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(54) Title: ALC1 INHIBITORS AND SYNERGY WITH PARPI

(57) Abstract: The present invention relates to small molecule compounds that allosterically inhibit ALC1 (CHD1L) and which induce the trapping of PARP1, PARP2 and/or PARP3 on chromatin or at DNA damage sites. Disruption of the chromatin remodeling forces of ALC1 through these agents enables a highly selective therapy for targeting the DNA damage functions of PARP enzymes in several proliferative diseases, notably BRCA-deficient cancers. Via inhibition of the enzymatic activity, the compounds engage the synthetic lethality between BRCA1/2 and ALC1. By trapping PARP enzymes, inhibitors of ALC1 potentiate the cancer cell killing properties of PARP inhibitors, enable therapeutic approaches where ALC1 is amplified as an oncogene, therapeutically make it possible to overcome PARP inhibitor resistance mechanisms and enable an alternative approach to the treatment of germline or acquired BRCA1/BRCA2 deficiency, including tumors defined by "BRCAness" or other changes in DNA repair networks.

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ALC1 INHIBITORS AND SYNERGY WITH PARPI

The present invention relates to small molecule compounds that allosterically inhibit ALC1 (CHD1L) and which induce the trapping of PARP1, PARP2 and/or PARP3 on chromatin or at DNA damage sites. Disruption of the chromatin remodeling forces of ALC1 through these agents enables a highly selective therapy for targeting the DNA damage functions of PARP enzymes in several proliferative diseases, notably BRCA-deficient cancers. Via inhibition of the enzymatic activity, the compounds engage the synthetic lethality between mutations in HRD pathways, including BRCA1/2 and ALC1. By trapping PARP enzymes, inhibitors of ALC1 potentiate the cancer cell killing properties of PARP inhibitors, enable therapeutic approaches where ALC1 is amplified as an oncogene, therapeutically make it possible to overcome PARP inhibitor resistance mechanisms and enable an alternative approach to the treatment of germline or acquired BRCA1/BRCA2 deficiency, including tumors defined by "BRCAness" or other changes in DNA repair networks.

Background of the Invention

For recognition of single-strand and double-strand breaks (SSBs/DSBs), the nuclear Poly-ADP-ribose polymerase (PARP) enzymes are early key factors in the DNA damage response (DDR). Using the metabolite NAD^+, PARP-1 and -2 add poly-ADP-ribose (PAR) chains to chromatin components and to factors belonging to the DDR, while PARP-3 targets chromatin components via mono-ADP-ribosylation. PARPs get recruited to DNA lesions by recognizing specifically altered, DNA-damage induced structures, which turns on their PARylation activity, which in turn regulates their and the activity of other DDR and chromatin proteins, facilitating the DDR (Ray Chaudhuri and Nussenzweig, 2017).

This catalytic activity can be inhibited by NAD^+ analogues and has become of particular interest and clinically useful in genetically-defined cancers. Notably, by targeting synthetic lethality in the context of BRCA1 or BRCA2 deficiency, so-called PARP inhibitors (PARPi) are used to treat homologous-repair (HR)-deficient and other cancers. This is thought to occur by lowering PARP activity and/or by biochemically "trapping" of PARP-1/2/3 on chromatin (Murai et al., 2012, 2014). While "trapping" remains molecularly ill-defined, the term defines an enhanced recruitment, association and/or retention of PARP-1/2/3 enzymes on damaged chromatin, typically induced by treatment of PARP-1 enzyme with PARP inhibitors (PARPi), or a decrease in the release of PARP-1/2/3 enzymes following their initial recruitment, which leads to a prolonged retention. This biochemically manifests itself in an enhanced steady-state association/retention/binding ("trapping") of the PARP enzymes with damaged genome regions/loci.

Due to the clinical advent of PARPi, PARP-1 has emerged as a powerful target for an increasing list of cancers, including in combination with immuno-oncology therapies, such as the current Lynparza/Keytruda trials, to give all but one of many examples. Moreover, first-line PARPi therapies and applications in contexts outside of germline BRCA-1/2 mutations are becoming possible.

Importantly, clinical PARPi compounds all bind essentially the same location at the catalytic center of the active site by blocking the binding of the substrate NAD^+, thus preventing poly(ADP-ribose) synthesis, largely by virtue of their structural similarity to nicotinamide, a moiety of the NAD^+ nucleotide.

Yet, PARPi exhibit greatly different clinical efficacy in tumor killing and patient outcomes in the clinic. One fundamental difference in the action of these PARPi is that they promote highly distinct levels of PARP-1/-2 trapping on chromatin. It is currently generally thought that the most powerful and clinically effective PARPi trap PARP-1 at the site of a DNA break much more strongly than clinically less useful PARPi. Upon PARP trapping, DNA lesions become more cytotoxic, especially in mutant tumor cells with genetic or epigenetic deficiencies in the repair of DNA strand breaks, such as functionally HR-deficient BRCA-1/2 mutant tumor cells. Further, it is currently not clear what relative or dominant contributions are carried out by PARP-1 vs. PARP-2 vs. PARP-3 enzymes, since all enzymes are involved in sensing DNA strand breaks and recruit to DNA damage sites, while PARP-1 and PARP-2 both promote PARylation of chromatin factors, while all existing clinical PARPi molecules barely distinguish between the two related PAR polymerase enzymes PARP-1 and PARP-2. In turn, PARP trapping is thought to lead to DNA replication stress, genomic instability and cell death in cancer cells (Lord and Ashworth, 2012). Enhanced trapping of PARP1, for example, is thought to lead to an increased ability to kill cancer cells, especially cancers with defective DNA repair pathways (Zandarashvili et al., 2020). Figure 1 shows the cytotoxic mechanism of PARP trapping via PARPi.

"PARP trapping" is thus described as an (enhanced) association of PARP-1 or PARP-2 or PARP-3 with chromatin in living cells. Using PARPi, the allosteric mechanism that contributes to binding of PARP-1 to DNA can be disrupted (Zandarashvili et al., 2020), with some PARPi contributing to retention and others facilitating pro-release mechanisms based on *in vitro* PARP-1, PARPi and DNA interactions (Zandarashvili et al., 2020). The different mechanisms of PARPi on PARP trapping are shown in Figure 3. U2OS cells treated with talazoparib show an enhanced retention of GFP-tagged PARP2 at induced DNA lesions, whereas cells treated with veliparib reveal overall less PARP2 recruitment to the DNA lesions.

Either PARP-1 or PARP-2 are necessary for a sufficient recruitment of SSB repair proteins to the damage site. Via PARylation, chromatin remodeling or histone-modifying enzymes are activated at DNA damage sites, which leads to changes in chromatin compaction (Luijsterburg et al., 2016; Mehrotra et al., 2011; Sellou et al., 2016; Smeenk et al., 2013; Timinszky et al., 2009).

Activation of PARP-1 and/or PARP-2 enzymes leads to the recruitment of many proteins, notably also specific chromatin remodeling enzymes, notably including the macrodomain-containing nucleosome remodeler ALC1 (CHD1L) (Ahel et al., 2009; Gottschalk et al., 2009; Lehmann et al., 2017; Singh et al., 2017). Macrodomains generally bind ADP-ribose, oligo- ADP-ribose and poly-ADP-ribose (Karras et al., 2005), thus proteins containing macrodomains respond and recruit to PARP activation sites on the genome, including during DNA damage and with relevance for cancer. Importantly, PAR or oligo-ADP-ribose binding to the macrodomains of ALC1 robustly turns on chromatin remodeling activity (Ahel et al., 2009; Gottschalk et al., 2009; Lehmann et al., 2017; Singh et al., 2017), revealing ALC1 as an allosterically-regulated chromatin remodeling enzyme, the first of its kind, and one of the very few enzymes whose

catalytic activity is directly regulated by PAR. Additionally, ALC1 is a validated oncogene and is often genetically amplified together with PARP1 in BRCA1/2-deficient ovarian and breast cancer samples (see Figure 2). ALC1 inhibitors, such as small molecules inhibiting the ATPase function and or nucleosome remodeling functions of ALC1, could potentiate the effect PARPi, lead to enhanced cancer cell killing and/or reduce off-target effects and thus lessen cellular toxicity in non-cancer cells. The fact that altering the expression level of ALC1 (in this instance by a CRISPR-based knockout) impacts the sensitivity of cancer cells to PARP inhibitors, also opens up the opportunity that altering the activity levels of ALC1 could overcome PARP inhibitor resistance, since removing ALC1 robustly potentiates the PARPi Olaparib to a level that may be sufficient to circumvent PARPi resistance, such as upon (but not limited to) reversion of the BRCA-deficiency status (e.g. by internal deletions or through loss of epigenetic BRCA1/2 gene silencing). Since the sensitivity of cancer cells to PARP inhibitors is generally accepted to (also) stem from the ability of PARPi to trap PARP1 on chromatin (and likely also trapping PARP2 enzymes – this has not been formally established in the field), we hypothesized that small molecule ALC1 inhibitors may mediate PARPi sensitization, bypass PARPi resistance and/or promote cancer cell killing through a direct or indirect impact on PARP1 and/or PARP2 trapping. Specifically, we hypothesized that inhibition of ALC1 with small molecules would enhance PARP1/2 trapping at DNA damage sites and thus, indirectly, promote DNA damage and cancer cell killing.

Recently, the first small molecule inhibitors targeting ALC1 (CHD1L) have been reported (Abbott et al., 2020). The publication revealed a role for ALC1 inhibitors in driving malignant colorectal cancer (CRC) due to its oncogenic function, specifically by impacting the Wnt/TCF-driven epithelial-to-mesenchymal transition (EMT) in CRC. Analysis with one specific ALC1 inhibitor further showed evidence for significant DNA damage, as measured by the DNA damage marker gammaH2AX. This led the authors to hypothesize that ALC1 may increase the efficacy of colorectal cancer standard-of-care DNA-damaging chemotherapies such as etoposide, which forms a ternary complex with DNA and the topoisomerase II enzyme, preventing re-ligation of the DNA strands following DNA replication, thus causing DNA strand breakage and cell death. Importantly, no suggestion, nor experimental evidence for an impact of ALC1 inhibitors on PARP-1/2/4 trapping was presented in this publication.

To analyze the mechanisms that cause the distinct trapping effects, the chromatin remodeler ALC1 (CHD1L) was hypothesized to regulate PARP retention. Containing a PAR-binding macrodomain, ALC1 regulates protein recruitment to DNA lesions. (Ahel et al., 2009; Gottschalk et al., 2009; Lehmann et al., 2017; Singh et al., 2017). As shown in Figures 5 and 6, inhibition of ALC1 via ALCi in U2OS cells led to specific retention of PARP-2 at DNA lesions.

Since ALC1 is upregulated in several tumors and is a validated oncogene in hepatocellular carcinoma (Cheng et al., 2013; Li et al., 2019; Su et al., 2014), inhibition of ALC1 via small molecule inhibitors leading to PARP-2 trapping could drive robust changes in DNA damage responses.

The present inventors hypothesized that manipulation of ALC1 activity via small molecules could be sufficient to bypass a low or high level of PARPi resistance. Thus, ALC1 and PARP-2 could be exploited to refine PARP-targeted therapies in oncology.

This hypothesis led to a part of the present invention that ALC1 manipulation via small molecule inhibitors impacts the response to DNA damage through PARP-1, PARP-2 and/or PARP-3 trapping, as well as the trapping of as-yet undescribed chromatin/DNA-damage associating PARP family members. These compounds, designed to inhibit the enzymatic activity of the ATP-dependent chromatin remodeler ALC1 (CHD1L), will potentiate accumulation of DNA damage and thus to mediate synthetic lethality upon BRCA deficiency *in vitro*, since PARP inhibition has been well documented to be synthetic lethal with loss of BRCA-1/2 tumor suppressor function based on preclinical and clinical evidence, suppress PARPi resistance mechanisms, open up ALC1 inhibition as a therapeutic approach for cancers that have intact HR pathways, and/or allow the targeting of ALC1-amplified tumors by disrupting ALC1's oncogene function such as HCC via promoting PARP-1/2/3 trapping. Also, since the ALC1 gene is a key mediator of PARP-chromatin rearrangements upon induced DNA damage (Sellou et al., 2016), small molecules targeting ALC1 activity may impact the nuclear, DNA-damage relevant functions of PARP-1/2/3 on chromatin rearrangements without impacting other roles of PARP-1/2/3 inside or outside of the cell's nucleus or without impacting non-DNA-damage induced PARP enzymes, which may result in a "second-generation PARPi" with reduced off-target effects and/or reduced side-effects.

The dynamics of PARP-1 and PARP-2 and PARP-3 enrichment at DNA damage sites can be visualized using live-cell imaging, as established for PARP-1 in the field (Ahel et al., 2009; Gottschalk et al., 2009). Wild-type PARP-1 and PARP-2 rapidly recruit to DNA lesions induced by laser-micro-irradiation. Via transient transfection of a GFP-tagged PARP-1 and PARP-2 in an immortalized cell line, we measured the impact of ALC1i on their recruitment to- and retention at DNA damage sites.

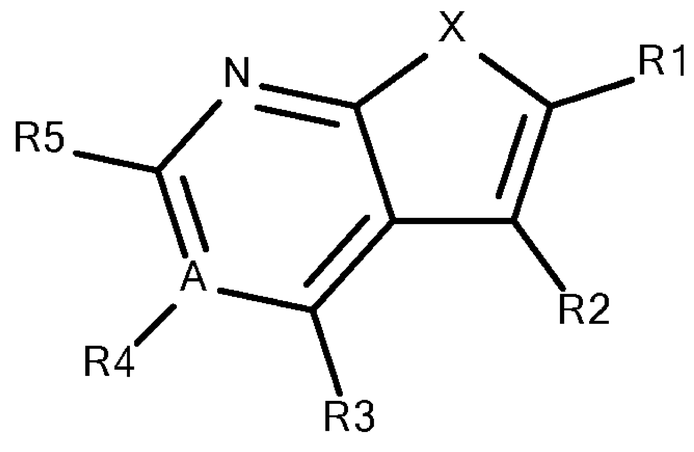
The present inventors were successful in identifying an allosteric binding pocket within the ATPase domain of ALC1 and used this information to model inhibitors of ALC1 activity. Given the above described relevance of ALC1 for various proliferative diseases, in particular those that are BRCA1/2 deficient. Thus the present invention provides a novel class of compounds to treat or ameliorate tumor diseases and in particular tumor diseases characterized by increased activity of ALC1, e.g. due to increased expression.

Furthermore, the present inventors determined that by using a combination of PARPi and an ALC1 inhibitor, preferably the allosteric ALC1 inhibitors of the present invention the effect of PARPis can surprisingly be enhanced. Thus, the present invention provides *inter alia* (i) an efficient therapy of tumors that are sensitive to PARPi, (ii) mediate PARPi sensitization, (iii) bypass PARPi resistance, (iv) allow the reduction of the amount of PARPi that is administered, and/or (v) promote cancer cell killing through a direct or indirect impact on PARP-1, PARP-2 and/or PARP-3 trapping.

Summary of the Invention

In a first aspect the present invention relates to an allosteric inhibitor of Chromodomain-helicase-DNA-binding protein 1-like (ALC1), wherein the inhibitor specifically binds to an allosteric binding pocket formed by an amino acid stretch spanning amino acid residues 101 to 219 of SEQ ID NO: 1.

In a further aspect the present invention relates to a compound of formula (I):



(I)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof, wherein:

X is N or S;

A is C or N;

R_1 is –CO-OR_6, -CO-R_7, or -CO-NR_6R_A, preferably R_1 is –CO-OR_6;

R_2 is -R_7, -NHR_8, -O-R_7, -C-O-R_7, Br, -C_{3-8}-cycloalkyl (preferably cyclopropyl), or –C_{4-8}-cycloalkenyl (preferably cyclohexenyl);

or

R_1 and R_2 together form a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, =O, [-O-CH_2-CH_2]-NH-CH(OH)-O-tBu, ;

R_3 is H, =O, -OH, -O-R_7, -R_7, or –$(CH_2)_m$-L, wherein m is 0, 1 or 2, and L is a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, -hydroxyC_{1-3}-alkyl and =O;

R_4 is H or -C_{1-3}-alkyl, preferably H;

R_5 is -$(CH_2)_m$-L, or -$(CH_2)_m$-(CH=CH)-L, wherein m is 0, 1 or 2, preferably 0 or 1, and L is a 5, 6 or 7 membered carbo- or heterocycle, adamantyl, C_{1-4}-alkyl, or -$N(CH_3)_2$, optionally substituted, preferably with 1, 2, 3 or 4 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -CO-OR_6, -Br, -Cl, -F, -I, -R_9, -O-R_9, =O, and [-O-CH_2-CH_2]$_q$-NH-biotin with q being 1, 2, 3, or 4, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle;

or

R_4 and R_5 together form a 5, 6, or 7 membered carbocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-R_9, -R_9, =CH-R_A, and –CH_2-R_A, preferably R_4 and R_5 together form a C_{5-7}-cycloalkyl;

R_6 is H, -C_{1-6}-alkyl, -C_{2-6}-alkenyl, -C_{2-6}-alkynyl, optionally substituted, preferably R_6 is H;

R_7 is -C_{1-3}-alkyl, -C_{2-3}-alkenyl, -C_{2-3}-alkynyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -Br, -Cl, -F, -I, -CH_3, -OCH_3, or -SCH_3;

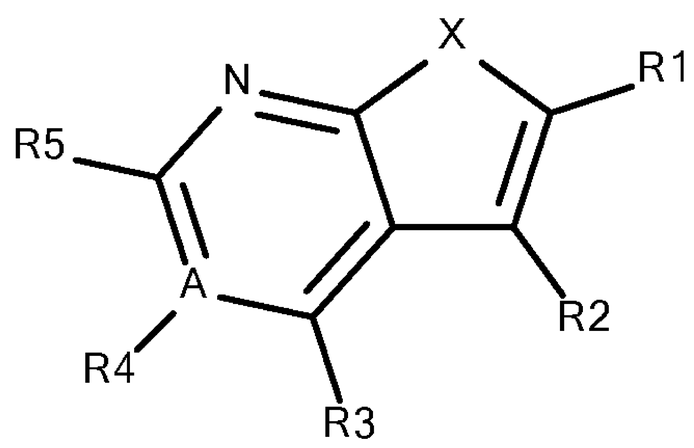
R_8 is H or C_{1-6}-alkyl, preferably H,

R_9 is -C_{1-6}-alkyl, -C_{2-6}-alkenyl, -C_{2-6}-alkynyl, -C_{1-6}-alkyl-aryl, or C_{1-6}-alkyl-heteroaryl (preferably isooxazole, thiazole, tetrazole, 1,2,4-thiadiazole, 1,2,3-thiadiazole, 1,2,5-thiadiazole, pyridine, 1,2,4-

oxadiazole, pyrazine, or pyrazole), optionally substituted with 1, 2 or 3 substituents selected from the group consisting of -Br, -Cl, -F, -I, -NO_2, -CN, -$CONH_2$, -CONH-C_{1-3}-alkyl (preferably –CONH-CH_3), -NH-CO-C_{1-3}-alkyl (preferably -NH-CO-CH_3), -C_{1-6}-alkyl (preferably -CH_3, ethyl, propyl, t-butyl, or pentyl), -C_{1-3}-haloalkyl (preferably-CF_3, or -CHF_2), -O-CHF_2, -O-CF_3, carbocycle (preferably cyclopropyl, cyclohexyl or phenyl), -O-carbocycle (preferably phenoxy), heterocycle (preferably pyrazolyl), -CO-heterocycle (preferably –CO-(1-pyrrolidinyl)),-SO_2-CH_3, -SO_2-$N(CH_3)_2$, -O-C_{1-4}-alkyl (preferably -OCH_3), -O-C_{1-3}-alkyl-O-C_{1-3}-alkyl (preferably –O-CH_2-O-CH_3), -SCH_3, or when R_9 is -C_{1-6}-alkyl-aryl, then two adjacent substituents on the aryl moiety can form a 5, 6 or 7 membered carbo- or heterocycle, which is optionally substituted;

R_A is H, carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -R_9, -O-R_7, -O-$(CH_2)_o$-R_9, -SO_2NH_2, and =O, wherein o is 0 or 1.

In yet another aspect, the present invention relates to a compound of formula (I):



(I)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof, wherein:

X is N or S;

A is C or N;

R_1 is –CO-OR_6, -CO-R_7, or -CO-NR_6R_A, preferably R_1 is –CO-OR_6;

R_2 is -R_7, -NHR_8, -C-O-R_7;

or

R_1 and R_2 together form a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O;

R_3 is H, =O, -OH, -O-R_7, -R_7, or –$(CH_2)_m$-L, wherein m is 0, 1 or 2, and L is a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, -hydroxyC_{1-3}-alkyl and =O;

R_4 is H or -C_{1-3}-alkyl, preferably H;

R_5 is -$(CH_2)_m$-L, or -$(CH_2)_m$-(CH=CH)-L, wherein m is 0, 1 or 2, preferably 0 or 1, and L is a 5, 6 or 7 membered carbo- or heterocycle, or adamantyl, optionally substituted, preferably with 1, 2, 3 or 4 substituents independently selected from the group consisting

of -OH, -NO_2, -CN, -CO-OR_6, -Br, -Cl, -F, -I, -R_9, -O-R_9, and =O, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle;

or

R_4 and R_5 together form a 5, 6, or 7 membered carbocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-R_9, -R_9, =CH-R_A, preferably R_4 and R_5 together form a C_{5-7}-cycloalkyl;

R_6 is H, -C_{1-6}-alkyl, -C_{2-6}-alkenyl, -C_{2-6}-alkynyl, optionally substituted, preferably R_6 is H;

R_7 is -C_{1-3}-alkyl, -C_{2-3}-alkenyl, -C_{2-3}-alkynyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -Br, -Cl, -F, -I, -CH_3, -OCH_3, or -SCH_3;

R_8 is H or C_{1-6}-alkyl, preferably H,

R_9 is -C_{1-6}-alkyl, -C_{2-6}-alkenyl, -C_{2-6}-alkynyl, or -C_{1-6}-alkyl-aryl, optionally substituted with 1, 2 or 3 substituents selected from the group consisting of -Br, -Cl, -F, -I, -CH_3, -OCH_3, or -SCH_3

R_A is H, carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -R_9, -O-R_7, -O-$(CH_2)_o$-R_9, -SO_2NH_2, and =O, wherein o is 0 or 1.

In a second aspect the present invention relates to a bifunctional compound comprising the allosteric inhibitor of ALC1 the first or further aspect of the present invention and a compound which recruits E3 ubiquitin ligase to ALC1(E3 recruiter), wherein the allosteric inhibitor of ALC1 and the E3 recruiter are covalently linked, optionally through a linker.

In a third aspect the present invention relates to a pharmaceutical composition comprising the allosteric inhibitor of ALC1 and pharmaceutically acceptable excipients.

In a fourth aspect the present invention relates to an ALC1 inhibitor (ALC1i) for use in treating or ameliorating a proliferative disease in a patient, wherein the method comprises the administration of said ALC1i and optionally the administration of a Poly(ADP-ribose)-Polymerase inhibitor (PARPi).

In a fifth aspect the present invention relates to a PARPi for use in treating or ameliorating a proliferative disease in a patient, wherein the method comprises the administration of said PARPi and the administration of said ALC1i.

