  $\text{R}$  is hydrogen or  $\text{C}_1\text{-C}_3$  alkyl.
25. A compound as claimed in claim 19 wherein  $\text{A}_1$  is hydrogen,  $\text{Q}_1$  is hydrogen,  $\text{X}_1$  is  $-\text{S}-$ ,  $\text{Ar}^3$  is optionally substituted phenyl and  $\text{L}_3$  is a bond.
26. A compound as claimed in any of claims 19 to 25 wherein optional substituents  $\text{R}_4$  and  $\text{R}_5$  and optional substituents in  $\text{Ar}^3$  are independently selected from fluoro, chloro, bromo,  $(\text{C}_1\text{-C}_3)\text{alkyl}$ , trifluoromethyl,  $(\text{C}_1\text{-C}_3)\text{alkoxy}$ , trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano,  $(\text{C}_1\text{-C}_3\text{alkyl})\text{SO}_2^-$ ,  $\text{NH}_2\text{SO}_2^-$ ,  $(\text{C}_1\text{-C}_3\text{alkyl})\text{NHSO}_2^-$ ,  $(\text{C}_1\text{-C}_3\text{alkyl})_2\text{NSO}_2^-$ ,  $-\text{CONR}^{\text{A}}\text{R}^{\text{B}}$ , and  $-\text{NR}^{\text{B}}\text{COR}^{\text{A}}$  wherein  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are independently hydrogen or a  $(\text{C}_1\text{-C}_6)\text{alkyl}$  group, or  $\text{R}^{\text{A}}$  and  $\text{R}^{\text{B}}$  are linked to the same  $\text{N}$  atom to form a cyclic amino ring.
27. A compound of formula (IB), or a salt, hydrate or solvate thereof::



wherein  $\text{A}_1$  is hydrogen or methyl,  $\text{X}_2$  is a bond,  $-\text{CH}_2-$ ,  $-\text{O}-$ ,  $-\text{S}-$ , or  $-\text{NR}-$  wherein  $\text{R}$  is hydrogen or  $\text{C}_1\text{-C}_3$  alkyl and  $\text{X}_1$  and  $\text{Ar}^3$  are as defined in claim 1, and  $\text{R}_4$  and  $\text{R}_5$  independently represent hydrogen or one or more optional substituents.

28. A compound as claimed in claim 27 wherein  $\text{A}_1$  is hydrogen.
29. A compound as claimed in claim 27 or claim 28 wherein  $\text{X}_1$  is  $-\text{S}-$ .



30. A compound as claimed in any of claims 27 to 29 wherein Ar<sup>3</sup> is optionally substituted phenyl.

31. A compound as claimed in any of claims 27 to 30 wherein X<sub>2</sub> is -CH<sub>2</sub>- or a bond.

32. A compound as claimed in any of claims 27 to 31 wherein optional substituents R<sub>4</sub> and R<sub>5</sub> and optional substituents in Ar<sup>3</sup> are independently selected from fluoro, chloro, bromo, (C<sub>1</sub>-C<sub>3</sub>)alkyl, trifluoromethyl, (C<sub>1</sub>-C<sub>3</sub>)alkoxy, trifluoromethoxy, trifluoromethylthio, dimethylamino, cyano, (C<sub>1</sub>-C<sub>3</sub>alkyl)SO<sub>2</sub>-, NH<sub>2</sub>SO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)NHSO<sub>2</sub>-, (C<sub>1</sub>-C<sub>3</sub>alkyl)<sub>2</sub>NSO<sub>2</sub>-, -CONR<sup>A</sup>R<sup>B</sup>, and -NR<sup>B</sup>COR<sup>A</sup> wherein R<sup>A</sup> and R<sup>B</sup> are independently hydrogen or a (C<sub>1</sub>-C<sub>6</sub>)alkyl group, or R<sup>A</sup> and R<sup>B</sup> are linked to the same N atom to form a cyclic amino ring.