In a sixth aspect the present invention relates to a kit of parts comprising separately packaged a PARPi and an ALC1i or a composition comprising a PARPi and an ALC1i, preferably with instructions for use to treat or ameliorate a proliferative disease.

Description of the Figures

In the following, the content of the Figures comprised in this specification is described. In this context please also refer to the detailed description of the invention above and/or below.

Figure 1: Cytotoxic mechanisms of PARPi on DNA repair pathways leading to PARP trapping. Upper pathway shows interference with DNA repair of single strand breaks (SSBs) via DNA replication fork damage leading to repair via the homologous recombination (HR) mechanism. Lower pathway shows trapping of PARP1/2 proteins on damaged DNA, leading to replication fork damage utilizing

additional repair pathways including Fanconi pathway (FA), template switching (TS), ATM, FEN1 (replicative flap endonuclease) and DNA polymerase β (Murai et al., 2012, S. 5591).

Figure 2: The chromatin remodeler ALC1 (CHD1L) is frequently co-amplified with the PARP1 gene in human ovarian and breast cancer samples. Genomic alterations of ALC1 (CHD1L), PARP1, PARP2, BRCA1, BRCA2 and the most closely related chromatin remodeler CHD1 among the genomes of 10792 breast, fallopian and ovarian cancer patients (OncoPrint analysis conducted on 08/12/2020 at the cBioPortal - www.cbioportal.org). The percentage numbers indicate the percentage of alterations in a particular gene for all genomes where the specific gene has been profiled. Gene amplifications (*black*), deep gene deletions (*dark grey*) are highlighted. Compared to CHD1, ALC1 is often amplified together with PARP1 (ALC1- PARP1: Odd's ratio (OR)=1.581, q-value=<0.001; CHD1-PARP1: OR=-0.125, q- value=0.250). Neither ALC1, nor PARP1 exhibit a deep deletion or frequent mutation when the tumors exhibit a deep deletion or mutation in the BRCA1 or BRCA2 tumor suppressor genes (ALC1-BRCA1/2: OR=<-3/-2.178, q-value=<0.001; PARP1-BRCA1/2: OR=<-3, q- value=<0.001).

Figure 3: GFP-PARP2 association at laser micro-irradiation sites in U2OS cells. U2OS cells were treated with PARPi veliparib (10 μM) and talazoparib (100 nM) and transfected with GFP-PARP2. Grey signal indicates PARP2 in the nucleus. Bright lines show recruitment of PARP2 to laser micro-irradiated damage sites. Images were taken 1 minute and 15 minutes after irradiation. Treatment with talazoparib shows enhanced retention of PARP2 at induced damage sites ("PARP trapping"), whereas treatment with veliparib leads to less recruitment of PARP2 to the damage site.

Figure 4: Schematic of live-cell PARP trapping assay. The cell nucleus microirradiated by a 355nm wavelength laser to induce DNA damage (indicated by black bar, left cell). Cells are then imaged for a period of 15 minutes. Grey bar shows recruitment of PARP1/2 to the induced DNA damage site (middle cell). A) the signal of PARP2 reduces over time, indicating a decrease in PARP1/2 retention B) prolonged retention of PARP2, a live-cell imaging correlate showing molecular trapping of PARP2 at the induced DNA damage site.

Figure 5: Relative recruitment of PARP2 to DNA damage site after treatment with ALCi-9. Wild-type U2OS cells were stably transfected with GFP-PARP2. Kinetics of GFP-PARP2 recruitment to and dissociation from DNA lesion was measured over 30 minutes in the presence and absence of compound ALCi-9. Treatment with ALCi-9 shows enhanced retention of PARP2 at DNA damage sites compared to DMSO. 9 nuclei were analyzed in 1 biological replicate. The data are shown as mean + S.E.M. normalized to pre-damaged GFP intensity at microirradiation sites.

Figure 6: Relative recruitment of PARP2 to DNA damage site after treatment with ALCi-9. Wild-type U2OS cells were stably transfected with GFP-PARP2. Kinetics of GFP-PARP2 recruitment to and dissociation from DNA lesion was measured over 30 minutes in the presence and absence of compound ALCi-9. Upper nucleus was treated with DMSO, lower nucleus was treated with ALCi-9 (10 μM) for 1h. Timepoint 0 min. shows nuclei before micro-irradiation, timepoint 1 min. and 30

min. show nuclei after irradiation. Treatment with ALCi-9 shows PARP2-trapping at DNA damage sites compared to DMSO.

Figure 7: PARP2 trapping after co-treatment with ALCi-9 and PARPi veliparib. Wild-type U2OS cells were stably transfected with GFP-PARP2. Kinetics of GFP-PARP2 recruitment to and dissociation from DNA lesion was measured over 30 minutes in the presence and absence of veliparib, compound ALCi-9 or a combination of both. 4-11 nuclei were analysed in 1 biological replicate. The data are shown as mean + S.E.M. normalized to pre-damaged GFP intensity at micro-irradiation sites.

Figure 8: Colony formation assay of BRCA positive and BRCA negative cells treated with ALCi. MDA-MB-231 cells (BRCA1/2 wildtype) and SUM-149-PT cells (BRCA1 negative) cells were seeded into 96-well plates and treated with titrations of different ALCi starting at 50 µM. The cells were cultured at 37°C, CO_2 5% for 11 days, fixed with 10%TCA and stained with sulforhodamine staining to analyse cell survival. The data was normalized to DMSO controls indicating 100 % survival. Inhibitor vs. response curves with variable slope (four parameters) were fitted using GraphPad Prism. Error bars are shown for two technical replicates.

Figure 9: PARPi co-treatment colony formation assay of BRCA negative cells. SUM-149-PT cells (BRCA1 negative) cells were seeded into 96-well plates and treated with PARPi in different concentrations and titrations of different ALCi starting at 50 µM. The cells were cultured at 37°C, CO_2 5% for 11 days, fixed with 10%TCA and stained with Sulforhodamine staining to analyze cell survival. Upper part of the figure shows survival curves of SUM-149-PT cells. Black curves indicate co-treatment of ALCi-x with PARPi-y. Treatment with ALCi-132 and ALCi-74 show enhanced cell killing compared to treatment with Veliparib only or ALCi only. Synergism of veliparib and ALCi-x are shown for certain concentrations in the bar-graphs. Here, control growth (%) under treatment with veliparib alone, treatment with ALCi-x alone and co-treatment are illustrated in grey.

Figure 10: Structures and associated compound codes of ALC1 inhibitors.

Figure 11: Nucleosome remodeling inhibition. IC_{50}s (µM) of ALC1 inhibitors in a FRET based nucleosome remodelling assay. IC_{50} values are presented by the following symbols: +++: IC_{50} < 25µM; ++: IC_{50} = 25-250µM; +: IC_{50} > 250µM; and '-': compounds is not active (for SAR purposes).

Figure 12: Cell proliferation inhibition EC50s (µM) of ALC1 inhibitors in a 5 day cell proliferation assay with an SRB based readout. EC_{50} values are presented by the following symbols: +++: EC_{50} < 10µM; ++: EC_{50} = 10-50µM; +: EC_{50} > 50µM; and '-': compounds is not active.

Figure 13: Surface cutaway of the first lobe of the ALC1 helicase domain in the "front" **(A)** and "back" **(B)** orientations showing the newly identified allosteric binding pocket. The ATP binding site is denoted by a black circle.

Figure 14: Surface cutaway of the first lobe of the ALC1 helicase domain with regions colored according to hydrophobicity in the "front" **(A)** and "back" **(B)** orientations. Darker colors are more hydrophilic.

Figure 15: Surface cutaway of the first lobe of the ALC1 helicase domain surface of ALCi-22 with regions colored according to hydrophobicity in the "front" **(A)** and "back" **(B)** orientations. Darker colors are more hydrophilic.

Figure 16: Surface cutaway of the first lobe of the ALC1 helicase domain with the Van der Waals surface of ligand ALCi-22 shown in white in the "front" **(A)** and "back" **(B)** orientations.

Figure 17: Surface cutaway of the first lobe of the ALC1 helicase domain with the stick representation of the ligand ALCi-22 shown in white in the "front" **(A)** and "back" **(B)** orientations.

Figure 18: Ligplot diagram of ALCi-22 bound to the allosteric site in the first lobe of the helicase domain of ALC1.

Figure 19: Surface cutaway of the first lobe of the ALC1 helicase domain with ligand ALCi-22 shown in white in the "front" orientation with specific interactions with ASN165 and ARG135 shown with black dashed lines.

Figure 20: PDB file for the novel allosteric pocket of ALC1. Structural coordinates of the key atoms of the amino acids at the surface of the allosteric binding pocket of human ALC1 comprised within the amino acids stretch spanning amino acids 101 to 219 of ALC1 according to SEQ ID NO: 1. The allosteric ALC1 inhibitors of the present invention interact with one or more of these key atoms in order to specifically bind to this pocket. The structure of the pocket of human ALC1 has been determined by homology modelling using swissmodel. The residues shown are the minimum set of amino acids required to reproduce docking results that were initially preformed on a larger ALC1 homology model generated using swissmodel. Specifically, the swissmodel model was used in initial docking experiments. This pocket was chosen due to its proximity to the ATP binding site and its novelty. These amino acids are required to form the pocket and allow for docking, and allow faster computation than when using the whole protein.

Figure 21: A table containing the supplier used for each of the inhibitors

Figure 22: A general synthesis scheme for inhibitors according to formula I

Figure 23: A table containing the percentage inhibition of ALC1 in the FRET-based nucleosome sliding assay at a compound concentration of 250µM for each of the inhibitors. For some compounds, the concentration of 250 µM had to be lowered due to solubility problems as indicated in the legend at the bottom of the table.

Detailed Description of the Invention

Before the present invention is described in detail below, it is to be understood that this invention is not limited to the particular methodology, protocols and reagents described herein as these may vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to limit the scope of the present invention which will be limited only by the appended claims. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art.

Several documents are cited throughout the text of this specification. Each of the documents cited herein (including all patents, patent applications, scientific publications, manufacturer's specifications, instructions etc.), whether supra or infra, is hereby incorporated by reference in its entirety. Nothing herein is to be construed as an admission that the invention is not entitled to antedate such disclosure by virtue of prior invention. Some of the documents cited herein are characterized as being "incorporated by reference". In the event of a conflict between the definitions or teachings of such incorporated references and definitions or teachings recited in the present specification, the text of the present specification takes precedence.

In the following, the elements of the present invention will be described. These elements are listed with specific embodiments, however, it should be understood that they may be combined in any manner and in any number to create additional embodiments. The variously described examples and preferred embodiments should not be construed to limit the present invention to only the explicitly described embodiments. This description should be understood to support and encompass embodiments which combine the explicitly described embodiments with any number of the disclosed and/or preferred elements. Furthermore, any permutations and combinations of all described elements in this application should be considered disclosed by the description of the present application unless the context indicates otherwise.

Definitions

To practice the present invention, unless otherwise indicated, conventional methods of chemistry, biochemistry, and recombinant DNA techniques are employed which are explained in the literature in the field (cf., e.g., Molecular Cloning: A Laboratory Manual, 2nd Edition, J. Sambrook et al. eds., Cold Spring Harbor Laboratory Press, Cold Spring Harbor 1989).

In the following, some definitions of terms frequently used in this specification are provided. These terms will, in each instance of its use, in the remainder of the specification have the respectively defined meaning and preferred meanings.

As used in this specification and the appended claims, the singular forms "a", "an", and "the" include plural referents, unless the content clearly dictates otherwise.

The term "Chromodomain-helicase-DNA-binding protein 1-like" abbreviated CHD1L refers to a protein that is also termed ALC1. The amino acid sequence of human ALC1 is as specified in SEQ ID NO: 1. The 897 amino acid residues long protein consists of an N-terminal Snf2-like DNA dependent ATPase domain spanning amino acid residues 40 to 513, which contains the conserved helicase motifs critical for catalysis (Flaus et al., 2006). This domain is composed of two RecA like lobes ranging from amino acid residues 48 to 261 and 351 to 513, respectively. The structure of a truncated N-terminal lobe of the ATPase domain has been determined by homology modeling in order to identify putative allosteric binding sites, a minimal coordinate file of this model is provided as Fig. 20 to allow the skilled person to identify model compounds within the allosteric binding pocket defined for the first time by the present inventors. The allosteric binding pocket is spatially separated from that part of ALC1 involved in binding ATP. The ATPase domain is followed by a linker region ranging from amino acid residues 514 to 703, which contains

a putative coiled-coil region (amino acid residues 638 to 675), and a C-terminal macrodomain (amino acid residues 704 to 897). The macrodomain has been shown to directly interact with the ATPase domain, thereby inhibiting its catalytic function (Lehmann et al., 2017; Singh et al., 2017). This interaction is released upon poly(ADP-ribose) binding to the macrodomain, leading to an activation of the chromatin remodelling enzyme.

The term "alkyl" as used in the context of the present invention refers to a saturated straight or branched carbon chain. Preferably, the chain comprises from 1 to 10 carbon atoms, i.e. 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10, e.g. methyl, ethyl propyl (n-propyl or iso-propyl), butyl (n-butyl, iso-butyl, sec-butyl, tert-butyl), pentyl, hexyl, heptyl, octyl, nonyl, decyl. Alkyl groups are optionally substituted.

The term "heteroalkyl" as used in the context of the present invention refers to a saturated straight or branched carbon chain. Preferably, the chain comprises from 1 to 9 carbon atoms, i.e. 1, 2, 3, 4, 5, 6, 7, 8, or 9, e.g. methyl, ethyl, propyl, iso-propyl, butyl, iso-butyl, sec-butyl, tert-butyl, pentyl, hexyl, heptyl, octyl, nonyl, which is interrupted one or more times, e.g. 1, 2, 3, 4, 5, with the same or different heteroatoms. Preferably, the heteroatoms are selected from O, S, and N, e.g. $-(CH_2)_n-X-(CH_2)_mCH_3$, with n = 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9, m = 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9 and X = S, O or NR' with R' = H or hydrocarbon (e.g. C_1 to C_6 alkyl). In particular "heteroalkyl" refers to $-O-CH_3$, $-OC_2H_5$, $-CH_2-O-CH_3$, $-CH_2-O-C_2H_5$, $-CH_2-O-C_3H_7$, $-CH_2-O-C_4H_9$, $-CH_2-O-C_5H_{11}$, $-C_2H_4-O-CH_3$, $-C_2H_4-O-C_2H_5$, $-C_2H_4-O-C_3H_7$, $-C_2H_4-O-C_4H_9$ etc. Heteroalkyl groups are optionally substituted.

The term "haloalkyl" refers to a saturated straight or branched carbon chain in which one or more hydrogen atoms are replaced by halogen atoms, e.g. by fluorine, chlorine, bromine or iodine. Preferably, the chain comprises from 1 to 10 carbon atoms, i.e. 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10. In particular, "haloalkyl" refers to $-CH_2F$, $-CHF_2$, $-CF_3$, $-C_2H_4F$, $-C_2H_3F_2$, $-C_2H_2F_3$, $-C_2HF_4$, $-C_2F_5$, $-C_3H_6F$, $-C_3H_5F_2$, $-C_3H_4F_3$, $-C_3H_3F_4$, $-C_3H_2F_5$, $-C_3HF_6$, $-C_3F_7$, $-CH_2Cl$, $-CHCl_2$, $-CCl_3$, $-C_2H_4Cl$, $-C_2H_3Cl_2$, $-C_2H_2Cl_3$, $-C_2HCl_4$, $-C_2Cl_5$, $-C_3H_6Cl$, $-C_3H_5Cl_2$, $-C_3H_4Cl_3$, $-C_3H_3Cl_4$, $-C_3H_2Cl_5$, $-C_3HCl_6$, and $-C_3Cl_7$. Haloalkyl groups are optionally substituted.

The term “5, 6, or 7 membered carbocycle” is used in the context of the present invention to refer to “cycloalkyl", “cycloalkenyl” or "aryl" with 5, 6, or 7 carbon atoms forming a ring.

The term “cycloalkyl” includes cyclopentyl, cyclohexyl, and cycloheptyl. Cycloalkyl groups are optionally substituted.

The term “cycloalkenyl” includes cyclopentenyl, cyclohexenyl, and cycloheptenyl. Cycloalkenyl groups are optionally substituted.

The term “aryl” refers to phenyl. Aryl is optionally substituted, e.g. naphthyl.

The term “5, 6, or 7 membered heterocycle” is used in the context of the present invention to refer to monocyclic "5, 6, or 7 membered heterocycloalkyl" or monocyclic “5, 6, or 7 membered heteroaryl” with 5, 6, or 7 atoms forming a ring.

The term “5, 6, or 7 membered heterocycloalkyl” refers to a saturated monocycle, wherein at least one of the carbon atoms are replaced by 1, or 2 (for the five membered ring) or 1, 2, or 3 (for the six membered ring) or 1, 2, 3, or 4 (for the seven membered ring) of the same or different heteroatoms,

preferably selected from O, N and S. Preferred examples of heterocycloalkyl include 1-(1,2,5,6-tetrahydropyridyl), 1-piperidinyl, 2-piperidinyl, 3-piperidinyl, 4-morpholinyl, 3-morpholinyl, tetrahydrofuran-2-yl, tetrahydrofuran-3-yl, tetrahydrothien-2-yl, tetrahydrothien-3-yl, 1-piperazinyl, or 2-piperazinyl. Heterocycloalkyl groups are optionally substituted.

The term "heteroaryl" as used in the context of the present invention refers to a 5, 6 or 7-membered aromatic monocyclic ring wherein at least one of the carbon atoms are replaced by 1, 2, or 3 (for the five membered ring) or 1, 2, 3, or 4 (for the six membered ring) of the same or different heteroatoms, preferably selected from O, N and S. Examples of preferred heteroaryls are furanyl, thienyl, oxazolyl, isoxazolyl, 1,2,5-oxadiazolyl, 1,2,3-oxadiazolyl, pyrrolyl, imidazolyl, pyrazolyl, 1,2,3-triazolyl, thiazolyl, isothiazolyl, 1,2,3,-thiadiazolyl, 1,2,5-thiadiazolyl, pyridinyl, pyrimidinyl, pyrazinyl, 1,2,3-triazinyl, 1,2,4-triazinyl, 1,3,5-triazinyl. Heteroaryls groups are optionally substituted.

If two or more radicals can be selected independently from each other, then the term "independently" means that the radicals may be the same or may be different.

The term "optionally substituted" in each instance if not further specified refers to halogen (in particular F, Cl, Br, or I), $-NO_2$, -CN, -OR'", -NR'R", -COOR'", -CONR'R", -NR'COR", -NR"COR'", -NR'CONR'R", $-NR'SO_2E$, -COR'"; $-SO_2NR'R"$, -OOCR'", -CR'"R""OH, -R'"OH, and -E;

R' and R" is each independently selected from the group consisting of hydrogen, alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, aralkyl, and heteroaryl or together form a heteroaryl, or heterocycloalkyl;

R'" and R"" is each independently selected from the group consisting of hydrogen, alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, alkoxy, aryl, aralkyl, heteroaryl, and -NR'R";

E is selected from the group consisting of alkyl, alkenyl, alkynyl, cycloalkyl, alkoxy, alkoxyalkyl, heterocycloalkyl, an alicyclic system, aryl and heteroaryl; optionally substituted.

"Pharmaceutically acceptable" means approved by a regulatory agency of the Federal or a state government or listed in the U.S. Pharmacopeia (United States Pharmacopeia-33/National Formulary-28 Reissue, published by the United States Pharmacopeia Convention, Inc., Rockville Md., publication date: April 2010) or other generally recognized pharmacopeia for use in animals, and more particularly in humans.

The term "pharmaceutically acceptable salt" refers to a salt of a compound of the present invention. Suitable pharmaceutically acceptable salts of the compound of the present invention include acid addition salts which may, for example, be formed by mixing a solution of a compound described herein or a derivative thereof with a solution of a pharmaceutically acceptable acid such as hydrochloric acid, sulfuric acid, fumaric acid, maleic acid, succinic acid, acetic acid, benzoic acid, citric acid, tartaric acid, carbonic acid or phosphoric acid. Furthermore, where the compound of the invention carries an acidic moiety, suitable pharmaceutically acceptable salts thereof may include alkali metal salts (e.g., sodium or potassium salts); alkaline earth metal salts (e.g., calcium or magnesium salts); and salts formed with suitable organic ligands (e.g., ammonium, quaternary ammonium and amine cations formed using counteranions such as halide, hydroxide, carboxylate, sulfate, phosphate, nitrate, alkyl sulfonate and aryl sulfonate). Illustrative

examples of pharmaceutically acceptable salts include but are not limited to: acetate, adipate, alginate, ascorbate, aspartate, benzenesulfonate, benzoate, bicarbonate, bisulfate, bitartrate, borate, bromide, butyrate, calcium edetate, camphorate, camphorsulfonate, camsylate, carbonate, chloride, citrate, clavulanate, cyclopentanepropionate, digluconate, dihydrochloride, dodecylsulfate, edetate, edisylate, estolate, esylate, ethanesulfonate, formate, fumarate, gluceptate, glucoheptonate, gluconate, glutamate, glycerophosphate, glycolylarsanilate, hemisulfate, heptanoate, hexanoate, hexylresorcinate, hydrabamine, hydrobromide, hydrochloride, hydroiodide, 2-hydroxyethanesulfonate, hydroxynaphthoate, iodide, isothionate, lactate, lactobionate, laurate, lauryl sulfate, malate, maleate, malonate, mandelate, mesylate, methanesulfonate, methylsulfate, mucate, 2-naphthalenesulfonate, napsylate, nicotinate, nitrate, N-methylglucamine ammonium salt, oleate, oxalate, pamoate (embonate), palmitate, pantothenate, pectinate, persulfate, 3-phenylpropionate, phosphate/diphosphate, picrate, pivalate, polygalacturonate, propionate, salicylate, stearate, sulfate, subacetate, succinate, tannate, tartrate, teoclate, tosylate, triethiodide, undecanoate, valerate, and the like (see, for example, Berge, S. M., et al, "Pharmaceutical Salts", Journal of Pharmaceutical Science, 1977, 66, 1-19). Certain specific compounds of the present invention contain both basic and acidic functionalities that allow the compounds to be converted into either base or acid addition salts.

The neutral forms of the compounds may be regenerated by contacting the salt with a base or acid and isolating the parent compound in the conventional manner. The parent form of the compound differs from the various salt forms in certain physical properties, such as solubility in polar solvents, but otherwise the salts are equivalent to the parent form of the compound for the purposes of the present invention.

In addition to salt forms, the present invention provides compounds which are in a prodrug form. Prodrugs of the compounds described herein are those compounds that readily undergo chemical changes under physiological conditions to provide a compound of formula (I) to (IV), and especially a compound shown in Fig. 14. A prodrug is an active or inactive compound that is modified chemically through *in vivo* physiological action, such as hydrolysis, metabolism and the like, into a compound of this invention following administration of the prodrug to a patient. Additionally, prodrugs can be converted to the compounds of the present invention by chemical or biochemical methods in an *ex vivo* environment. For example, prodrugs can be slowly converted to the compounds of the present invention when placed in a transdermal patch reservoir with a suitable enzyme. The suitability and techniques involved in making and using prodrugs are well known by those skilled in the art. For a general discussion of prodrugs involving esters, see Svensson L.A. and Tunek A. (1988) Drug Metabolism Reviews 19(2): 165-194 and Bundgaard H. “Design of Prodrugs”, Elsevier Science Ltd. (1985). Examples of a masked carboxylate anion include a variety of esters, such as alkyl (for example, methyl, ethyl), cycloalkyl (for example, cyclohexyl), aralkyl (for example, benzyl, p-methoxybenzyl), and alkylcarbonyloxyalkyl (for example, pivaloyloxymethyl). Amines have been masked as arylcarbonyloxymethyl substituted derivatives which are cleaved by esterases *in vivo* releasing the free drug and formaldehyde (Bundgaard H. et al. (1989) J. Med. Chem. 32(12): 2503-2507). Also, drugs containing an acidic NH group, such as imidazole, imide, indole and the like, have been masked with N-acyloxymethyl groups (Bundgaard H. “Design of Prodrugs”, Elsevier Science Ltd. (1985)).

Hydroxy groups have been masked as esters and ethers. EP 0 039 051 A2 discloses Mannich-base hydroxamic acid prodrugs, their preparation and use.

The compounds of the present invention may also contain unnatural proportions of atomic isotopes at one or more of the atoms that constitute such compounds. For example, the compounds may be radiolabeled with radioactive isotopes, such as for example tritium (^{3}H), iodine-125 (^{125}I) or carbon-14 (^{14}C). All isotopic variations of the compounds of the present invention, whether radioactive or not, are intended to be encompassed within the scope of the present invention.

As used herein, “para position” when referring to the substituent of an aryl means that the substituent occupies the position opposite to the position at which the aryl is linked to the backbone of the compound.

As used herein, a “patient” means any mammal or bird that may benefit from a treatment with the compounds described herein. Preferably, a “patient” is selected from the group consisting of laboratory animals, domestic animals, or primates including chimpanzees and human beings. It is particularly preferred that the “patient” is a human being.

As used herein, "treat", "treating" or “treatment” of a disease or disorder means accomplishing one or more of the following: (a) reducing the severity of the disorder; (b) limiting or preventing development of symptoms characteristic of the disorder(s) being treated; (c) inhibiting worsening of symptoms characteristic of the disorder(s) being treated; (d) limiting or preventing recurrence of the disorder(s) in patients that have previously had the disorder(s); and (e) limiting or preventing recurrence of symptoms in patients that were previously symptomatic for the disorder(s).

As used herein, “prevent”, “preventing”, “prevention”, or “prophylaxis” of a disease or disorder means preventing that a disorder occurs in a subject for a certain amount of time. For example, if a compound described herein is administered to a subject with the aim of preventing a disease or disorder, said disease or disorder is prevented from occurring at least on the day of administration and preferably also on one or more days (e.g. on 1 to 30 days; or on 2 to 28 days; or on 3 to 21 days; or on 4 to 14 days; or on 5 to 10 days) following the day of administration.

A “pharmaceutical composition” according to the invention may be present in the form of a composition, wherein the different active ingredients and diluents and/or carriers are admixed with each other, or may take the form of a combined preparation, where the active ingredients are present in partially or totally distinct form. An example for such a combination or combined preparation is a kit-of-parts.

An “effective amount” is an amount of a therapeutic agent sufficient to achieve the intended purpose. The effective amount of a given therapeutic agent will vary with factors such as the nature of the agent, the route of administration, the size and species of the animal to receive the therapeutic agent, and the purpose of the administration. The effective amount in each individual case may be determined empirically by a skilled artisan according to established methods in the art.

The term “carrier”, as used herein, refers to a diluent, adjuvant, excipient, or vehicle with which the therapeutic agent is administered. Such pharmaceutical carriers can be sterile liquids, such as saline solutions in water and oils, including those of petroleum, animal, vegetable or synthetic origin, such as

peanut oil, soybean oil, mineral oil, sesame oil and the like. A saline solution is a preferred carrier when the pharmaceutical composition is administered intravenously. Saline solutions and aqueous dextrose and glycerol solutions can also be employed as liquid carriers, particularly for injectable solutions. Suitable pharmaceutical excipients include starch, glucose, lactose, sucrose, gelatine, malt, rice flour, chalk, silica gel, sodium stearate, glycerol monostearate, talc, sodium chloride, dried skim milk, glycerol, propylene glycol, water, ethanol and the like. The composition, if desired, can also contain minor amounts of wetting or emulsifying agents, or pH buffering agents. These compositions can take the form of solutions, suspensions, emulsions, tablets, pills, capsules, powders, sustained-release formulations and the like. The composition can be formulated as a suppository, with traditional binders and carriers such as triglycerides. The compounds of the invention can be formulated as neutral or salt forms. Pharmaceutically acceptable salts include those formed with free amino groups such as those derived from hydrochloric, phosphoric, acetic, oxalic, tartaric acids, etc., and those formed with free carboxyl groups such as those derived from sodium, potassium, ammonium, calcium, ferric hydroxides, isopropylamine, triethylamine, 2-ethylamino ethanol, histidine, procaine, etc. Examples of suitable pharmaceutical carriers are described in "Remington's Pharmaceutical Sciences" by E. W. Martin. Such compositions will contain a therapeutically effective amount of the compound, preferably in purified form, together with a suitable amount of carrier so as to provide the form for proper administration to the patient. The formulation should suit the mode of administration.

Embodiments of the Invention

The present inventors have identified and characterized within ALC1 a pocket that appears to be involved in allosteric regulation of the ATPase activity of ALC1. Compounds that specifically bind to this pocket are capable of inhibiting the ATPase activity of ALC1. Compounds that bind to the ATPase site of ALC1 and block the ATPase activity have to compete with ATP for binding to the ATPase site. Since the cellular ATP concentration is in the range of 1 to 10 mM depending on the cellular compartment, very high binding affinities in the low nanomolar range are required to successfully prevent ATP from binding to the ATPase site of ALC1. Allosteric inhibitors of ALC1 do not have this limitation since they do not have to prevent ATP from binding but inhibit ALC1's ATPase activity through a different mechanism. by preventing. The present inventors have identified compounds that are capable of specifically binding to the allosteric pocket and determined the spatial and electronic requirements of compounds that fit into this pocket. Thus, by defining the "lock" the inventors were able to define the "keys", i.e. compounds, fitting into this lock, i.e. the allosteric binding pocket, and that are capable of forming non-covalent bonds or other stabilizing interactions to allow them to specifically bind in the pocket. Using this rational design approach the present inventors identified compounds that were capable of inhibiting ALC1's movement on chromatin and thus led to so-called PARP trapping. These compounds were also tested for their ability to kill two different tumor cell lines one of which was BRCA deficient.

Structure-based computer modeling of ligand-protein interactions is now a core component of modern drug discovery (Charifson and Kuntz, 1997). Computational methods have played a key role in the

drug discovery process for a growing number of marketed drugs, including HIV protease inhibitors (Charifson and Kuntz, 1997; Greer et al., 1994; Jorgensen, 2004) and zanamivir (an antiviral neuraminidase inhibitor) (von Itzstein et al., 1993), and in the development of new drug candidates, such as HIV integrase inhibitors (Hazuda et al., 2004; Schames et al., 2004), hepatitis C protease inhibitors (Liverton et al., 2008; Thomson and Perni, 2006), and beta-secretase inhibitors (BACE-1) (Stauffer et al., 2007). There are three major classes of physical computer methods available in the field (listed from fastest to slowest, and least physical to most physical): (1) very fast molecular docking methods, including DOCK, Glide, AutoDock, FlexX, ICN, PMF, and GOLD, Molecular dynamics based free energy methods (MD), such as MM/GBSA or MM/PBSA, in which solvent, protein, and ligand are subject to forces exerted by each other and thermal fluctuations and move in iterative steps as a response to these forces, and (4) absolute binding free energy (ABFE) methods, including alchemical simulations, which are the most expensive computationally, but which include the physics in the most rigorous way that is currently practical. ABFE methods start from an unbound ligand and potentially the unbound structure of the protein to attempt to predict the structures, affinities, and thermal properties of the complexes of interest. These strategies known in the art and in particular the approach described in the experimental section can be used to identify compounds that are allosteric inhibitors of ALC1 by binding to the allosteric binding pocket within ALC1 first identified by the present inventors.

Accordingly, in a **first** aspect the present invention provides an allosteric inhibitor of ALC1 wherein the inhibitor specifically binds to an allosteric binding pocket formed by an amino acid stretch of human ALC1 spanning amino acid residues 101 to 219 of SEQ ID NO: 1. The term “specifically binds” as used in this context indicates a K_D of the compound to full length human ALC1 with an amino acid sequence according to SEQ ID NO: 1 of 200 µM or lower, preferably of 100 µM, more preferably of 50 µM, more preferably of 10 µM or lower, more preferably of 5 µM or lower, even more preferably of 1 µM and even more preferably of 500 nM or lower. The skilled person is well aware of how to measure dissociation constants of small molecules with regard to proteins, which includes surface plasmon resonance. Preferably the K_D of a compound of the invention is measured by immobilizing full length human ALC1 on the surface of a chip and the compound is subsequently applied to the immobilized protein. Preferably such measurement is carried out at 37°C.

In a preferred embodiment of the present invention, the allosteric inhibitor of ALC1 exhibits an ID_{50} value in a FRET based nucleosome remodeling assay of 500 µM or less, preferably 250 µM or less, more preferably 100 µM or less, more preferably 50 µM or less, more preferably 10 µM or less, more preferably 5 µM or less, or even more preferably 1 µM or less.

Not every amino acid within the amino acid stretch spanning amino acid residues 101 to 219 of SEQ ID NO: 1 is forming the surface of the allosteric pocket of ALC1 available for binding to the compounds of the invention. This is due to the fact that some amino acids are buried in the pocket and are poorly accessible and others are not even part of the pocket but are located within or on the outside surface of ALC1. Thus, in a preferred embodiment the allosteric binding pocket to which the inhibitors of ALC1 of the present invention specifically bind comprises or consists of amino acids L101, Y153, C156, L157,

A160, L163, K164, V173, D174, E175, A176, H177, R178, L179, S183, L186, H187, T189, L190, F193, L200, L201, T202, N208, S209, E212, L213, L216, and F219 of SEQ ID NO: 1, more preferably the binding pocket comprises or consists of Y153, C156, L157, A160, L163, V173, E175. R178, L186, H187, L190 F 193, L200, and E212 of SEQ ID NO: 1. To date, there is no 3D structure of ALC1 available, however the structures of several homologous remodellers have been deposited at the Protein Data Bank (PDB). Thus, the skilled person can model the allosteric binding pocket of ALC1 based on the homology to other chromatin remodelling enzymes. Such models are also depicted in Fig. 13 to Fig. 19 with and without compounds of the invention in the pocket. In particular the volume model of an exemplary compound of the invention shown in Fig. 16 A and B depicts how the skilled person can visualize the suitability of a given compound to fit into the allosteric binding pocket. Fig. 18 only depicts the amino acids available in the pocket for interaction with the compound of the invention and provides further guidance on the selection of compounds that fulfill the steric, hydrophobicity, and hydrophilicity as well as charge requirements in the pocket. A minimal set of structural coordinates of the amino acids of ALC1 involved in binding to the compounds of the invention is provided in Fig. 20.

Based on their orientation within the pocket the different amino acids that are accessible at the surface of the pocket can form different non-covalent bond, in particular hydrogen bonds, ionic interactions, van der Waals interactions and hydrophobic interactions. Accordingly, in a preferred embodiment the inhibitor forms non-covalent bond(s) with one or more amino acids of the allosteric binding pocket, preferably with one or more of the backbone of amino acids L157, A160, K164, V173, D174, H177, R178, L179, L186, N208, and/or E212 of ALC1 and/or the sidechains of L101, Y153, C156, L157, A160, L163, E175, R178, L179, L186, H187, L190, F193, T202, N208, E212, or L213 of ALC1, more preferably with the backbone of D174. H177, and R178 of ALC1, and the sidechain of Y153, E175. R178, H187, T202, N208 and/or E212 of ALC1.

In a preferred embodiment the inhibitor of ALC1 non-covalently binds to:

(i) the aromatic ring of the sidechain of amino acid Y153 of ALC1 ring face-to-face or edge-to-face pi-pi interaction with aromatic carbo- or heterocyclic substituents or forming cation-pi, polar-pi, or halogen-pi interactions with polar, charged, or carbo-halogen substituents;

(ii) the terminal oxygen of the sidechain of amino acid Y153 of ALC1 with a hydrogen bond donating group;

(iii) the carbonyl oxygen of the backbone of H177 with carbo halogens or hydrogen bond donating groups;

(iv) the carbonyl oxygen of the backbone of D174 with carbo halogens or hydrogen bond donating groups;

(v) the sidechain of E175 with a hydrogen bond donating or accepting group;

(vi) the sidechain of R178 with a hydrogen bond donating or accepting group;

(vii) the backbone carbonyl oxygen of R178 with carbo halogens or hydrogen bond donating groups;

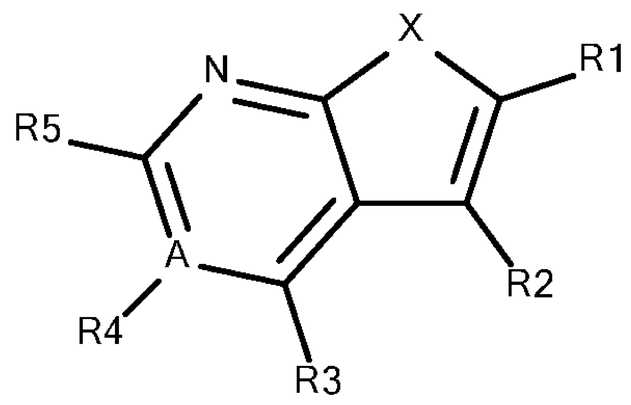
(viii) the sidechain of H187 ring face-to-face or edge-to-face pi-pi interaction with aromatic carbo- or heterocyclic substituents or forming cation-pi, polar-pi, or halogen-pi interactions with polar, charged, or carbo-halogen substituents or with a hydrogen bond donating or accepting group

(ix) the sidechain of T202 with a hydrogen bond donating or accepting group;

(x) the sidechain of N208 with a hydrogen bond donating or accepting group; and

(xi) the sidechain of E212 with a hydrogen bond donating or accepting group.

In a preferred embodiment of the first aspect of the invention the allosteric inhibitor has the structure of formula (I):



wherein

(i) R_5 comprises an aromatic ring that pi-stacks with the aromatic ring of amino acid Y153; and/or

(ii) N is a hydrogen bond accepting group for the terminal OH of amino acid Y153; and/or

(iii) R_1 comprises a group that is a hydrogen bond donating group to the backbone carbonyl oxygen of amino acid H177 of ALC1; and/or

(iv) R_3 comprises a carbohalogen or hydrogen bond donating group that binds to the carbonyl oxygen of the backbone of amino acid D174 of ALC1; and/or

(v) R_1 and R_2 together form an aromatic or heteroaromatic monocyle comprising a hydrogen bond donating or accepting group especially at or adjacent to the R_1 position which can act as a hydrogen bond donating or accepting group to the side chain of amino acid E175 of ALC1 and/or amino acid R178 of ALC1; and/or

(vi) R_1 and R_2 together form a substituted carbo- or heteromonocycle comprising a hydrogen bond donating or accepting group, preferably at or adjacent to the R_1 position which is a hydrogen bond donating or accepting group to the side chain of amino acid R178 of ALC1; and/or

(vii) R_3 comprises an aromatic ring that pi-stacks with the aromatic ring amino acid H187 of ALC1 or is an electron poor substituent, especially at, forming polar-pi or cation-pi interactions with the aromatic ring of amino acid H187 of ALC1;

(viii) R_1 and R_2 together form an aromatic or heteroaromatic monocycle comprising a hydrogen bond donating or accepting group especially at or adjacent to the R_2 position which can act as a hydrogen bond donating or accepting group to the side chain of amino acid T202 and/or amino acid N208 of ALC1;

(ix) R_4 is H or -C_{1-3}-alkyl, preferably H; and/or

(x) R_5 is -$(CH_2)_m$-L, or -$(CH_2)_m$-(CH=CH)-L, wherein m is 0, 1 or 2, preferably 0 or 1, and L is a 5, 6 or 7 membered carbo- or heterocycle, or adamantyl, optionally substituted, preferably with 1, 2, 3 or 4

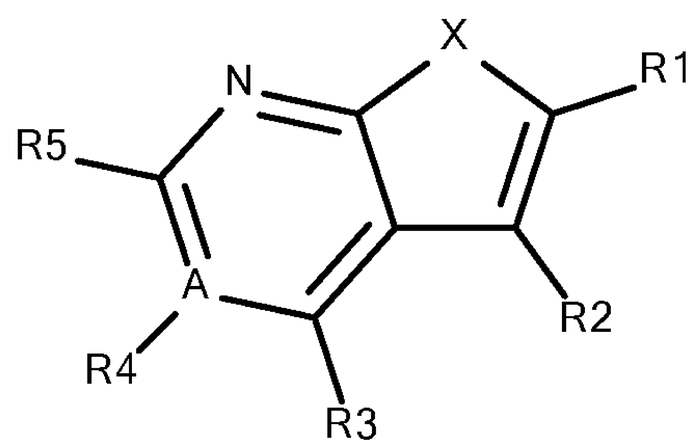
substituents independently selected from the group consisting of -OH, -NO_2, -CN, -CO-OR_6, -Br, -Cl, -F, -I, -R_9, -O-R_9, and =O, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle; and/or

(xi) R_4 and R_5 together form a 5, 6, or 7 membered carbocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-R_9, -R_9, =CH-R_A, preferably R_4 and R_5 together form a C_{5-7}-cycloalkyl; and/or

(xii) X is S or N;

(xiii) A is N or C.

In a further aspect or in a preferred embodiment of the first aspect of the invention, the invention is directed to the allosteric inhibitor having the structure of formula (I):



(I)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof, wherein:

X is N or S;

A is C or N;

R_1 is –CO-OR_6, -CO-R_7, or -CO-NR_6R_A, preferably R_1 is –CO-OR_6;

R_2 is -R_7, -NHR_8, -O-R_7, -C-O-R_7, Br, -C_{3-8}-cycloalkyl (preferably cyclopropyl), or –C_{4-8}-cycloalkenyl (preferably cyclohexenyl);

or

R_1 and R_2 together form a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, =O, [-O-CH_2-CH_2]-NH-CH(OH)-O-tBu, ;

R_3 is H, =O, -OH, -O-R_7, -R_7, or –$(CH_2)_m$-L, wherein m is 0, 1 or 2, and L is a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, -hydroxyC_{1-3}-alkyl and =O;

R_4 is H or -C_{1-3}-alkyl, preferably H;

R_5 is -$(CH_2)_m$-L, or -$(CH_2)_m$-(CH=CH)-L, wherein m is 0, 1 or 2, preferably 0 or 1, and L is a 5, 6 or 7 membered carbo- or heterocycle, adamantyl, C_{1-4}-alkyl, or -$N(CH_3)_2$, optionally substituted, preferably with 1, 2, 3 or 4 substituents independently selected from the group consisting

of -OH, -NO_2, -CN, -CO-OR_6, -Br, -Cl, -F, -I, -R_9, -O-R_9, =O, and [-O-CH_2-CH_2]$_q$-NH-biotin with q being 1, 2, 3, or 4, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle;

or

R_4 and R_5 together form a 5, 6, or 7 membered carbocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-R_9, -R_9, =CH-R_A, and –CH_2-R_A, preferably R_4 and R_5 together form a C_{5-7}-cycloalkyl;

R_6 is H, -C_{1-6}-alkyl, -C_{2-6}-alkenyl, -C_{2-6}-alkynyl, optionally substituted, preferably R_6 is H;

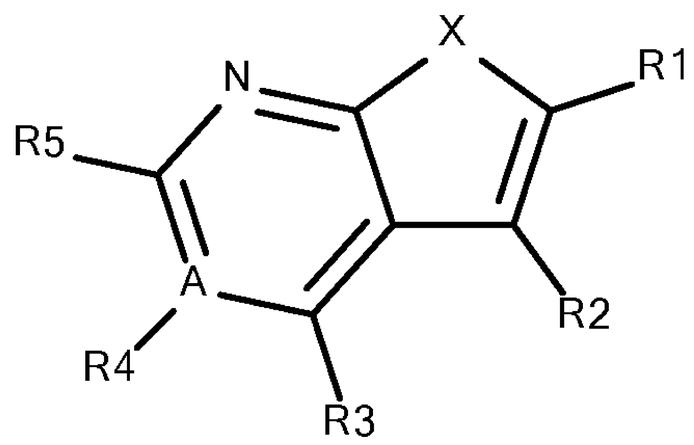
R_7 is -C_{1-3}-alkyl, -C_{2-3}-alkenyl, -C_{2-3}-alkynyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -Br, -Cl, -F, -I, -CH_3, -OCH_3, or -SCH_3;

R_8 is H or C_{1-6}-alkyl, preferably H,

R_9 is -C_{1-6}-alkyl, -C_{2-6}-alkenyl, -C_{2-6}-alkynyl, -C_{1-6}-alkyl-aryl, or C_{1-6}-alkyl-heteroaryl (preferably isooxazole, thiazole, tetrazole, 1,2,4-thiadiazole, 1,2,3-thiadiazole, 1,2,5-thiadiazole, pyridine, 1,2,4-oxadiazole, pyrazine, or pyrazole), optionally substituted with 1, 2 or 3 substituents selected from the group consisting of -Br, -Cl, -F, -I, -NO_2, -CN, -$CONH_2$, -CONH-C_{1-3}-alkyl (preferably –CONH-CH_3), -NH-CO-C_{1-3}-alkyl (preferably -NH-CO-CH_3), -C_{1-6}-alkyl (preferably -CH_3, ethyl, propyl, t-butyl, or pentyl), -C_{1-3}-haloalkyl (preferably-CF_3, or -CHF_2), -O-CHF_2, -O-CF_3, carbocycle (preferably cyclopropyl, cyclohexyl or phenyl), -O-carbocycle (preferably phenoxy), heterocycle (preferably pyrazolyl), -CO-heterocycle (preferably –CO-(1-pyrrolidinyl)),-SO_2-CH_3, -SO_2-N(CH_3)$_2$, -O-C_{1-4}-alkyl (preferably -OCH_3), -O-C_{1-3}-alkyl-O-C_{1-3}-alkyl (preferably –O-CH_2-O-CH_3), -SCH_3, or when R_9 is -C_{1-6}-alkyl-aryl, then two adjacent substituents on the aryl moiety can form a 5, 6 or 7 membered carbo- or heterocycle, which is optionally substituted;

R_A is H, carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -R_9, -O-R_7, -O-(CH_2)$_o$-R_9, -SO_2NH_2, and =O, wherein o is 0 or 1.