33. A compound selected from the group consisting of

[2-benzhydryl-4-(4-chlorophenyl)-thiazol-5-yl]-acetic acid,  
 [2-benzhydryl-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-[1-(4-chloro-phenyl)-2-phenyl-ethyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 {4-(4-chloro-phenyl)-2-[(4-chloro-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid,  
 [2-[(4-chloro-phenyl)-phenyl-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-[bis-(4-fluoro-phenyl)-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 {4-(4-fluoro-phenyl)-2-[(4-methoxy-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid,  
 {4-(4-chloro-phenyl)-2-[(4-methoxy-phenyl)-phenyl-methyl]-thiazol-5-yl}-acetic acid,  
 [2-[(3,4-difluoro-phenyl)-phenyl-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-[bis-(4-methoxy-phenyl)-methyl]-4-(4-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-benzhydryl-4-(3-fluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-[bis-(4-fluoro-phenyl)-methyl]-4-(3,4-difluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-benzhydryl-4-(3,4-difluoro-phenyl)-thiazol-5-yl]-acetic acid,  
 [2-[bis-(4-fluoro-phenyl)-methyl]-4-(3-fluoro-phenyl)-thiazol-5-yl]-acetic acid,

and salts hydrates and solvates thereof.

34. A pharmaceutical composition comprising a compound as claimed in any of claims 1 to 33, together with a pharmaceutically acceptable carrier.

35. Use of a compound as claimed in any of claims 1 to 33 in the manufacture of a composition for the treatment of disease responsive to modulation of CRTH2 receptor activity.

36. A method of treatment of disease responsive to modulation of CRTH2 receptor activity comprising administering to a subject suffering such disease and effective amount of a compound as claimed in any of claims 1 to 33..

37. Use as claimed in claim 35 or a method as claimed in claim 36 wherein the disease is one associated with elevated levels of prostaglandin D2 (PGD2) or one or more active metabolites thereof.

38. Use or a method as claimed in claim 37 wherein the disease is an inflammatory, autoimmune, respiratory or allergy disease.

39. Use or method as claimed in claim 37 wherein the disease is selected from asthma, rhinitis, allergic airway syndrome, allergic rhinobronchitis, bronchitis, chronic obstructive pulmonary disease (COPD), nasal polyposis, sarcoidosis, farmer's lung, fibroid lung, cystic fibrosis, chronic cough, conjunctivitis, atopic dermatitis, Alzheimer's disease, amyotrophic lateral sclerosis, AIDS dementia complex, Huntington's disease, frontotemporal dementia, Lewy body dementia, vascular dementia, Guillain-Barre syndrome, chronic demyelinating polyradiculoneuropathy, multifocal motor neuropathy, plexopathy, multiple sclerosis, encephalomyelitis, panencephalitis, cerebellar degeneration and encephalomyelitis, CNS trauma, migraine, stroke, rheumatoid arthritis, ankylosing spondylitis, Behçet's Disease, bursitis, carpal tunnel syndrome, inflammatory bowel disease, Crohn's disease, ulcerative colitis, dermatomyositis, Ehlers-Danlos Syndrome (EDS), fibromyalgia, myofascial pain, osteoarthritis (OA), osteonecrosis, psoriatic arthritis, Reiter's syndrome (reactive arthritis), sarcoidosis, scleroderma, Sjogren's Syndrome, soft tissue disease, Still's Disease, tendinitis, polyarteritis Nodossa, Wegener's Granulomatosis, myositis (polymyositis dermatomyositis), gout, atherosclerosis, lupus erythematosus, systemic lupus erythematosus (SLE), type I diabetes, nephritic syndrome, glomerulonephritis, acute and chronic renal failure, eosinophilia fascitis, hyper IgE syndrome, sepsis, septic shock, ischemic reperfusion injury in the heart, allograft rejection after transplantations, and graft versus host disease.

40. Use or method as claimed in claim 37 wherein the disease selected from asthma, rhinitis, allergic airway syndrome, and allergic rhinobronchitis.