In yet another aspect or in a more preferred embodiment of the first aspect of the invention, the invention is directed to an allosteric inhibitor having the structure of formula (I):



(I)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof, wherein:

X is N or S;

A is C or N;

R_1 is –CO-OR_6, -CO-R_7, or -CO-NR_6R_A, preferably R_1 is –CO-OR_6;

R_2 is $-R_7$, $-NHR_8$, $-O-R_7$, $-C-O-R_7$;

or

R_1 and R_2 together form a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, $-NO_2$, -CN, -Br, -Cl, -F, -I, $-O-C_{1-3}$-alkyl, and =O;

R_3 is H, =O, -OH, $-O-R_7$, $-R_7$, or $-(CH_2)_m$-L, wherein m is 0, 1 or 2, and L is a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, $-NO_2$, -CN, -Br, -Cl, -F, -I, $-O-C_{1-3}$-alkyl, -hydroxyC_{1-3}-alkyl and =O;

R_4 is H or $-C_{1-3}$-alkyl, preferably H;

R_5 is $-(CH_2)_m$-L, or $-(CH_2)_m$-(CH=CH)-L, wherein m is 0, 1 or 2, preferably 0 or 1, and L is a 5, 6 or 7 membered carbo- or heterocycle, or adamantyl, optionally substituted, preferably with 1, 2, 3 or 4 substituents independently selected from the group consisting of -OH, $-NO_2$, -CN, $-CO-OR_6$, -Br, -Cl, -F, -I, $-R_9$, $-O-R_9$, and =O, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle;

or

R_4 and R_5 together form a 5, 6, or 7 membered carbocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, $-NO_2$, -CN, -Br, -Cl, -F, -I, $-O-R_9$, $-R_9$, $=CH-R_A$, preferably R_4 and R_5 together form a C_{5-7}-cycloalkyl;

R_6 is H, $-C_{1-6}$-alkyl, i.e. C_1-, C_2-, C_3-, C_4-, C_5- or C_6-alkyl, $-C_{2-6}$-alkenyl, i.e. C_2-, C_3-, C_4-, C_5- or C_6-alkenyl, --C_{2-6}-alkynyl, i.e. C_2-, C_3-, C_4-, C_5- or C_6-alkynyl, optionally substituted, preferably R_6 is H;

R_7 is $-C_{1-3}$-alkyl, i.e. C_1-, C_2-, C_3-alkyl, $-C_{2-3}$-alkenyl, i.e. C_2-, C_3-alkenyl, $-C_{2-3}$-alkynyl, i.e. C_2-, C_3-alkynyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -Br, -Cl, -F, -I, $-CH_3$, $-OCH_3$, or $-SCH_3$;

R_8 is H or C_{1-6}-alkyl, preferably H,

R_9 is $-C_{1-6}$-alkyl, i.e. C_1-, C_2-, C_3-, C_4-, C_5- or C_6-alkyl, $-C_{2-6}$-alkenyl, i.e. C_2-, C_3-, C_4-, C_5- or C_6-alkenyl, --C_{2-6}-alkynyl, i.e. C_2-, C_3-, C_4-, C_5- or C_6-alkynyl, or $-C_{1-6}$-alkyl-aryl, i.e. C_1-, C_2-, C_3-, C_4-, C_5- or C_6-alkyl-aryl, optionally substituted with 1, 2 or 3 substituents selected from the group consisting of -Br, -Cl, -F, -I, $-CH_3$, $-OCH_3$, or $-SCH_3$

R_A is H, carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, $-NO_2$, -CN, -Br, -Cl, -F, -I, $-R_9$, $-O-R_7$, $-O-(CH_2)_o-R_9$, $-SO_2NH_2$, and =O, wherein o is 0 or 1.

In a preferred embodiment of the first aspect or the further aspect of the invention X is N.

In a preferred embodiment of the first aspect or the further aspect of the invention A is C.

In a preferred embodiment of the first aspect of the invention R_1 is $-CO-OR_6$, or $-CO-NR_6R_A$ preferably R_6 is H, $-C_{1-3}$-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, $-C_{2-3}$-alkenyl, i.e. C_2-, C_3-, -alkenyl, $-C_{2-3}$-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H;

In a preferred embodiment of the first aspect or the further aspect of the invention R_1 is –CO-OH.

In a preferred embodiment of the first aspect or the further aspect of the invention X is N and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H.

In a preferred embodiment of the first aspect or the further aspect of the invention A is C and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C and R_1 is –CO-OH or -CO-NH_2.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OH and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C and R_1 is –CO-OH or -CO-NH_2 and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, and R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, and R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C and R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 and R_2 together form an uracil or 3-deazauracil.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 and R_2 together form an uracil or 3-deazauracil.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, and R_1 and R_2 together form an uracil or 3-deazauracil.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C and R_1 and R_2 together form an uracil or 3-deazauracil.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OH and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OH or -CO-NH_2 and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OH and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OH or -CO-NH_2 and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted,

preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OH and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OH or -CO-NH_2 R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted,

preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OH, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OH or -CO-NH_2 and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is -C_{1-3}-alkyl, i.e.

C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1, R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or

–$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, and R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect of the invention R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OH and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -

C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OH or -CO-NH_2 and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OH, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -

alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 is –CO-OH or -CO-NH_2 and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is C, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is C and R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N and R_1 is –CO-OH or -CO-NH_2.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N and R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N and R_1 is –CO-OH or -CO-NH_2 and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, and R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N and R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, and R_1 and R_2 together form an uracil or 3-deazauracil.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N and R_1 and R_2 together form an uracil or 3-deazauracil.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3

is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OH or -CO-NH_2 and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OH or -CO-NH_2 and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents

independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, -R_7, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5, 6 or 7 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents

independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OH or -CO-NH_2 R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_1 is –CO-OH, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OH or -CO-NH_2 and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or –$(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl and R_3 is -C_{1-3}-alkyl, i.e. C_1-

, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-alkyl, or $-(CH_2)_m$-L, wherein m is 0 and L is phenyl or a 5 membered heteroaryl, preferably phenyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and -hydroxyC_{1-3}-alkyl.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OH or -CO-NH_2 and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OR_6, or -CO-NR_6R_A preferably R_6 is H, -C_{1-3}-alkyl, i.e. C_1-, C_2-, C_3-, -alkyl, -C_{2-3}-alkenyl, i.e. C_2-, C_3-, -alkenyl, -C_{2-3}-alkynyl, i.e. C_2-, C_3-optionally substituted, preferably R_6 is H and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 is –CO-OH or -CO-NH_2 and R_2 is -NHR_8, wherein R_8 is H or C_{1-6}-alkyl, preferably H and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting

of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N, R_1 and R_2 together form a 6 membered aryl or heteroaryl moiety, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, and =O, preferably -OH and =O and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention A is N, R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention X is N, A is N and R_1 and R_2 together form an uracil or 3-deazauracil and R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_5 is -$(CH_2)_m$-L, , wherein m is 0, or 1 or -(CH_2)-(CH=CH)-L and L is phenyl or a 5, or 6 membered heteroaryl, or adamantyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -CO-OR_6, -Br, -Cl, -F, -I, -R_9, -O-R_9, and =O, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_4 and R_5 together form a 5 or 6 membered non-substituted or mono substituted heterocycloalkyl, preferably with =CH-R_A substituted at the R_4 position.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention $R_A$is a substituted carbocycle with 1 or 2 substituents independently selected from the group consisting of -Br, -Cl, -F, -O-$(CH_2)_o$-R_9, or -SCH_3, wherein o is 0 or 1.

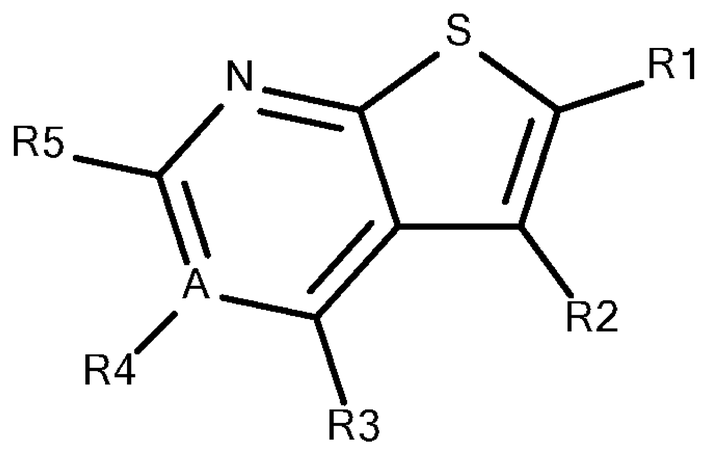
In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_4 and R_5 together form a 5 or 6 membered non-substituted or mono substituted heterocycloalkyl, preferably with =CH-R_A substituted at the R_4 position, wherein $R_A$is a substituted carbocycle with 1 or 2 substituents independently selected from the group consisting of -Br, -Cl, -F, -O-$(CH_2)_o$-R_9, or -SCH_3, wherein o is 0 or 1.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_9 is -C_{1-4}-alkyl, i.e. C_1-, C_2-, C_3-, or C_4-alkyl, -C_{2-4}-alkenyl, i.e. C_2-, C_3-, or C_4-alkenyl, or -C_{1-6}-alkyl-aryl, i.e. C_1-, C_2-, C_3-, C_4-, C_5- or C_6-alkyl-aryl, optionally substituted with 1 or 2 substituents selected from the group consisting of -Cl, -CH_3, -OCH_3, or -SCH_3.

In a preferred embodiment of the first aspect or the further aspect or the yet another aspect of the invention R_5 is -$(CH_2)_m$-L, , wherein m is 0, or 1 or -(CH_2)-(CH=CH)-L and L is phenyl or a 5, or 6 membered heteroaryl, or adamantyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -CO-OR_6, -Br, -Cl, -F, -I, -R_9, -O-R_9, and =O, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle, wherein R_9 is -

C_{1-4}-alkyl, i.e. C_1-, C_2-, C_3-, or C_4-alkyl, -C_{2-4}-alkenyl, i.e. C_2-, C_3-, or C_4-alkenyl, or -C_{1-6}-alkyl-aryl, i.e. C_1-, C_2-, C_3-, C_4-, C_5- or C_6-alkyl-aryl, optionally substituted with 1 or 2 substituents selected from the group consisting of -Cl, -CH_3, -OCH_3, or -SCH_3.

In a particularly preferred embodiment of the first aspect of the invention the allosteric inhibitor has the structure of formula (Ia):



(Ia)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof, wherein:

A is C or N;

R_1 is –COOH

R_2 is -CH_3 or -NH_2

or

R_1 and R_2 together form a uracil or 3-deazauracil;

R_3 is H, =O, -OH, thiophenyl, phenyl, 3,4,5 hydroxymethyl phenyl, CF_2H, or CF_3;

R_4 is H

R_5 is -L, or -CH_2-(CH=CH)-L, wherein L is a 6 membered carbo- or heterocycle, or adamantyl, optionally substituted with 1 or 2 substituents independently selected from the group consisting of -OH, -NO_2, -Br, -Cl, -F, CH_3, -O-R_9, and =O, or two adjacent substituents form a 5 or 6 membered heterocycle;

or

R_4 and R_5 together form a 5 or 6 membered non-substituted or mono substituted heterocycloalkyl, preferably with =CH-R_A substituted at the R_4 position;

R_9 is -C_{1-4}-alkyl, i.e. C_1-, C_2-, C_3-, or C_4-alkyl, -C_{2-4}-alkenyl, i.e. C_2-, C_3-, or C_4-alkenyl, or -C_{1-6}-alkyl-aryl, i.e. C_1-, C_2-, C_3-, C_4-, C_5- or C_6-alkyl-aryl, optionally substituted with 1 or 2 substituents selected from the group consisting of -Cl, -CH_3, -OCH_3, or -SCH_3;

R_A is a substituted carbocycle with 1 or 2 substituents independently selected from the group consisting of -Br, -Cl, -F, -O-$(CH_2)_o$-R_9, or -SCH_3, wherein o is 0 or 1.

In a particularly preferred embodiment the compounds of the first and further aspect of the invention have the specific structures as indicated in Fig. 10.

The use of bifunctional compounds recruiting proteins involved in targeting proteins for degradation by the proteasome has emerged as a potential therapeutic strategy to degrade proteins that are involved in disease processes. This approach has met particular attention in cancer therapy (Khan S. *et al.*, 2020 and

Bushweller JH, 2019). Such bifunctional compounds are generally referred to as PROteolysis TArgeting Chimeras (PROTACs). The allosteric inhibitors of ALC1 of the first and further aspect of the invention specifically bind to ALC1 and are, thus suitable to recruit a protein that is part of the ubiquitination pathway to ALC1.

Accordingly, in a **second** aspect the present invention relates to a bifunctional compound comprising the allosteric inhibitor of ALC1 the first or further aspect of the present invention and a compound which recruits a protein that is part of the ubiquitination pathway to ALC1, preferably E3 ubiquitin ligase to ALC1(E3 recruiter), wherein the allosteric inhibitor of ALC1 and the E3 recruiter are covalently linked, optionally through a linker. In the context of the bifunctional compounds of the present invention that ability of the allosteric inhibitors of ALC1 of the first and further aspect of the invention to specifically bind to ALC1 is of particular importance. It is, thus preferred that the allosteric inhibitors of ACL1 bind to full length human ALC1 with an amino acid sequence according to SEQ ID NO: 1 with a KD of 50 µM, more preferably of 10 µM or lower, more preferably of 5 µM or lower, even more preferably of 1 µM, more preferably of 500 nM, more preferably of 200 nM and even more preferably of 100 nM or lower.

The protein of the ubiquitination pathway may either be bound by a small molecule or a protein ligand, e.g. an antibody or antibody-like protein, that specifically binds to a protein of the ubiquitination pathway. Such protein ligands have been described, for example in US 7,223,556 B1. Small molecules compounds that bind to a protein that is part of the ubiquitination pathway are well known in the art and can be used in the bifunctional compounds of the present invention. Examples of such molecules are described in EP 3 131 588, WO 2017/024317, US 6,306,663, US 7,041,298, US 2016/0176916, US 2016/0235730, US 2016/0235731, US 2016/0243247, WO 2016/105518, WO 2016/077380, WO 2016/105518, WO 2016/077375, WO 2017/007612, and WO 2017/024317.

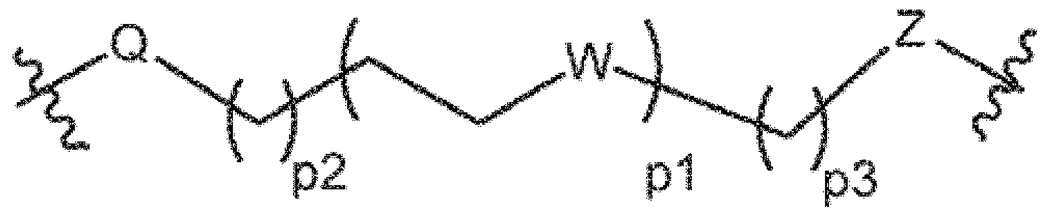
The allosteric inhibitors of ALC1 is covalently linked to the compound which recruits a protein that is part of the ubiquitination pathway to ALC1. Preferably, the two components are covalently linked to each other through a linker. Suitable linkers have varying length and functionality. Preferably the linker is a carbon chain. In preferred embodiments, the carbon chain optionally comprises one, two, three, or more heteroatoms selected from N, O, and S. In preferred embodiments, the carbon chain comprises only saturated chain carbon atoms. In preferred embodiments, the carbon chain optionally comprises two or more unsaturated chain carbon atoms (e.g., C=C or C≡EC). In certain embodiments, one or more chain carbon atoms in the carbon chain are optionally substituted with one or more substituents, preferably oxo, C_1-C_6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_1-C_3 alkoxy, OH, halogen, NH_2, -NH(C_1-C_3 alkyl), -N(C_1-C_3 alkyl)$_2$, CN, C_3-C_7 cycloalkyl, heterocyclyl, phenyl, and heteroaryl).

In certain embodiments, the linker comprises at least 5 chain atoms (e.g., C, O, N, and S). In certain embodiments, the Linker comprises less than 20 chain atoms (e.g., C, O, N, and S). In certain embodiments, the Linker comprises 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, or 19 chain atoms (e.g., C, O, N, and S). In certain embodiments, the Linker comprises 5, 7, 9, 11, 13, 15, 17, or 19 chain atoms (e.g., C, O, N, and S). In certain embodiments, the Linker comprises 5, 7, 9, or 11 chain atoms (e.g., C, O, N, and S). In

certain embodiments, the Linker comprises 6, 8, 10, 12, 14, 16, or 18 chain atoms (e.g., C, O, N, and S). In certain embodiments, the Linker comprises 6, 8, 10, or 12 chain atoms (e.g., C, O, N, and S).

In certain embodiments, the Linker is a carbon chain optionally substituted with non-bulky substituents, preferably oxo, C_1-C_6 alkyl, C_2-C_6 alkenyl, C_2-C_6 alkynyl, C_1-C_3 alkoxy, OH, halogen, NH_2, -$NH(C_1$-C_3 alkyl), -$N(C_1$-C_3 alkyl)$_2$, CN, C_3-C_7 cycloalkyl, and CN).

In certain embodiments, the Linker is of Formula L(VI):



(VI)

or an enantiomer, diastereomer, or stereoisomer thereof, wherein

p1 is an integer selected from 0 to 12;

p2 is an integer selected from 0 to 12;

p3 is an integer selected from 1 to 6;

each W is independently absent, CH_2, O, S, NH or NR_5;

Z is absent, CH_2, O, NH or NR_5;

each R_5 is independently H or C_1-C_3 alkyl, preferably C_1-C_3 alkyl; and

Q is absent or -$CH_2C(0)NH$-,

wherein the linker is covalently bonded to the compound that compound which recruits a protein that is part of the ubiquitination pathway with the bond that is next to Q and to the allosteric inhibitor of ALC1 with the bond that is next to Z, and wherein the total number of chain atoms in the linker is less than 20.

In a **third** aspect the present inventions relates to a pharmaceutical composition comprising the allosteric inhibitor of ALC1 and a pharmaceutically acceptable excipient.

In a **fourth** aspect the present inventions relates to an ALC1 inhibitor (ALC1i) preferably those of the first aspect of the invention, for use in treating or ameliorating a proliferative disease in a patient, which comprises the administration of said ALC1i and optionally the administration of a Poly(ADP-ribose)-Polymerase inhibitor (PARPi). The present inventors have discovered that the PARP trapping activity of known PARPi's can be enhanced by ALC1i. Due to this surprising synergy the combined use of PARPi's and ALC1i's in the treatment of various proliferative diseases is particularly advantageous. This synergy is not limited to the allosteric inhibitors of the present invention, but will also be observed with inhibitors that inhibit ALCi by, e.g. binding to the ATPase site or by decreasing its expression, e.g. siRNAs directed at ALC1.

The ALC1 may be provided to the physician administering the antiproliferative therapy separately from the PARPi or in a kit of parts. Thus, in the embodiments in which both are to be combined to obtain the benefit of the synergy the ALC1 may be provided with instructions to combine it with a PARPi of alternatively in a fourth aspect the PARPi may be provided with instructions to combine it with a ALC1.

Accordingly, in a **fifth** aspect the present invention relates to a PARPi for use in treating or

ameliorating a proliferative disease in a patient, wherein the method comprises the administration of said PARPi and the administration of ALC1i.

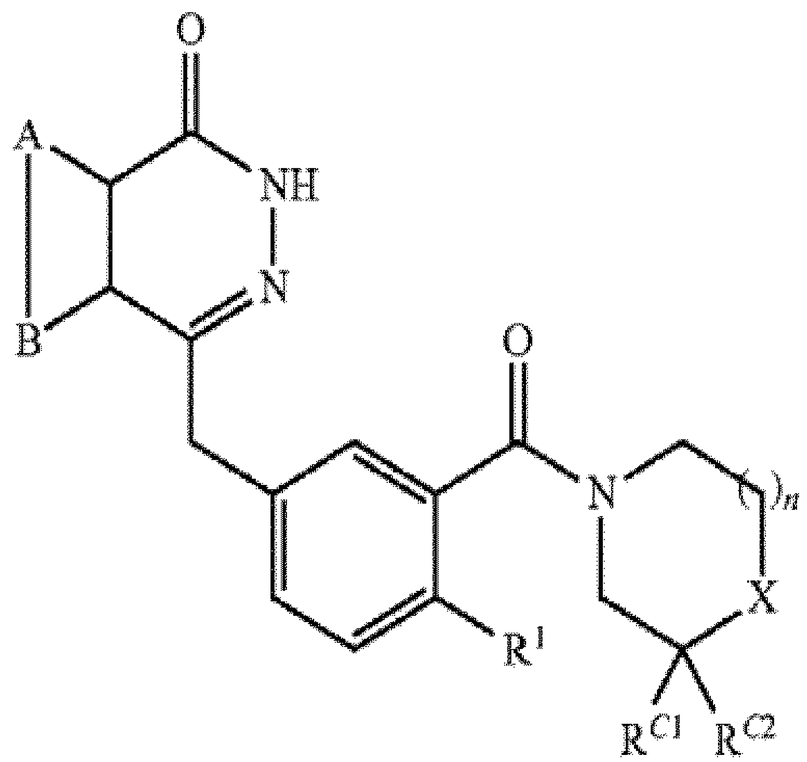
In a preferred embodiment of the ALC1i for use of the fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention the PARPi lowers PARP activity and/or inhibits PARP1, PARP2 and/or PARP3, preferably PARP2 on chromatin. The latter phenomenon is also referred to as PARP trapping. Thus, in a preferred embodiment PARP1, PARP2 and/or PARP3, preferably PARP2 is trapped.

In a preferred embodiment the ALC1i for use of the fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention, the PARPi

(i) that lowers PARP activity is selected from small interfering RNA, and

(ii) that inhibits PARP1 is selected from the group consisting of a compound of

(a) formula (II)



(II)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

A and B together represent an optionally substituted, fused aromatic ring;

X is NR^X or CR^XR^Y;

if $X=NR^X$ then n is 1 or 2 and if $X=CR^XR^Y$ then n is 1;

R^X is selected from the group consisting of H, optionally substituted C_{1-20} alkyl, C_{5-20} aryl, C_{3-20} heterocyclyl, amido, thioamido, ester, acyl, and sulfonyl groups;

R^Y is selected from H, hydroxy, amino;

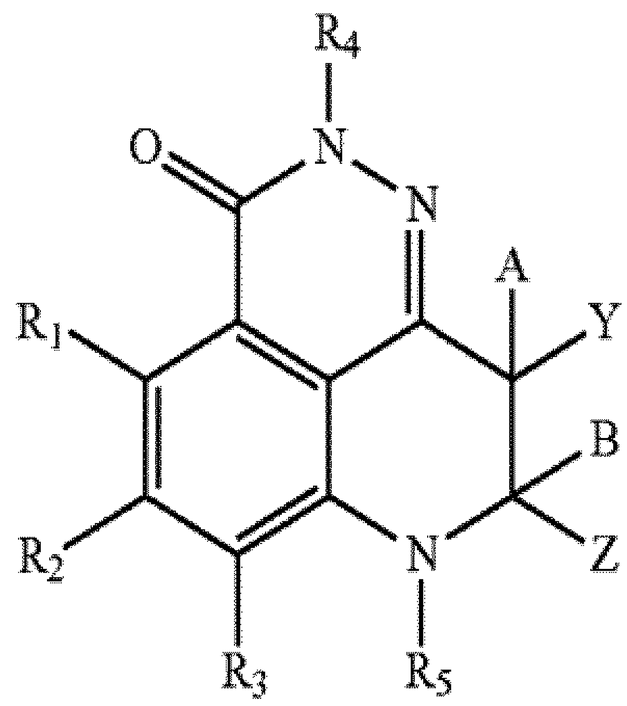
or R^X and R^Y may together form a spiro-C_{3-7} cycloalkyl or heterocyclyl group;

R^{C1} and R^{C2} are independently selected from the group consisting of hydrogen and C_{1-4} alkyl or when X is CR^XR^Y, R^{C1}, R^{C2}, R^X and R^Y, together with the carbon atoms to which they are attached, may form an optionally substituted fused aromatic ring; and

R^1 is selected from H and halo;

and

(b) formula (III)



(III)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

Y and Z are each independently selected from the group consisting of:

1. an aryl group optionally substituted with 1, 2, or 3 R_6 ;
2. a heteroaryl group optionally substituted with 1, 2, or 3 R_6;
3. a substituent independently selected from the group consisting of hydrogen, alkenyl (e.g. C_{2-6}-alkenyl), alkoxy (e.g. C_{1-6}-alkoxy), alkoxyalkyl (e.g. C_{1-6}-alkoxy-C_{1-6}-alkyl), alkoxycarbonyl (e.g. C_{1-6}-alkoxy-carbonyl), alkoxycarbonylalkyl (e.g. C_{1-6}-alkoxy-carbonyl-C_{1-6}-alkyl), alkyl (e.g. C_{1-6}-alkyl), alkynyl (e.g. C_{2-6}-alkynyl), arylalkyl (e.g. aryl-C_{1-6}-alkyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), cycloalkylalkyl (e.g. C_{3-8}-cycloalkyl-C_{1-6}-alkyl), haloalkyl (e.g. C_{1-6}-haloalkyl), hydroxyalkylene (e.g. hydroxy-C_{1-6}-alkylene), oxo, heterocycloalkyl (e.g. C_{2-8}-hetero cycloalkyl), heterocycloalkylalkyl (e.g. C_{2-8}-heterocycloalkyl-C_{1-6}-alkyl), alkylcarbonyl (e.g. C_{1-6}-alkyl-carbonyl), arylcarbonyl, heteroarylcarbonyl, alkylsulfonyl (e.g. C_{1-6}-alkyl-sulfonyl), arylsulfonyl, heteroarylsulfonyl, (R_AR_B)alkylene (e.g. (R_AR_B)-C_{1-6}-alkylene), (NR_AR_B)carbonyl, (NR_AR_B)carbonylalkylene (e.g. NR_AR_B)carbonyl-C_{1-6}-alkylene), (NR_AR_B)sulfonyl, and (R_AR_B)sulfonylalkylene (e.g. (R_AR_B)sulfonyl-C_{1-6}-alkylene);

wherein each R_6 is selected from OH, NO_2, CN, Br, Cl, F, I, C_{1-6}-alkyl, C_{3-8}-cycloalkyl, C_{2-8} -heterocycloalkyl; C_{2-6}-alkenyl, alkoxy (e.g. C_{1-6}-alkoxy), alkoxyalkyl (e.g. C_{1-6}-alkoxy-C_{1-6}-alkyl), alkoxycarbonyl (e.g. C_{1-6}-alkoxy-carbonyl), alkoxycarbonylalkyl (e.g. C_{1-6}-alkoxy-carbonyl-C_{1-6}-alkyl), C_{2-6}-alkynyl, aryl, arylalkyl (e.g. aryl-C_{1-6}-alkyl), C_{3-8}-cycloalkylalkyl (e.g. C_{3-8}-cycloalkyl-C_{1-6}-alkyl, haloalkoxy (e.g. C_{1-6}-haloalkoxy), haloalkyl (e.g. C_{1-6}-haloalkyl), hydroxyalkylene (e.g. hydroxy-C_{1-6}-alkylene), oxo, heteroaryl, heteroarylalkoxy (e.g. heteroaryl- C_{1-6}-alkoxy), heteroaryloxy, heteroarylthio, heteroarylalkylthio (e.g. heteroaryl-C_{1-6}-alkylthio), heterocycloalkoxy (e.g. C_{2-8}-heterocycloalkoxy), C_{2-8}-heterocycloalkylthio, heterocyclooxy, heterocyclothio, NR_AR_B, (R_AR_B)C_{1-6}-alkylene, (NR_AR_B)carbonyl, (R_AR_B)carbonylalkylene (e.g. R_AR_B)carbonyl-C_{1-6}-alkylene), (NR_AR_B)sulfonyl, and (NR_AR_B)sulfonylalkylene (e.g. (NR_AR_B)sulfonyl-C_{1-6}-alkylene);

R_1, R_2, and R_3 are each independently selected from the group consisting of hydrogen, halogen, alkenyl (e.g. C_{2-6}-alkenyl), alkoxy (e.g. C_{1-6}-alkoxy), alkoxycarbonyl (e.g. C_{1-6}-alkoxy-

carbonyl), alkyl (e.g. C_{1-6}-alkyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), alkynyl (e.g. C_{2-6}-alkynyl), cyano, haloalkoxy (e.g. C_{1-6}-haloalkoxy), haloalkyl (e.g. C_{1-6}-haloalkyl), hydroxyl, hydroxyalkylene (e.g. hydroxy-C_{1-6}-alkylene), nitro, NR_AR_B, NR_AR_B alkylene (e.g. NR_AR_B C_{1-6}-alkylene), and (R_AR_B)carbonyl;

A and B are each independently selected from hydrogen, Br, Cl, F, I, OH, C_{1-6}-alkyl, C_{3-8}-cycloalkyl, alkoxy (e.g. C_{1-6}-alkoxy), alkoxyalkyl (e.g. C_{1-6}-alkoxy-C_{1-6}-alkyl), wherein C_{1-6}-alkyl, C_{3-8}-cycloalkyl, alkoxy, alkoxyalkyl are optionally substituted with at least one substituent selected from OH, NO_2, CN, Br, Cl, F, I, C_{1-6}-alkyl, and C_{3-8}-cycloalkyl, wherein B is not OH;

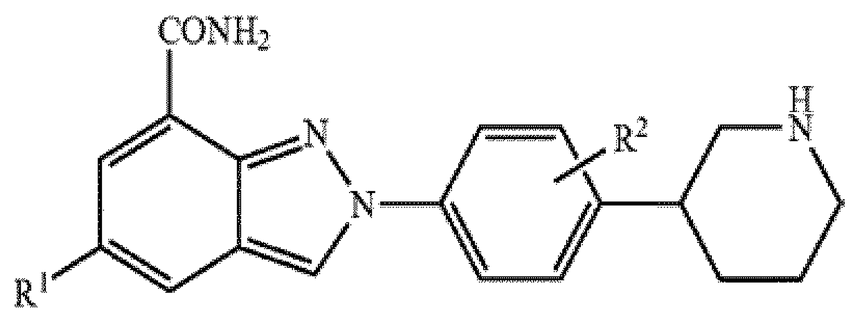
R_A, and R_B are independently selected from the group consisting of hydrogen, alkyl (e.g. C_{1-6}-alkyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), and alkylcarbonyl (e.g. C_{1-6}-alkyl-carbonyl); or RA and RB taken together with the atom to which they are attached form a 3-10 membered heterocycle ring optionally having one to three heteroatoms or hetero functionalities selected from the group consisting

of -O-, -NH, -N(C_{1-6} -alkyl)-, -NCO(C_{1-6}-alkyl)-, -N(aryl)-, -N(aryl-C_{1-6}-alkyl-), -N(substituted-aryl-C_{1-6}-alkyl-)-, -N(heteroaryl)-, -N(heteroaryl-C_1-C_6-alkyl-)-, -N(substituted-heteroaryl-C_{1-6} alkyl-)-, and -S- or S(O)q-, wherein q is 1 or 2 and the 3-10 membered heterocycle ring is optionally substituted with one or more substituents;

R_4 and R_5 are each independently selected from the group consisting of hydrogen, alkyl (e.g. C_{1-6}-alkyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), alkoxyalkyl (e.g. C_{1-6}-alkoxy-C_{1-6}-alkyl), haloalkyl (e.g. C_{1-6}-haloalkyl), hydroxyalkylene (e.g. hydroxy-C_{1-6}-alkylene), and (NR_AR_B)alkylene (e.g. NR_AR_B C_{1-6}-alkylene);

(iii) that inhibits PARP1 and PARP2 is selected from the group consisting of a compound of

(a) formula (IV)



(IV)

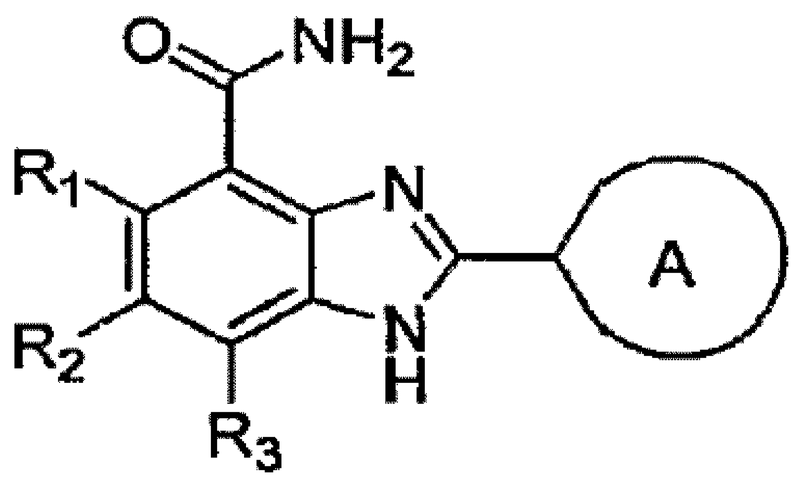
and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

R_1 is hydrogen or fluorine; and

R_2 is hydrogen or fluorine;

and

(b) formula (V)



(V)

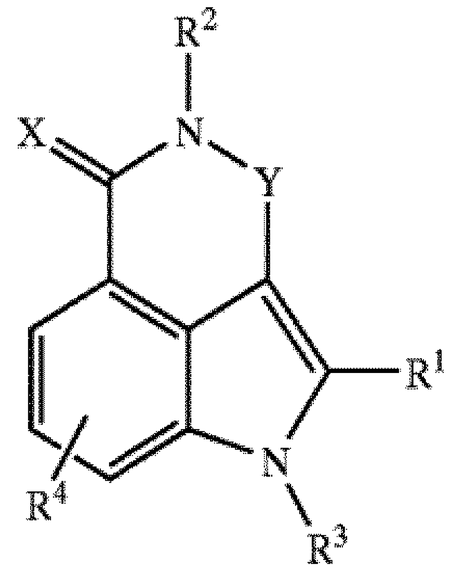
and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

R_1, R_2, and R_3 are independently selected from the group consisting of hydrogen, alkenyl (e.g. C_{1-6}-alkenyl), alkoxy (e.g. C_{1-6}-alkoxy), alkoxycarbonyl (e.g. C_{1-6}-alkoxycarbonyl), alkyl (e.g. C_{1-6}-alkyl), alkynyl (e.g. C_{1-6}-alkynyl), cyano, haloalkoxy (e.g. C_{1-6}-haloalkoxy), haloalkyl (e.g. C_{1-6}-haloalkyl), halogen, hydroxy, hydroxyalkyl (e.g. C_{1-6}-hydroxyalkyl), nitro, NR_AR_B, and (NR_AR_B)carbonyl;

A is a nonaromatic 4, 5, 6, 7, or 8-membered ring that contains 1 or 2 nitrogen atoms and, optionally, one sulfur or oxygen atom, wherein the nonaromatic ring is optionally substituted with 1, 2, or 3 substituents selected from the group consisting of alkenyl (e.g. C_{1-6}-alkenyl), alkoxy (e.g. C_{1-6}-alkoxy), alkoxyalkyl (e.g. C_{1-6}-alkoxy-C_{1-6}-alkyl), alkoxycarbonyl (e.g. C_{1-6}-alkoxycarbonyl), alkoxycarbonylalkyl (e.g. C_{1-6}-alkoxycarbonyl-C_{1-6}-alkyl), alkyl (e.g. C_{1-6}-alkyl), alkynyl (e.g. C_{1-6}-alkynyl), aryl, arylalkyl (e.g. aryl- C_{1-6}-alkyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), cycloalkylalkyl (e.g. C_{3-8}-cycloalkyl-C_{1-6}-alkyl), cyano, haloalkoxy (e.g. C_{1-6}-haloalkoxy), haloalkyl (e.g. C_{1-6}-haloalkyl), halogen, heterocycle, heterocyclealkyl (e.g. heterocycle-C_{1-6}-alkyl), heteroaryl, heteroarylalkyl (e.g. heteroaryl-C_{1-6}-alkyl), hydroxy, hydroxyalkyl (e.g. C_{1-6}-hydroxyalkyl), nitro, NR_CR_D, (NR_CR_D)alkyl (e.g. (NR_CR_D)-C_{1-6}-alkyl), (NR_CR_D)carbonyl, (NR_CR_D)carbonylalkyl (e.g. (NR_CR_D)carbonyl-C_{1-6}-alkyl), and (NR_CR_D)sulfonyl; and

R_A, R_B, R_C, and R_D are independently selected from the group consisting of hydrogen, alkyl (e.g. C_{1-6}-alkyl), and alkycarbonyl (e.g C_{1-6}-alkylcarbonyl).

(iv) that inhibits PARP1, PARP2 and PARP3 is a compound of formula (VI)



(VI)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

R_1 is: H; halogen; cyano; an optionally substituted alkyl (e.g. C_{1-6}-alkyl), alkenyl (e.g. C_{2-6}-alkenyl), alkynyl (e.g. C_{2-6}-alkynyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), heterocycloalkyl (e.g. C_{2-8}-heterocycloalkyl), aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, and amino, alkoxy (e.g. C_{1-6}-alkoxy), alkyl (e.g. C_{1-6}-alkyl), and aryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, carboxy, and optionally substituted amino and ether groups (such as O-aryl)); or -C(O)-R_{10}, where R_{10} is: H; an optionally substituted alkyl (e.g. C_{1-6}-alkyl), alkenyl (e.g. C_{1-6}-alkenyl), alkynyl (e.g. C_{1-6}-alkynyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), heterocycloalkyl (e.g. C_{2-8}-heterocycloalkyl), aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, amino, and alkyl (e.g. C_{1-6}-alkyl) and aryl groups unsubstituted or substituted with one or more substituents selected from halo, hydroxy, nitro, and amino); or OR_{100} or $NR_{100}R_{110}$, where R_{100} and R_{110} are each independently H or an optionally substituted alkyl (e.g. C_{1-6}-alkyl), alkenyl (e.g. C_{2-6}-alkenyl), alkynyl (e.g. C_{2-6}-alkynyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), heterocycloalkyl (e.g. C_{2-8}-heterocycloalkyl), aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from alkyl (e.g. C_{1-6}-alkyl), alkenyl (e.g. C_{2-6}-alkenyl), alkynyl (e.g. C_{2-6}-alkynyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), heterocycloalkyl (e.g. C_{2-8}-heterocycloalkyl), aryl, and heteroaryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, amino, and alkyl (e.g. C_{1-6}-alkyl) and aryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, and optionally substituted amino groups);

R_2 is H or alkyl (e.g. C_{1-6}-alkyl);

R_3 is H or alkyl (e.g. C_{1-6}-alkyl);

R_4 is H, halogen or alkyl (e.g. C_{1-6}-alkyl);

X is O or S;

Y is $(CR_5R_6)(CR_7R_8)_n$ or N-C(R_5), where:

n is 0 or 1;

R_5 and R_6 are each independently H or an optionally substituted alkyl (e.g. C_{1-6}-alkyl), alkenyl (e.g. C_{2-6}-alkenyl), alkynyl (e.g. C_{2-6}-alkynyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), heterocycloalkyl (e.g. C_{2-8}-heterocycloalkyl), aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, amino, and lower alkyl (e.g. C_{1-4}-alkyl), lower alkoxy (e.g. C_{1-4}-alkoxy), or aryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, and amino); and

R_7 and R_8 are each independently H or an optionally substituted alkyl (e.g. C_{1-6}-alkyl), alkenyl (e.g. C_{2-6}-alkenyl), alkynyl (e.g. C_{2-6}-alkynyl), cycloalkyl (e.g. C_{3-8}-cycloalkyl), heterocycloalkyl (e.g. C_{2-8}-heterocycloalkyl), aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, amino, and lower alkyl (e.g. C_{1-4}-

alkyl), lower alkoxy (e.g. C_{1-4}-alkoxy), and aryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, and amino);

where when R_1, R_4, R_5, R_6, and R_7 are each H, R_8 is not unsubstituted phenyl.

In a preferred embodiment the ALC1i for use of the fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention the PARPi is selected from the group consisting of Olaparib, Talazoparib, Niraparib, Rucaparib, and Veliparib, in particular of Veliparib, Olaparib, and Talazoparib.

In a preferred embodiment the ALC1i for use of the fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention the ALC1i is a direct inhibitor of the ATPase activity of ALC1, or is an allosteric inhibitor of ALC1.

In a preferred embodiment the ALC1i for use of fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention the ALC1i is the inhibitor of ALC1 of any of the first or further aspect of the invention or the bifunctional compound of the second aspect.

In a preferred embodiment the ALC1i for use of the fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention the proliferative disease is selected from a BRCA1 and/or 2-deficient tumor, a tumor in which expression of PARP1, PARP2, PARP3 and/or ALC1 is increased in comparison to non-tumor cells.

In a preferred embodiment the ALC1i for use of the fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention the tumor disease is selected from hepato cellular carcinoma, breast cancer, ovarian cancer , prostate cancer, and colorectal cancer.

In a preferred embodiment the ALC1i for use of the fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention (i) the ALC1i potentiates the cancer-cell killing efficacy of the PARPi, (ii) a reduced amount of PARPi is administered, and/or (iii) PARPi resistance is bypassed.

In a preferred embodiment the ALC1i for use of the fourth aspect of the invention or the PARPi for use of the fifth aspect of the invention the PARPi and ALC1i are administered concomitantly or separately.

In a **sixth** aspect the present invention relates to a kit of parts comprising separately packaged a PARPi and an ALC1i or a composition comprising a PARPi and an ALC1i, preferably with instructions for use to treat or ameliorate a proliferative disease.

Experimental Section

Cell Lines used

A preferred cell line used in the context of the examples is the osteosarcoma cell line termed U2OS. The U2OS cell line is a human cancer cell line that was established from a 15-year-old, Caucasian female in 1964 by J. Ponten and E. Saksela from a moderately differentiated sarcoma of the tibia. (U-2 OS ATCC ® HTB-96™ Homo sapiens bone osteosarcoma, 2016) It is available from numerous sources including ATCC® HTB-96®.

As a BRCA wild-type cell line, MDA-MB-231 cells were used. The cells were established from an aneuploid female human. The cells were extracted from the mammary gland (breast) in the metastatic site

as a pleural effusion. (MDA-MB-231 (ATCC® HTB-26™ Homo sapiens epithelial mammary gland) It is available from numerous sources including ATCC® HTB-26™.

As a BRCA negative cell line, SUM-149-PT cells were used. The cell line is a triple negative breast cancer (TNBC) cell line, derived from primary human invasive ductual carcinoma metastatic nodule from a 40 year old female. It contains a hemizygous BRCA1 mutation (p.Pro724Leufs*12) and is available from numerous sources including bioIVT.

PARP-2 trapping:

U2OS cells were seeded onto 4-well Nunc Lab-Tek chambers (Thermo Fisher Scientific) in normal DMEM. Cells were cultured over night at 37 °C and transfected with a GFP-tagged PARP2 plasmid using Lipofectamine. 24h after transfection, the cells were imaged using the Zeiss AxioObserver Z1 confocal spinning-disk microscope equipped with a sCMOS ORCA Flash 4.0 camera (Hamamatsu). Live-cell imaging experiments were performed with C-Apo 63× water immersion objective lens. During this time, the cells were maintained in Leibovitz's L-15 media (Gibco), supplemented with 10% FBS, at 37 °C in the absence of CO_2. For PARP-2 trapping imaging and analysis, cells with comparable transgene expression levels were selected. DNA damage was induced along a line of 88 pixels that is exposed for 400 msec with 20% laser power of a 355 nm laser operated through a single-point scanning head (UGA-42 firefly, Rapp OptoElectronics). Schematic of live-cell PARP-2 trapping assay was shown in figure 4.

The accumulation of fluorophore-tagged proteins at laser micro-irradiation sites was followed for 15-30 minutes. The cells were treated for 1 hour with the indicated inhibitor concentrations at 37 °C prior to experimental analysis. As a control, cells were treated with corresponding concentrations of DMSO. The accumulation of fluorophore-tagged proteins at micro-irradiation sites was quantified using a custom-made macro in Fiji/ImageJ. The damage region of interest was selected, the mean fluorescent intensity of the nucleus was determined, and the background signal was subtracted. The recruitment was calculated via the following formula: (damage region (t) – background signal (t)) / (nucleus intensity (t) – background (t))

Inhibitor vs. Response (cell survival) assay

For validation of the small molecule inhibitors, the synthetic lethality of BRCA and ALC1 was addressed using MDA-MB-231 cells as a BRCA wild-type cell line and SUM-149-PT as a BRCA1 deficient cell line. Cells were seeded in 96-well plates (5000 cells/well) and treated with titrations of ALC1 inhibitors starting at 50 µM. As a control for "no-treatment", DMSO was added to the cells. The cells were cultured at 37°C, CO_2 5 % for 5 days until they were fixed with 10% TCA for 1h and stained with sulforhodamine dye for 30 minutes. After washing the cells with 1% Acetic Acid, 10 mM Tris (pH 10.5) solution was used to solubilize the stained cells. The absorbance was measured at 492 nm using the SUNRISE TECAN, the data were normalized to the number of cells at timepoint 0 and to 100 % survival (=DMSO control) and analyzed using GraphPad Prism. Survival curves were fitted using "Inhibitor vs.

response curves with variable slope (four parameters)". The IC50 values for treatment with ALC1 inhibitors are shown in figure 8.

For further validation of the compounds, colony formation assays were applied. Here, less cells were seeded for the assay (100 cells / well). The cells were treated with ALC1 inhibitor or with a combination of PARPi and an ALC1 inhibitor for 11 days. The cells were fixed and data was analyzed as mentioned above. Results for treatment with ALC1 inhibitors are shown in figures 8 and 9.

FRET-based nucleosome sliding assay

This assay utilizes mid-positioned mononucleosomes that allow for monitoring the sliding activity of the ALC1 remodeling enzyme using a FRET readout. Each nucleosome is labeled with two FRET dyes: the octamer is labeled with Cy5 (Cy5-maleimide coupling to H2B) and one of the DNA ends is labeled with Cy3. The DNA template includes the 147 bp 601 DNA positioning sequence flanked by DNA overhangs on each side. Other nucleosome positioning sequences, both artificial constructs and naturally occurring sequences, even if less efficient than the 601 sequence in positioning nucleosomes, can also be used. The nucleosomes are assembled by salt gradient dialysis using purified, Cy5-labeled histone octamers and purified, Cy3-labeled DNA templates to yield the FRET-labeled mid-positioned nucleosomes. These nucleosomes will start with low FRET and will have a low Cy5 fluorescence signal when excited with the Cy3 excitation maximum wavelength as the two fluorophores are too far apart for efficient FRET. As the ALC1 remodeling reaction proceeds and the remodeling enzymes slides the octamer towards the DNA end, the distance between the two FRET dyes decreases and the signal from Cy5/FRET increases. Hence, increase in FRET can be directly used as readout for sliding.