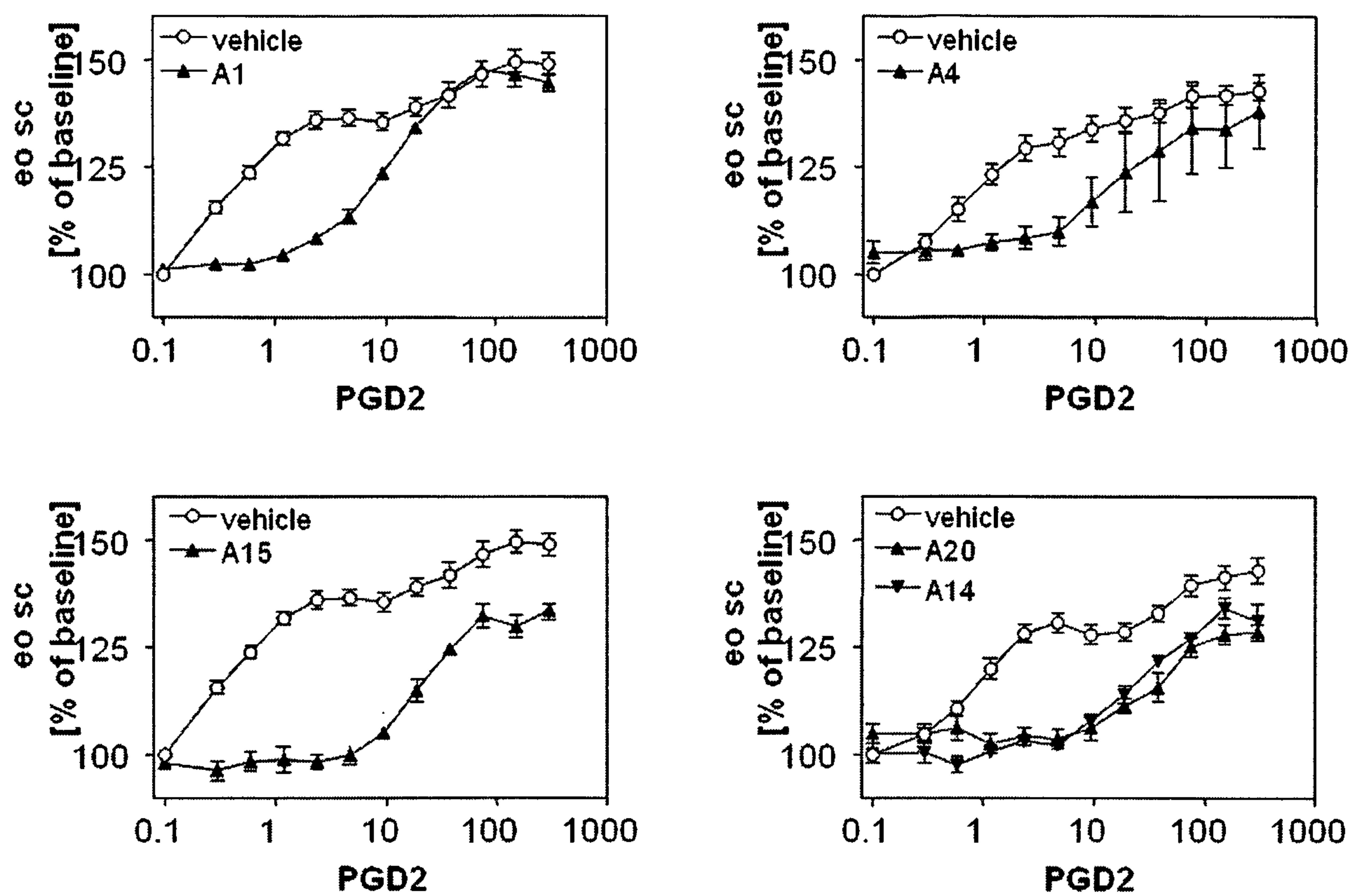


Figure 1