<u>DNA Template Construction for Mononucleosome Reconstitution</u>

For reconstitution of mononucleosomes, the non-natural Widom 601 nucleosome positioning sequence was used as a high affinity binding site for the histone octamer (*see* Lowary, P. T. & Widom, J. New DNA sequence rules for high affinity binding to histone octamer and sequence-directed nucleosome positioning. *J. Mol. Biol.* **276**, 19–42 (1998)). Cy3-labeled DNA containing these 601 sequences can be constructed using methods including PCR amplification, restriction digestion of DNA plasmids followed by a Klenow end labeling reaction or other standard molecular biological techniques.

<u>Preparation of ALC1 and Histone Octamers</u>

Full length human ALC1 (1-897) or truncated versions thereof were expressed and purified as N-terminally 6 × His-tagged fusion protein from *E. coli* as published before (Singh, H.R., *et al.*, 2017).

Human histone proteins were recombinantly expressed in *E.coli* (either using classical IPTG induction or using autoinduction media) and purified from *E. coli* inclusion bodies. The purification scheme includes the extraction/solubilization of histones from inclusion bodies using guanidium chloride, followed by reverse phase chromatography. The purified histones were lyophilized resulting in TFA-salts of the purified histone proteins.

Preparation of nucleosomes

To assemble the nucleosomes, template DNA (250 µg/ml final concentration) was mixed with purified histone octamers in a high salt buffer at different molar ratios of histone octamers to DNA. The ionic strength of this mixture was then reduced < 600 mM NaCl by continuous dialysis against a low salt buffer at 4°C. Finally, the material was dialyzed against TEA-20 (10 mM triethanolamine-Cl pH 7.5, 20 mM NaCl, 0.1 mM EDTA). The best molar ratio, i.e. the ratio that yields full assembly of the DNA into nucleosomes was picked and used for further assemblies.

Alternatively, the nucleosomes can be assembled by other methods such as deposition of histone octamers onto DNA using polyglutamate or histone chaperones, or by salt step dilution.

Method of Measuring ALC1 mediated sliding; ALC1 nucleosomal sliding assay

Sliding reactions were performed in 384 well plates at RT in 10 mM Tris-HCl, pH 8.1, 75 mM KCl, 1 mM $MgCl_2$, 1.0 mM EGTA, 10% glycerol, 0.5 mM dithiothreitol (DTT), 0.01% TritonX100, 0.02% NP40 and reaction mixtures contained mid-positioned nucleosome, tri-ADP ribose or $(ADP\text{-}ribose)_n$ and ALC1 chromatin remodeling enzyme. Sliding was initiated by addition of ATP followed by shaking the plates for 5 sec at 1450 rpm and sealing them with a foil compatible with fluorescence reading. The FRET signal was immediately recorded using a fluorometer (BMG reader PheraStar FSX, channel A: excitation 520 nm, emission 680 nm; channel B: excitation 520 nm, emission 590 nm) and unless stated otherwise, remodeling proceeded for 30 min.

The FRET signal was calculated as the signal at 680 nm (emission of Cy5) divided by the signal at 590 nm (emission of Cy3) and multiplied by 10,000. To obtain an apparent rate of ALC1-mediated nucleosome sliding, the increase in FRET as a function over time was plotted and the initial velocities of ALC1-mediated nucleosome sliding were obtained by fitting the resulting kinetic trace by a linear curve fit.

High Throughput Screening (HTS) and IC50 determination for Molecules that Modulate ALC1-mediated sliding

For High Throughput Screening (HTS) and IC50 determination for compounds that modulate the sliding activity of ALC1, the nucleosome was incubated for 30 min as described above with ALC1 and triADP-ribose or $(ADP\text{-}ribose)_n$ in the presence of the putative ALCi prior to initiating sliding by ATP addition. Then, the rate of sliding (initial velocity) was determined as described above and compared against the rate of sliding in the absence of the putative modulator/compound (%inhibition). For IC_{50} determination, the observed %inhibition (y-axis) was plotted against compound concentrations (x-axis) using GraphPad Prism and fitted using a nonlinear regression model (four parameters).

In Silico Modeling of ALC1 Inhibitors

In order to identify the binding pocket of the small molecule inhibitors of ALC1, a homology model of the ALC1 helicase domain was built for use in molecular docking and molecular dynamics simulations.

The homology model and all ligands were then prepared for molecular docking and flexible docking was then preformed into the homology model on an Intel(R) Xeon(R) Platinum 8268 CPU @ 2.90GHz cpu ALCi-22 was chosen to be run in MD simulations due to its low IC50 in biochemical sliding assays and docking pose, which was in a previously unidentified pocket within the ATPase domain but not the ATP binding site itself. MD was then initiated on an NVIDIA Tesla V100-SXM2-32gb GPU. After the MD simulation was complete, every 10th frame was taken from the trajectory. These frames were aligned to the initial pose and PCA was carried out. Plots of the PCA were generated using the first two principle components. 8 clusters of protein conformations were identified manually. A random point near the center of each cluster was extracted as PDB files. These frames were inspected manually and frame number 33449405 was eventually selected for use in figures due to the ligand proximity to a catalytic residue in the ALC1 ATP binding site as well as its occupancy of a previously undescribed binding pocket. This pocket is composed of the following amino acids of human ALC1: L101, Y153, C156, L157, A160, L163, K164, V173, D174, E175, A176, H177, R178, L179, S183, L186, H187, T189, L190, F193, L200, L201, T202, N208, S209, E212, L213, L216, F219.

SAR Analysis of ALC1 Inhibitors

Examining the biochemical and cellular data, several clear trends emerge relating to the structure and activity of the ligands. The "tail" of the ligands clearly show that long, hydrophobic attachments are preferred with a terminal cyclopentane (ALCi-123 vs ALCi-125) or without (ALCi-4 vs ALCi-2, vs ALCi-1, vs ALCi-22). Additionally, hydrophilic substituents in the "tail" region are highly detrimental (ALCi-135). This is in line with the modeling pose which shows that the "tail" of the molecule is positioned in the highly hydrophobic region of the binding pocket (figures 14 and 15). Considering the pyridine ring, it appears that a CF_3 substitution opposite the N is beneficial over a CF_2H substitution (ALCi-8 vs ALCi-4), but a thiophene ring is favored over a CF_3 (ALCi-4 vs ALCi-56). This is again explained well by the modeling pose, which shows this region of the molecule is again interacting with a highly hydrophobic region of the binding pocket (figures 14 and 15). Additionally, in the "head" region of the inhibitors, molecules with more hydrophilic substituents are favored over those with fewer (ALCi-6 vs ALCi-72). Additionally, it appears that the highest potency is achieved when a carboxylic acid is substituted in the "head" region (ALCi-132), which is predicted to interact directly with ARG135 and potentially ASN 165 (figure 19). In fact, it appears that interaction with ARG165 may be critical for inhibition or binding as ALCi-31, ALCi-32, ALCi-33, and ALCi-34, which lack corresponding hydrophilic groups at the head region, are all inactive (data not shown). Taken together, it is clear that the SAR of the compounds supports the binding site prediction in the novel binding pocket by in-silico modeling.

Synthesis of Selected ALC1 Inhibitors

The synthesis of ALCi-72 begins with an Aldol condensation between 1-(4-bromophenyl)ethan-1-one and ethyl 2,2,2-trifluoroacetate with LiHMDS as base in THF at a temperature from -78 °C to room temperature over 16 hours, yielding 1-(4-bromophenyl)-4,4,4-trifluorobutane-1,3-dione (see Figure 22, R = Br). This product then participates in pyridine formation with 2-cyanoethanethioamide in acetic acid and ethanol under reflux yielding 6-(4-bromophenyl)-2-sulfanylidene-4-(trifluoromethyl)-2,3-dihydropyridine-3-carbonitrile. In step 3, 6-(4-bromophenyl)-2-sulfanylidene-4-(trifluoromethyl)-2,3-dihydropyridine-3-carbonitrile undergoes a cyclization to thiophenopyridine with ethyl 2-chloroacetate with sodium carbonate as base in ethanol under reflux conditions over 12 hours, which yields ethyl 3-amino-6-(4-bromophenyl)-4-(trifluoromethyl)thieno[2,3-b]pyridine-2-carboxylate. Finally, in step 5, ethyl 3-amino-6-(4-bromophenyl)-4-(trifluoromethyl)thieno[2,3-b]pyridine-2-carboxylate undergoes urea formation and cyclization into the final product, ALCi-72, by means of $ClSO_2NCO$, in DCM and water under reflux and then sodium hydroxide under reflux for 6 hours respectively.

ALCi-117 synthesis starts with an Aldol condensation between 1-(4-butoxyphenyl)ethan-1-one and ethyl 2,2,2-trifluoroacetate with NaH a base in THF from 0 °C to room temperature over 16 hours to produce 1-(4-butoxyphenyl)-4,4,4-trifluorobutane-1,3-dione. This product then participates in a pyridine formation with 2-cyanoethanethioamide in acetic acid and ethanol, yielding 6-(4-butoxyphenyl)-2-sulfanyl-4-(trifluoromethyl)pyridine-3-carbonitrile. In step 3, 6-(4-butoxyphenyl)-2-sulfanyl-4-(trifluoromethyl)pyridine-3-carbonitrile undergoes a cyclization to thiophenopyridine with ethyl 2-chloroacetate with sodium carbonate as base in ethanol under reflux conditions, which yields ethyl 3-amino-6-(4-butoxyphenyl)-4-(trifluoromethyl)thieno[2,3-b]pyridine-2-carboxylate. Step 4 is a Sandmeyer reaction with ethyl 3-amino-6-(4-butoxyphenyl)-4-(trifluoromethyl)thieno[2,3-b]pyridine-2-carboxylate, yielding ethyl 3-bromo-6-(4-butoxyphenyl)-4-(trifluoromethyl)thieno[2,3-b]pyridine-2-carboxylate. Subsequently, ethyl 3-bromo-6-(4-butoxyphenyl)-4-(trifluoromethyl)thieno[2,3-b]pyridine-2-carboxylate is incubated with CH_3BF_3-K+, Cs_2CO_3, $Pd(dppf)Cl_2$, DCM, and dioxane at 150 °C for 30 minutes in a Suzuki coupling reaction to yield ethyl 6-(4-butoxyphenyl)-3-methyl-4-(trifluoromethyl)thieno[2,3-b]pyridine-2-carboxylate. Finally, step 6 is a hydrolysis of ethyl 6-(4-butoxyphenyl)-3-methyl-4-(trifluoromethyl)thieno[2,3-b]pyridine-2-carboxylate with sodium hydroxide to yield the produce, ALCi-117.

ALCi-132 synthesis begins with the synthesis of the intermediate 4-[(4-chlorophenyl)methoxy]-3-methoxybenzaldehyde to be used in the final step via a 1-(bromomethyl)-4-chlorobenzene between 4-hydroxy-3-methoxybenzaldehyde and 1-(bromomethyl)-4-chlorobenzene under reflux conditions with acetone and potassium carbonate. Step 1 of the synthesis is a thiophene formation employing ethyl 3-oxobutanoate, ethyl 2-cyanoacetate and S8 in ethanol and Et_2NH to form 2,4-diethyl 5-amino-3-methylthiophene-2,4-dicarboxylate. 2,4-diethyl 5-amino-3-methylthiophene-2,4-dicarboxylate then participates in an amide formation with oxolane-2,5-dione, in a mixture of ether, benzene and dioxane at room temperature to form 3-{[3-carbamoyl-5-(ethoxycarbonyl)-4-methylthiophen-2-yl]carbamoyl}propanoic acid. In step 3, 3-{[3-carbamoyl-5-(ethoxycarbonyl)-4-methylthiophen-2-

yl]carbamoyl}propanoic acid undergoes a Steglich esterification to form ethyl 4-carbamoyl-5-(4-methoxy-4-oxobutanamido)-3-methylthiophene-2-carboxylate. ethyl 4-carbamoyl-5-(4-methoxy-4-oxobutanamido)-3-methylthiophene-2-carboxylate then undergoes a $Zn(BH_4)_2$ reduction reaction to form ethyl 4-carbamoyl-5-(4-hydroxybutanamido)-3-methylthiophene-2-carboxylate, which is then cyclized using sodium hydroxide under reflux conditions for 16 hours to form 2-(3-hydroxypropyl)-5-methyl-4-oxo-4H,4aH-thieno[2,3-d]pyrimidine-6-carboxylic acid. 2-(3-hydroxypropyl)-5-methyl-4-oxo-4H,4aH-thieno[2,3-d]pyrimidine-6-carboxylic acid is then esterified using EtOH with H_2SO_4 under reflux for 16 hours, yielding ethyl 2-(3-hydroxypropyl)-5-methyl-4-oxo-4H,4aH-thieno[2,3-d]pyrimidine-6-carboxylate. A Mitsunobu reaction is utilized at room temperature to convert ethyl 2-(3-hydroxypropyl)-5-methyl-4-oxo-4H,4aH-thieno[2,3-d]pyrimidine-6-carboxylate to ethyl 4-methyl-2-oxo-6-thia-1λ^4,8-diazatricyclo[7.3.0.0^{3,7}]dodeca-1(9),4,7-triene-5-carboxylate, which finally undergoes an aldol condensation with the intermediate 4-[(4-chlorophenyl)methoxy]-3-methoxybenzaldehyde with Ac_2O under reflux to produce ALCi-132.

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Claims

1. An allosteric inhibitor of Chromodomain-helicase-DNA-binding protein 1-like (ALC1), wherein the inhibitor specifically binds to an allosteric binding pocket formed by an amino acid stretch spanning amino acid residues 101 to 219 of SEQ ID NO: 1.

2. The allosteric inhibitor of ALC1 of claim 1, wherein the allosteric binding pocket comprises or consists of L101, Y153, C156, L157, A160, L163, K164, V173, D174, E175, A176, H177, R178, L179, S183, L186, H187, T189, L190, F193, L200, L201, T202, N208, S209, E212, L213, L216, and F219 of SEQ ID NO: 1, preferably comprises or consists of Y153, C156, L157, A160, L163, V173, E175. R178, L186, H187, L190 F 193, L200, and E212 of SEQ ID NO: 1.

3. The allosteric inhibitor of ALC1 of claim 1 or 2, wherein the inhibitor forms non-covalent bond(s) with one or more amino acids of the allosteric binding pocket, preferably with one or more of the backbone of amino acids L157, A160, K164, V173, D174, H177, R178, L179, L186, N208, and/or E212 and/or the sidechains of L101, Y153, C156, L157, A160, L163, E175, R178, L179, L186, H187, L190, F193, T202, N208, E212, and/or L213, more preferably with the backbone of D174. H177, and R178, and the sidechain of Y153, E175. R178, H187, T202, N208 and E212, preferably the inhibitor non-covalently binds to:

   (i) the aromatic ring of the sidechain of Y153 ring face-to-face or edge-to-face pi-pi interaction with aromatic carbo- or heterocyclic substituents or forming cation-pi, polar-pi, or halogen-pi interactions with polar, charged, or carbo-halogen substituents;

   (ii) the terminal oxygen of the sidechain of Y153 with a hydrogen bond donating group;

   (iii) the carbonyl oxygen of the backbone of H177 with carbo halogens or hydrogen bond donating groups;

   (iv) the carbonyl oxygen of the backbone of D174 with carbo halogens or hydrogen bond donating groups;

   (v) the sidechain of E175 with a hydrogen bond donating or accepting group;

   (vi) the sidechain of R178 with a hydrogen bond donating or accepting group;

   (vii) the backbone carbonyl oxygen of R178 with carbo halogens or hydrogen bond donating groups;

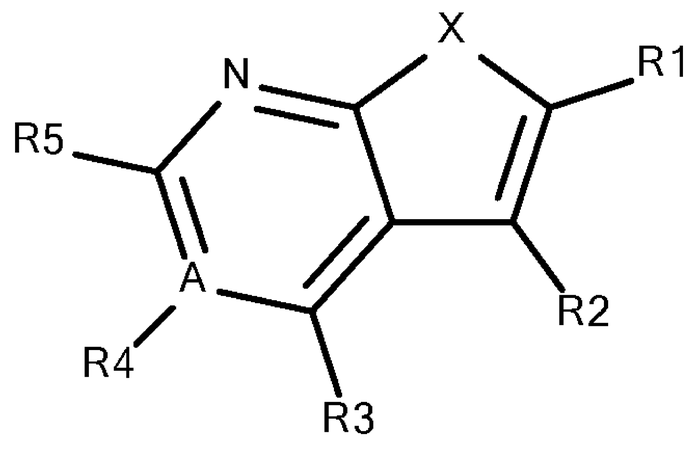
   (viii) the sidechain of H187 ring face-to-face or edge-to-face pi-pi interaction with aromatic carbo- or heterocyclic substituents or forming cation-pi, polar-pi, or halogen-pi interactions with polar, charged, or carbo-halogen substituents or with a hydrogen bond donating or accepting group

   (ix) the sidechain of T202 with a hydrogen bond donating or accepting group;

   (x) the sidechain of N208 with a hydrogen bond donating or accepting group; and

   (xi) the sidechain of E212 with a hydrogen bond donating or accepting group.

4. The inhibitor of ALC1 of claim 3, wherein the allosteric inhibitor has the structure of formula (I):



wherein

(i) R_5 comprises an aromatic ring that pi-stacks with the aromatic ring of Y153; and/or

(ii) N is a hydrogen bond accepting group for the terminal OH of Y153; and/or

(iii) R_1 comprises a group that is a hydrogen bond donating group to the backbone carbonyl oxygen of H177; and/or

(iv) R_3 comprises a carbohalogen or hydrogen bond donating group that binds to the carbonyl oxygen of the backbone of D174; and/or

(v) R_1 and R_2 together form an aromatic or heteroaromatic monocyle comprising a hydrogen bond donating or accepting group especially at or adjacent to the R_1 position which can act as a hydrogen bond doating or accepting group to the side chain of E175 and/or R178; and/or

(vi) R_1 and R_2 together form a substituted carbo- or heteromonocycle comprising a hydrogen bond donating or accepting group, preferably at or adjacent to the R_1 position which is a hydrogen bond donating or accepting group to the side chain of R178; and/or

(vii) R_3 comprises an aromatic ring that pi-stacks with the aromatic ring H187 or is an electron poor substituent, especially at, forming polar-pi or cation-pi interactions with the aromatic ring of H187; and/or

(viii) R_1 and R_2 together form an aromatic or heteroaromatic monocyle comprising a hydrogen bond donating or accepting group especially at or adjacent to the R_2 position which can act as a hydrogen bond donating or accepting group to the side chain of T202 and/or N208; and/or

(ix) R_4 is H or -C_{1-3}-alkyl, preferably H; and/or

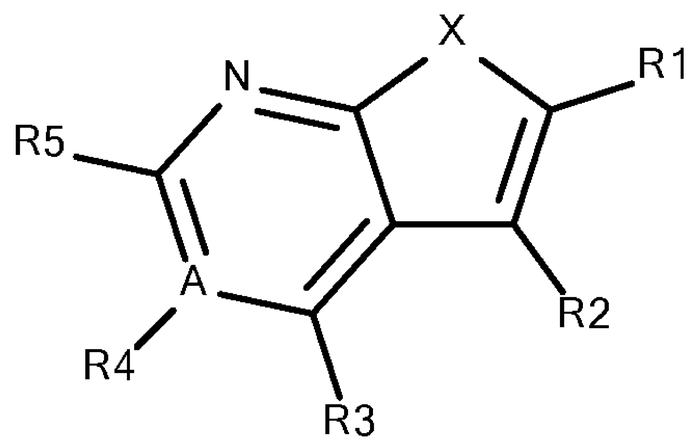
(x) R_5 is -$(CH_2)_m$-L, or -$(CH_2)_m$-(CH=CH)-L, wherein m is 0, 1 or 2, preferably 0 or 1, and L is a 5, 6 or 7 membered carbo- or heterocycle, or adamantyl, optionally substituted, preferably with 1, 2, 3 or 4 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -CO-OR_6, -Br, -Cl, -F, -I, -R_9, -O-R_9, and =O, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle; and/or

(xi) R_4 and R_5 together form a 5, 6, or 7 membered carbocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-R_9, -R_9, =CH-R_A, preferably R_4 and R_5 together form a C_{5-7}-cycloalkyl; and/or

(xii) X is N or S; and/or

(xiii) A is C or N.

5. The allosteric inhibitor of ALC1 of any of claims 1 to 4, wherein the allosteric inhibitor has the structure of formula (I):



(I)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof, wherein:

X is N or S;

A is C or N;

R_1 is –CO-OR_6, -CO-R_7, or -CO-NR_6R_A, preferably R_1 is –CO-OR_6;

R_2 is -R_7, -NHR_8, -O-R_7, -C-O-R_7, Br, -C_{3-8}-cycloalkyl (preferably cyclopropyl), or –C_{4-8}-cycloalkenyl (preferably cyclohexenyl);

or

R_1 and R_2 together form a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, =O, [-O-CH_2-CH_2]-NH-CH(OH)-O-tBu, ;

R_3 is H, =O, -OH, -O-R_7, -R_7, or –$(CH_2)_m$-L, wherein m is 0, 1 or 2, and L is a 5, 6 or 7 membered carbo- or heterocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-C_{1-3}-alkyl, -hydroxyC_{1-3}-alkyl and =O;

R_4 is H or -C_{1-3}-alkyl, preferably H;

R_5 is -$(CH_2)_m$-L, or -$(CH_2)_m$-(CH=CH)-L, wherein m is 0, 1 or 2, preferably 0 or 1, and L is a 5, 6 or 7 membered carbo- or heterocycle, adamantyl, C_{1-4}-alkyl, or -$N(CH_3)_2$, optionally substituted, preferably with 1, 2, 3 or 4 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -CO-OR_6, -Br, -Cl, -F, -I, -R_9, -O-R_9, =O, and [-O-CH_2-CH_2]$_q$-NH-biotin with q being 1, 2, 3, or 4, or two adjacent substituents form a 5, 6 or 7 membered carbo- or heterocycle;

or

R_4 and R_5 together form a 5, 6, or 7 membered carbocycle, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -O-R_9, -R_9, =CH-R_A, and –CH_2-R_A, preferably R_4 and R_5 together form a C_{5-7}-cycloalkyl;

R_6 is H, -C_{1-6}-alkyl, -C_{2-6}-alkenyl, -C_{2-6}-alkynyl, optionally substituted, preferably R_6 is H;

R_7 is -C_{1-3}-alkyl, -C_{2-3}-alkenyl, -C_{2-3}-alkynyl, optionally substituted, preferably with 1, 2, or 3 substituents independently selected from the group consisting of -Br, -Cl, -F, -I, -CH_3, -OCH_3, or -SCH_3;

R_8 is H or C_{1-6}-alkyl, preferably H,

R_9 is -C_{1-6}-alkyl, -C_{2-6}-alkenyl, -C_{2-6}-alkynyl, -C_{1-6}-alkyl-aryl, or C_{1-6}-alkyl-heteroaryl (preferably isooxazole, thiazole, tetrazole, 1,2,4-thiadiazole, 1,2,3-thiadiazole, 1,2,5-thiadiazole, pyridine, 1,2,4-oxadiazole, pyrazine, or pyrazole), optionally substituted with 1, 2 or 3 substituents selected from the group consisting of -Br, -Cl, -F, -I, -NO_2, -CN, -$CONH_2$, -CONH-C_{1-3}-alkyl (preferably –CONH-CH_3), -NH-CO-C_{1-3}-alkyl (preferably -NH-CO-CH_3), -C_{1-6}-alkyl (preferably -CH_3, ethyl, propyl, t-butyl, or pentyl), -C_{1-3}-haloalkyl (preferably-CF_3, or -CHF_2), -O-CHF_2, -O-CF_3, carbocycle (preferably cyclopropyl, cyclohexyl or phenyl), -O-carbocycle (preferably phenoxy), heterocycle (preferably pyrazolyl), -CO-heterocycle (preferably –CO-(1-pyrrolidinyl)),-SO_2-CH_3, -SO_2-$N(CH_3)_2$, -O-C_{1-4}-alkyl (preferably -OCH_3), -O-C_{1-3}-alkyl-O-C_{1-3}-alkyl (preferably –O-CH_2-O-CH_3), -SCH_3, or when R_9 is -C_{1-6}-alkyl-aryl, then two adjacent substituents on the aryl moiety can form a 5, 6 or 7 membered carbo- or heterocycle, which is optionally substituted;

R_A is H, carbo- or heterocycle, optionally substituted, preferably with 1, 2 or 3 substituents independently selected from the group consisting of -OH, -NO_2, -CN, -Br, -Cl, -F, -I, -R_9, -O-R_7, -O-$(CH_2)_o$-R_9, -SO_2NH_2, and =O, wherein o is 0 or 1.

6. A bifunctional compound comprising the allosteric inhibitor of ALC1 of claims 1 to 5 and a compound which recruits E3 ubiquitin ligase to ALC1 (E3 recruiter), wherein the allosteric inhibitor of ALC1 and the E3 recruiter are covalently linked, optionally through a linker.

7. A pharmaceutical composition comprising the allosteric inhibitor of ALC1 of claims 1 to 5 or the bifunctional compound of claim 6 and a pharmaceutically acceptable excipient.

8. An ALC1 inhibitor (ALC1i) for use in a method for treating or ameliorating a proliferative disease in a patient, wherein the method comprises the administration of said ALC1i and optionally the administration of a Poly(ADP-ribose)-Polymerase inhibitor (PARPi).

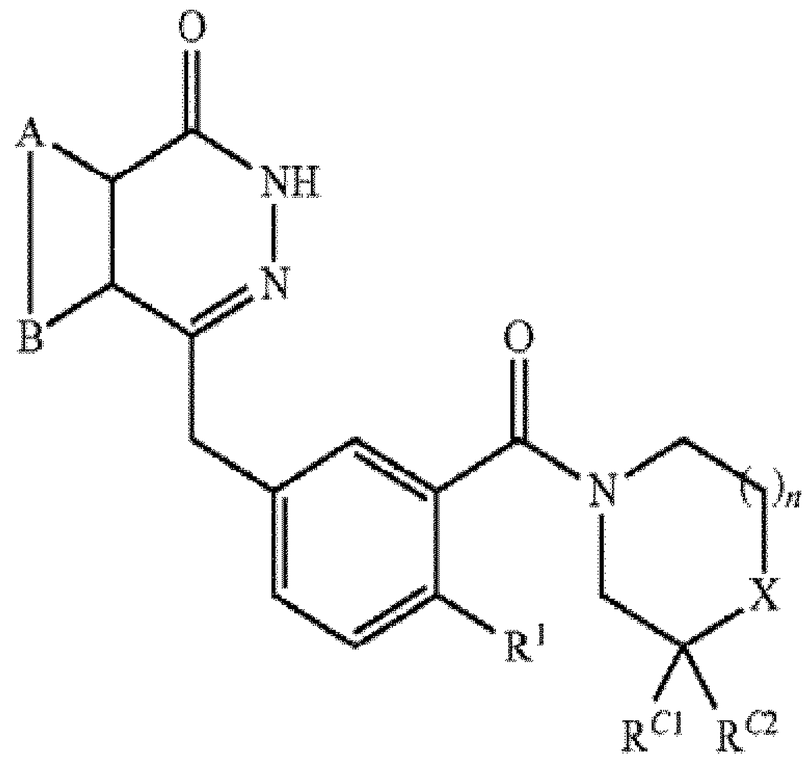
9. A PARPi for use in treating or ameliorating a proliferative disease in a patient, wherein the method comprises the administration of said PARPi and the administration of ALC1i.

10. The ALC1i for use of claim 8 or the PARPi for use of claim 9, wherein the PARPi lowers PARP activity and/or inhibits PARP1, PARP2 and/or PARP3, preferably PARP2 on chromatin, wherein preferably the PARPi

(i) that lowers PARP activity is selected from small interfering RNA, and

(ii) that inhibits PARP1 is selected from the group consisting of a compound of

(a) formula (II)



(II)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

A and B together represent an optionally substituted, fused aromatic ring;

X is NR^X or CR^XR^Y;

if $X=NR^X$ then n is 1 or 2 and if $X=CR^XR^Y$ then n is l;

R^X is selected from the group consisting of H, optionally substituted C_{1-20} alkyl, C_{5-20} aryl, C_{3-20} heterocyclyl, amido, thioamido, ester, acyl, and sulfonyl groups;

R^Y is selected from H, hydroxy, amino;

or R^X and R^Y may together form a spiro-C_{3-7} cycloalkyl or heterocyclyl group;

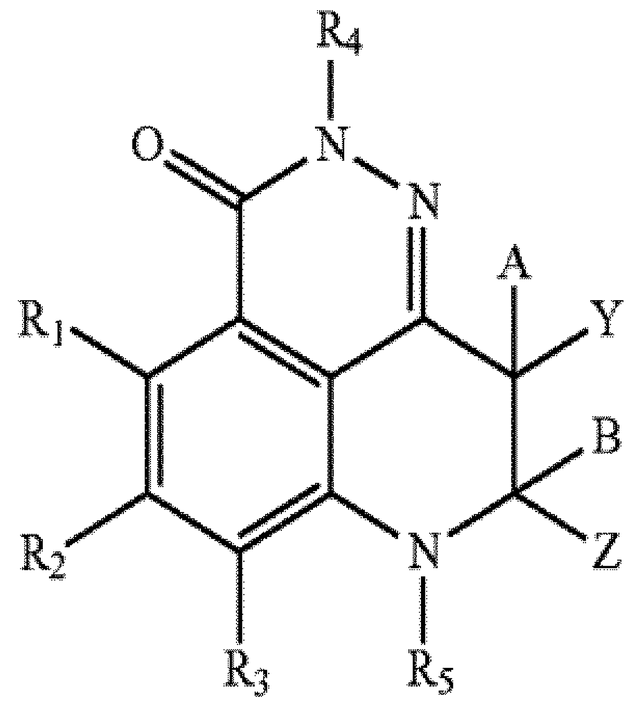
R^{C1} and R^{C2} are independently selected from the group consisting of hydrogen and C_{1-4} alkyl

or when X is CR^XR^Y, R^{C1}, R^{C2}, R^X and R^Y, together with the carbon atoms to which they are attached, may form an optionally substituted fused aromatic ring; and

R^1 is selected from H and halo;

and

(b) formula (III)



(III)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

Y and Z are each independently selected from the group consisting of:

1. an aryl group optionally substituted with 1, 2, or 3 R_6 ;
2. a heteroaryl group optionally substituted with 1, 2, or 3 R_6;
3. a substituent independently selected from the group consisting of hydrogen, alkenyl, alkoxy, alkoxyalkyl, alkoxycarbonyl, alkoxycarbonylalkyl, alkyl, alkynyl, arylalkyl, cycloalkyl, cycloalkylalkyl, haloalkyl, hydroxyalkylene, oxo, heterocycloalkyl, heterocycloalkylalkyl, alkylcarbonyl, arylcarbonyl, heteroarylcarbonyl alkylsulfonyl, arylsulfonyl, heteroarylsulfonyl, (R_AR_B)alkylene, (NR_AR_B)carbonyl, (NR_AR_B)carbonylalkylene, (NR_AR_B)sulfonyl, and (R_AR_B)sulfonylalkylene;

wherein each R_6 is selected from OH, NO_2, CN, Br, Cl, F, I, C_{1-6}-alkyl, C_{3-8}-cycloalkyl, C_{2-8} -heterocycloalkyl; C_{2-6}-alkenyl, alkoxy, alkoxyalkyl, alkoxycarbonyl, alkoxycarbonylalkyl, C_{2-6}-alkynyl, aryl, arylalkyl, C_{3-8}-cycloalkylalkyl, haloalkoxy, haloalkyl, hydroxyalkylene, oxo, heteroaryl, heteroarylalkoxy, heteroaryloxy, heteroarylthio, heteroarylalkylthio, heterocycloalkoxy, C_{2-8}-heterocycloalkylthio, heterocyclooxy, heterocyclothio, NR_AR_B, (R_AR_B)C_{1-6}-alkylene, (NR_AR_B)carbonyl, (R_AR_B)carbonylalkylene, (NR_AR_B)sulfonyl, and (NR_AR_B)sulfonylalkylene;

R_1, R_2, and R_3 are each independently selected from the group consisting of hydrogen, halogen, alkenyl, alkoxy, alkoxycarbonyl, alkyl, cycloalkyl, alkynyl, cyano, haloalkoxy, haloalkyl, hydroxyl, hydroxyalkylene, nitro, NR_AR_B, NR_AR_B alkylene, and (R_AR_B)carbonyl;

A and B are each independently selected from hydrogen, Br, Cl, F, I, OH, C_{1-6}-alkyl, C_{3-8}-cycloalkyl, alkoxy, alkoxyalkyl wherein C_{1-6}-alkyl, C_{3-8}-cycloalkyl, alkoxy, alkoxyalkyl are optionally substituted with at least one substituent selected from OH, NO_2, CN, Br, Cl, F, I, C_{1-6}-alkyl, and C_{3-8}-cycloalkyl, wherein B is not OH;

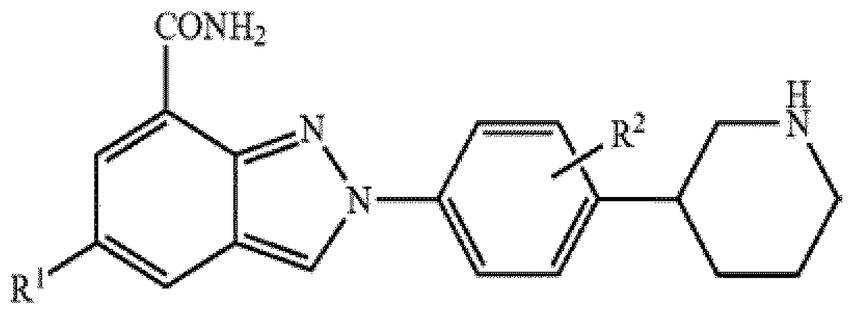
R_A, and R_B are independently selected from the group consisting of hydrogen, alkyl, cycloalkyl, and alkylcarbonyl; or RA and RB taken together with the atom to which they are attached form a 3-10 membered heterocycle ring optionally having one to three heteroatoms or hetero functionalities selected from the group consisting of -O-, -NH, -N(C_{1-6} -alkyl)-, -NCO(C_{1-6}-alkyl)-, -N(aryl)-, -N(aryl-C_{1-6}-alkyl-), -N(substituted-aryl-C_{1-6}-alkyl-)-, -N(heteroaryl)-, -N(heteroaryl-C_1-C_6 -alkyl-)-, -N(substituted-heteroaryl-C_{1-6} alkyl-)-, and -S- or S(O)q-, wherein q is 1 or 2 and the 3-10 membered heterocycle ring is optionally substituted with one or more substituents;

R_4 and R_5 are each independently selected from the group consisting of hydrogen, alkyl, cycloalkyl, alkoxyalkyl, haloalkyl, hydroxyalkylene, and (NR_AR_B)alkylene;

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof;

(iii) that inhibits PARP1 and PARP2 is selected from the group consisting of a compound of

(a) formula (IV)



(IV)

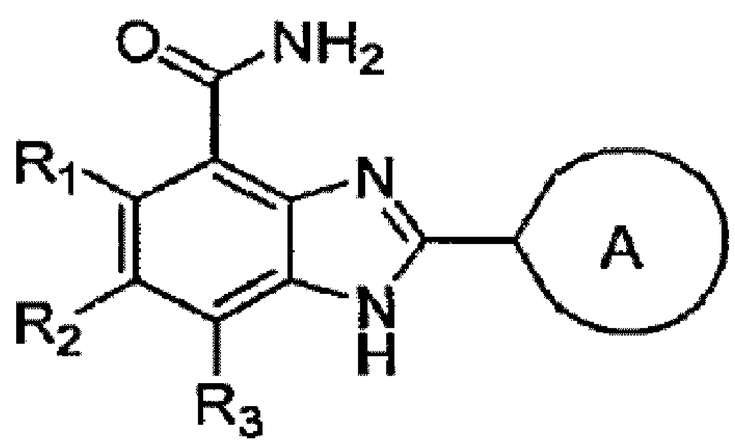
and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

R_1 is hydrogen or fluorine; and

R_2 is hydrogen or fluorine;

and

(b) formula (V)



(V)

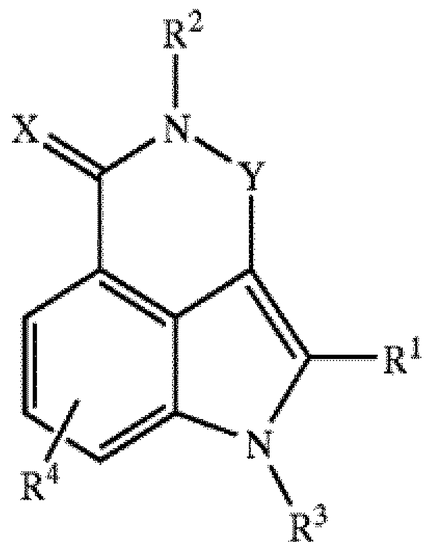
and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

R_1, R_2, and R_3 are independently selected from the group consisting of hydrogen, alkenyl, alkoxy, alkoxycarbonyl, alkyl, alkynyl, cyano, haloalkoxy, haloalkyl, halogen, hydroxy, hydroxyalkyl, nitro, NR_AR_B, and (NR_AR_B)carbonyl;

A is a nonaromatic 4, 5, 6, 7, or 8-membered ring that contains 1 or 2 nitrogen atoms and, optionally, one sulfur or oxygen atom, wherein the nonaromatic ring is optionally substituted with 1, 2, or 3 substituents selected from the group consisting of alkenyl, alkoxy, alkoxyalkyl, alkoxycarbonyl, alkoxycarbonylalkyl, alkyl, alkynyl, aryl, arylalkyl, cycloalkyl, cycloalkylalkyl, cyano, haloalkoxy, haloalkyl, halogen, heterocycle, heterocyclealkyl, heteroaryl, heteroarylalkyl, hydroxy, hydroxyalkyl, nitro, NR_CR_D, (NR_CR_D)alkyl, (NR_CR_D)carbonyl, (NR_CR_D)carbonylalkyl, and (NR_CR_D)sulfonyl; and

R_A, R_B, R_C, and R_D are independently selected from the group consisting of hydrogen, alkyl, and alkycarbonyl

(iii) that inhibits PARP1, PARP2 and PARP3 is acompound of formula (VI)



(V)

and isomers, salts, solvates, chemically protected forms, and prodrugs thereof wherein:

R_1 is: H; halogen; cyano; an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, and amino, alkoxy, alkyl, and aryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, carboxy, and optionally substituted amino and ether groups (such as O-aryl)); or -C(O)-R_{10}, where R_{10} is: H; an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, amino, and alkyl and aryl groups unsubstituted or substituted with one or more substituents selected from halo, hydroxy, nitro, and amino); or OR_{100} or $NR_{100}R_{110}$, where R_{100} and R_{110} are each independently H or an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, and heteroaryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, amino, and alkyl and aryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, and optionally substituted amino groups);

R_2 is H or alkyl;

R_3 is H or alkyl;

R_4 is H, halogen or alkyl;

X is O or S;

Y is $(CR_5R_6)(CR_7R_8)_n$ or N-C(R_5), where:

n is 0 or 1;

R_5 and R_6 are each independently H or an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, amino, and lower alkyl, lower alkoxy, or aryl groups unsubstituted or substituted

with one or more substituents selected from halogen, hydroxy, nitro, and amino); and

R_7 and R_8 are each independently H or an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, heterocycloalkyl, aryl, or heteroaryl group (e.g., unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, amino, and lower alkyl, lower alkoxy, and aryl groups unsubstituted or substituted with one or more substituents selected from halogen, hydroxy, nitro, and amino);

where when R_1, R_4, R_5, R_6, and R_7 are each H, R_8 is not unsubstituted phenyl.

11. The ALC1i for use of claim 8 or 10 or the PARPi for use of claim 9 or 10, wherein the PARPi is selected from the group consisting of Olaparib, Talazoparib, Niraparib, Rucaparib, and Veliparib, in particular of Veliparib, Olaparib, and Talazoparib.

12. The ALC1i for use of claim 8, 10 or 11 or the PARPi for use of claim 9 to 11, wherein the ALC1i is a direct inhibitor of the ATPase activity of ALC1, or is an allosteric inhibitor of ALC1, wherein preferably the ALC1i is the inhibitor of ALC1 of any of claims 1 to 5 or a bifunctional compound of claim 6.

13. The ALC1i for use of claim 8 or 10 to 12 or the PARPi for use of claim 9 to 12, wherein the proliferative disease is selected from a BRCA-1 and/or BRCA-2-deficient tumor, and a tumor in which expression of PARP-1, PARP-2, PARP-3 and/or ALC1 is increased in comparison to non-tumor cells, and/or wherein the proliferative disease is selected from hepatocellular carcinoma, breast cancer, ovarian cancer, prostate cancer, colorectal cancer.

14. The ALC1i for use of claim 8 or 10 to 13 or the PARPi for use of claim 9 to 13, wherein the PARPi and ALC1i are administered concomitantly or separately.

15. A kit of parts comprising separately packaged a PARPi and an ALC1i or a composition comprising a PARPi and an ALC1i, preferably with instructions for use to treat or ameliorate a proliferative disease.

Figure 1

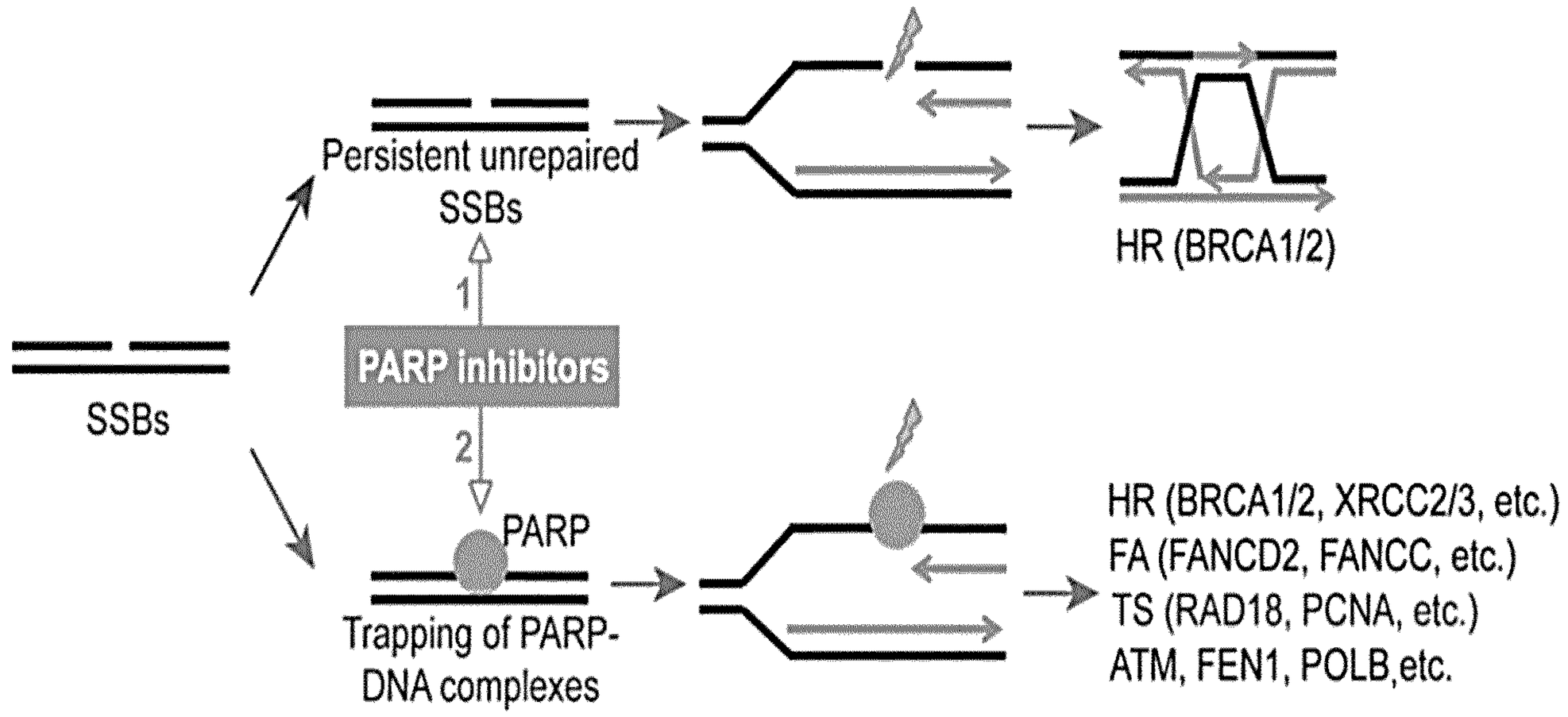


Figure 2

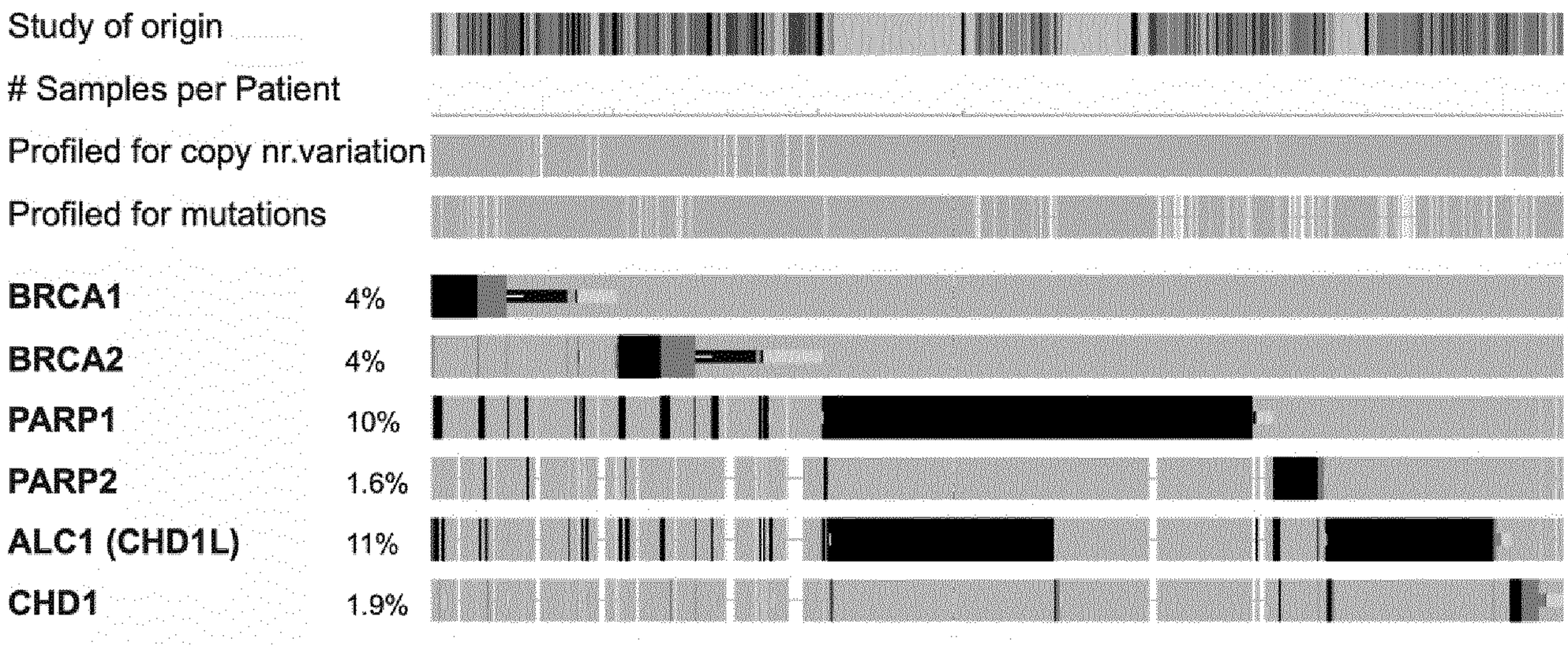


Figure 3

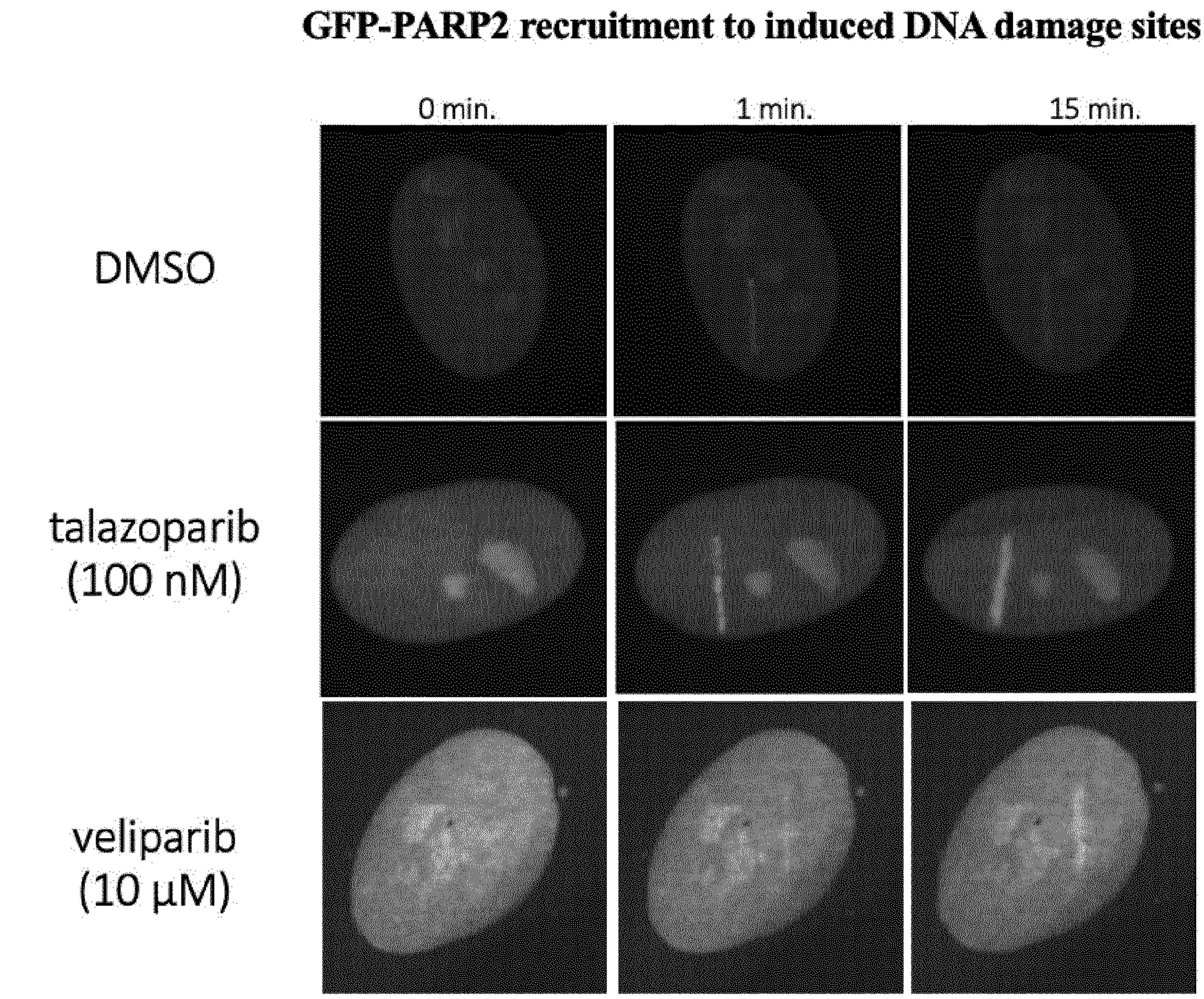


Figure 4

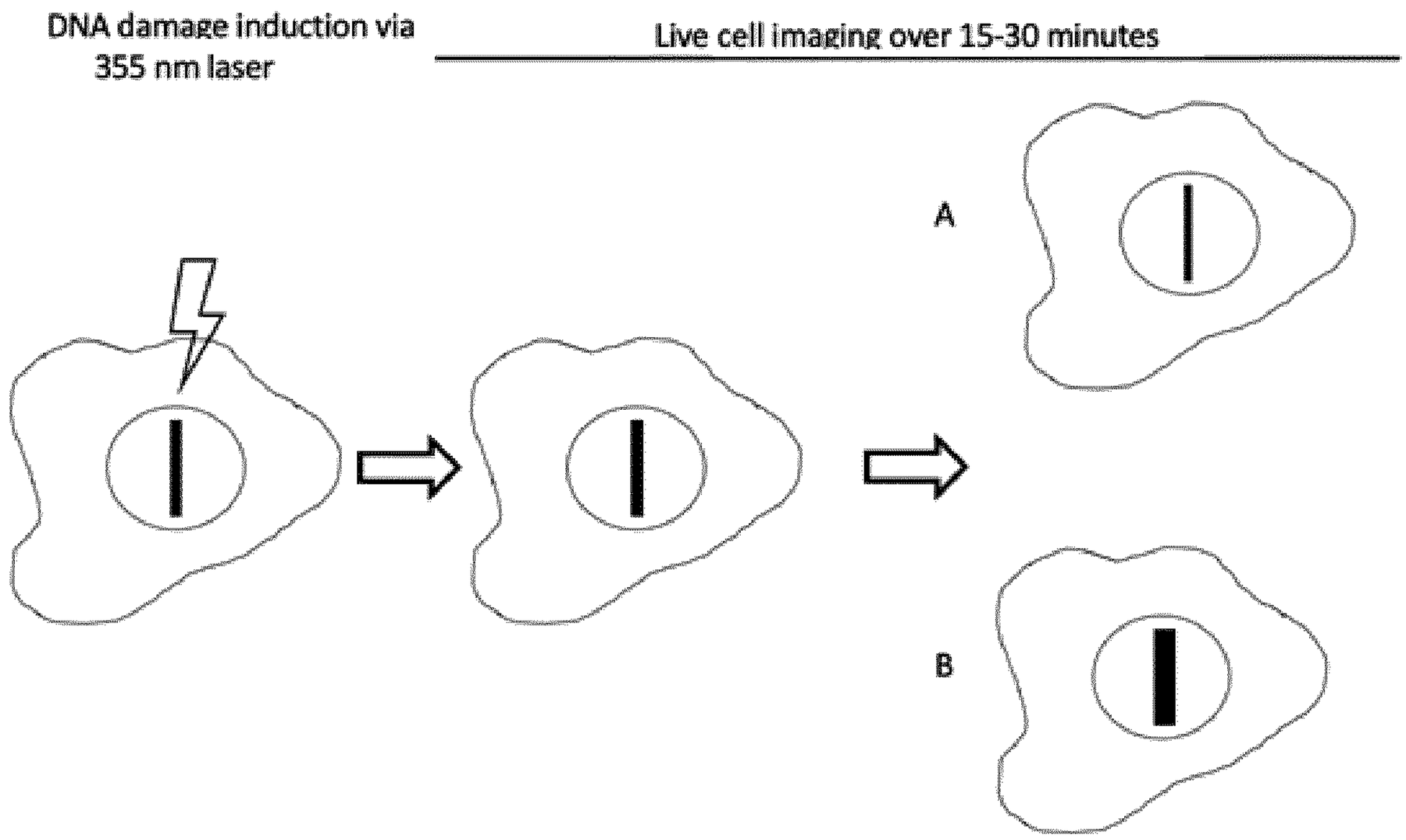


Figure 5

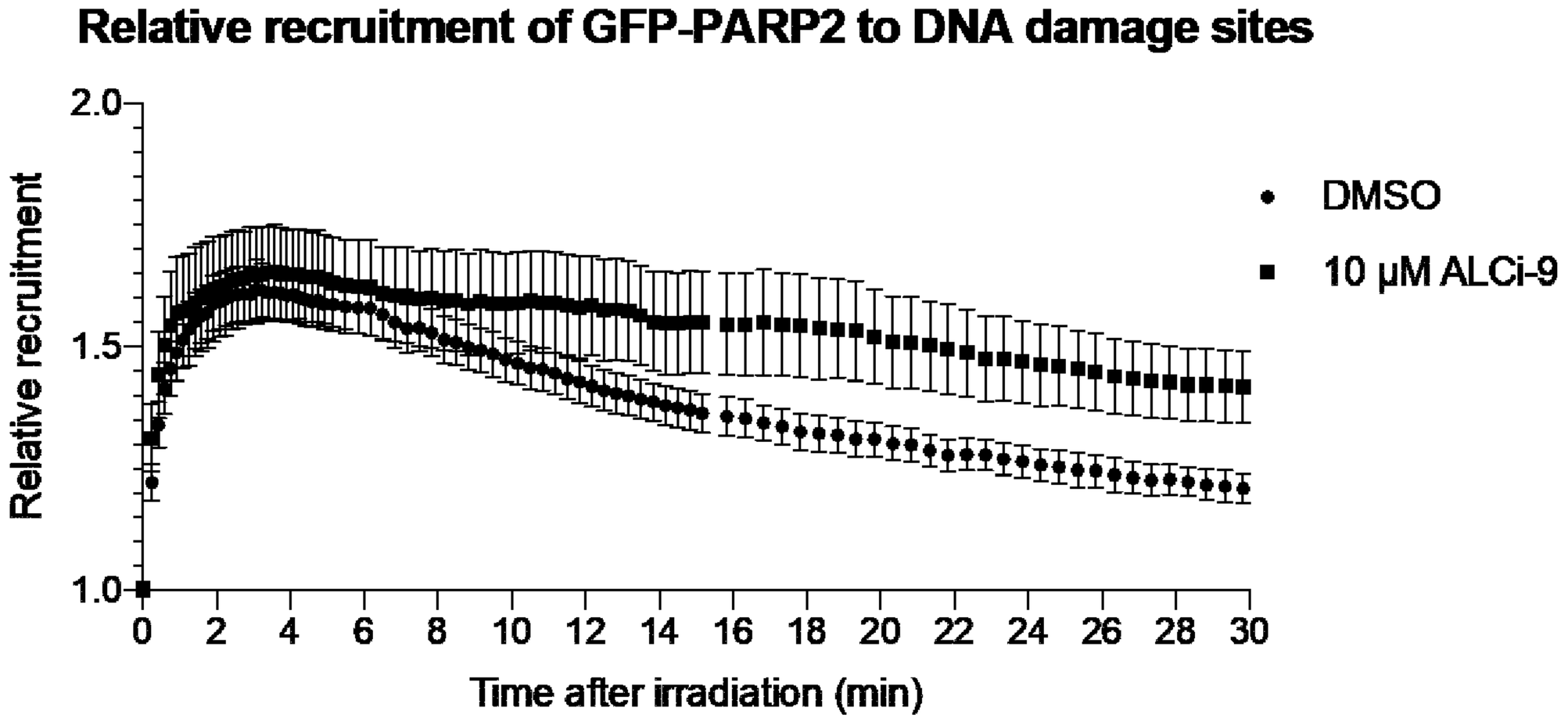


Figure 6

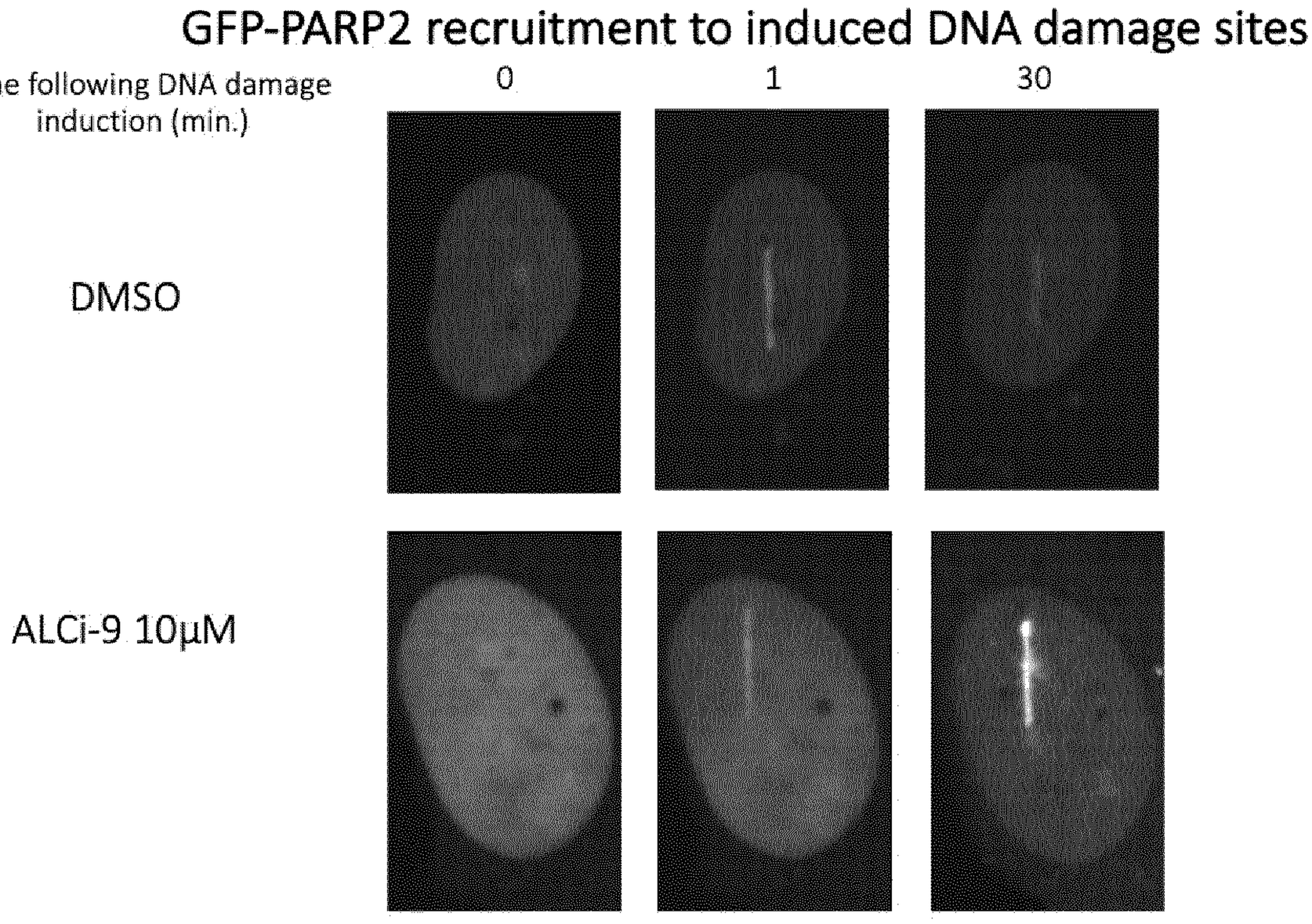


Figure 7

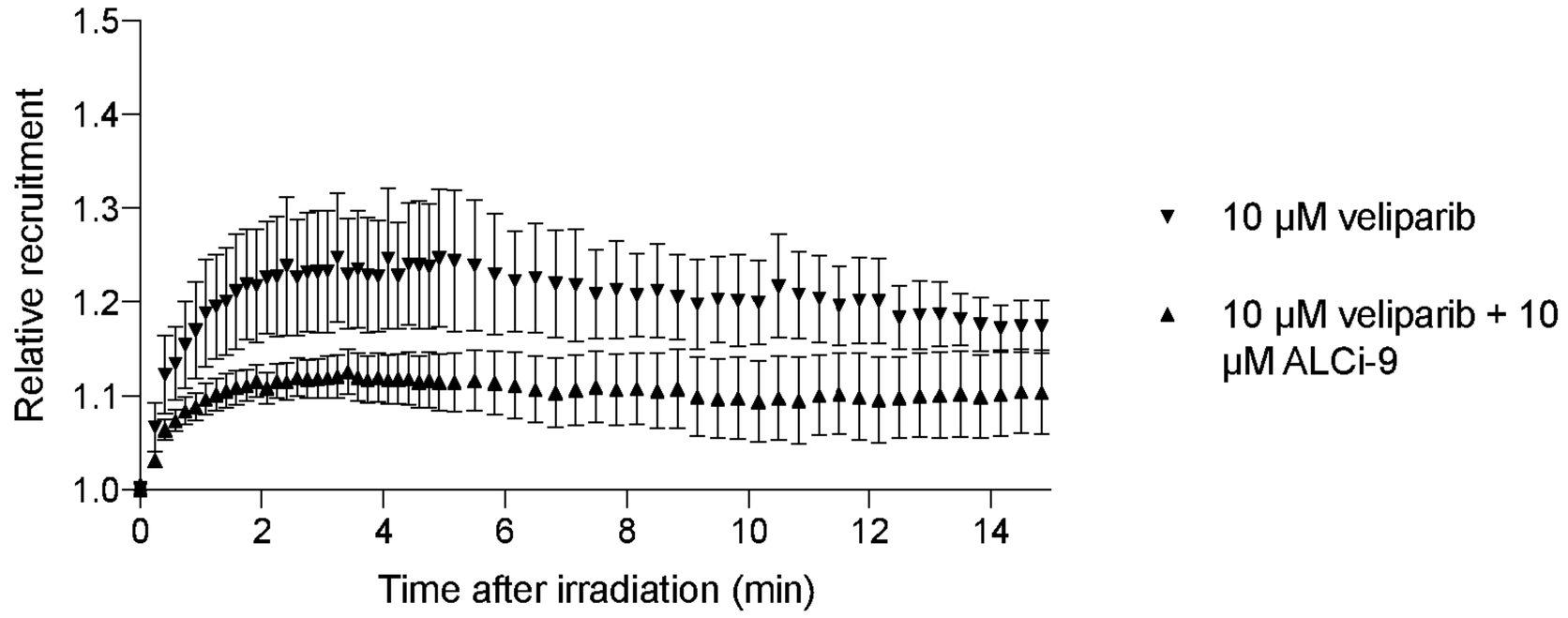


Figure 8

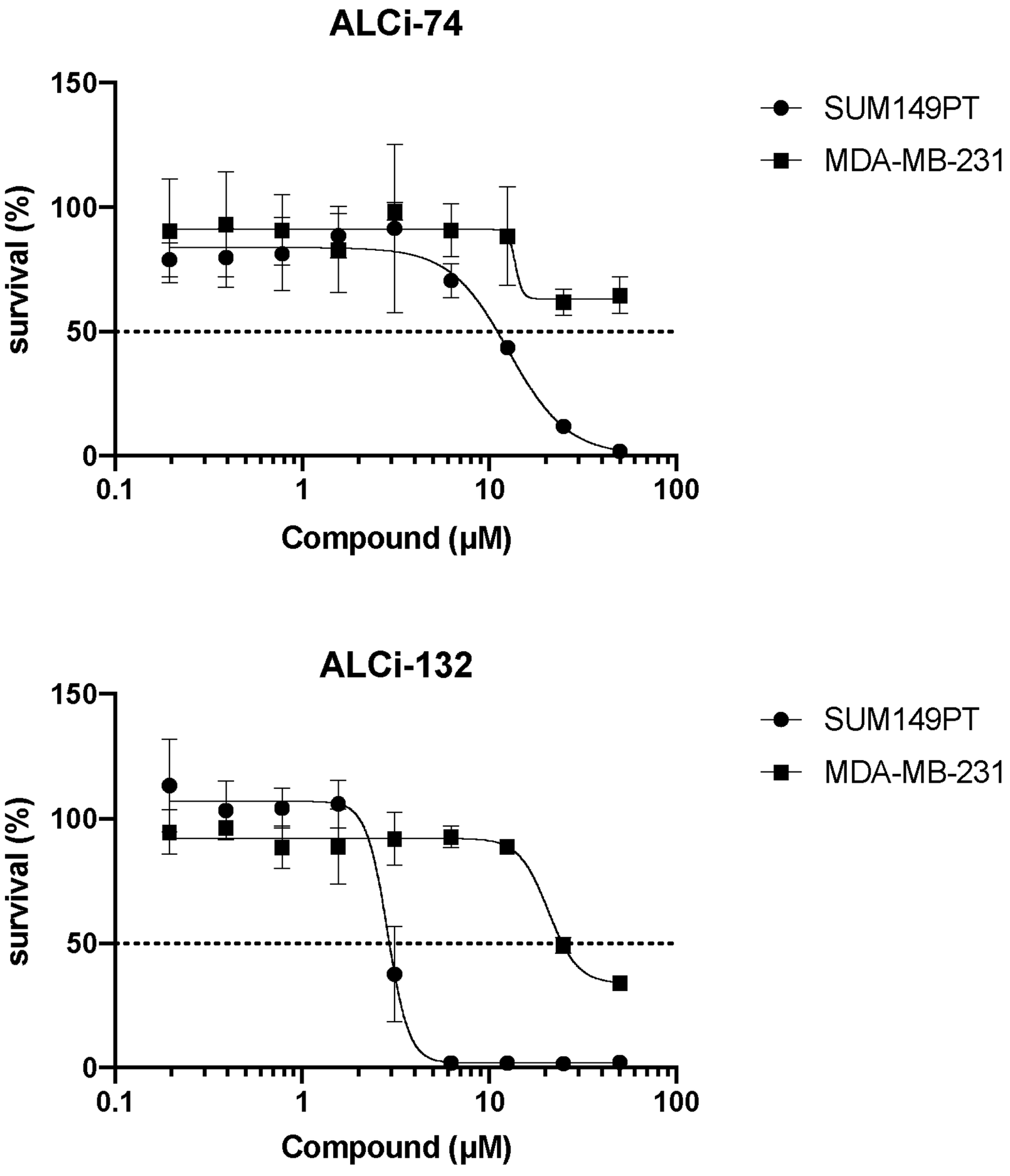


Figure 9, part 1

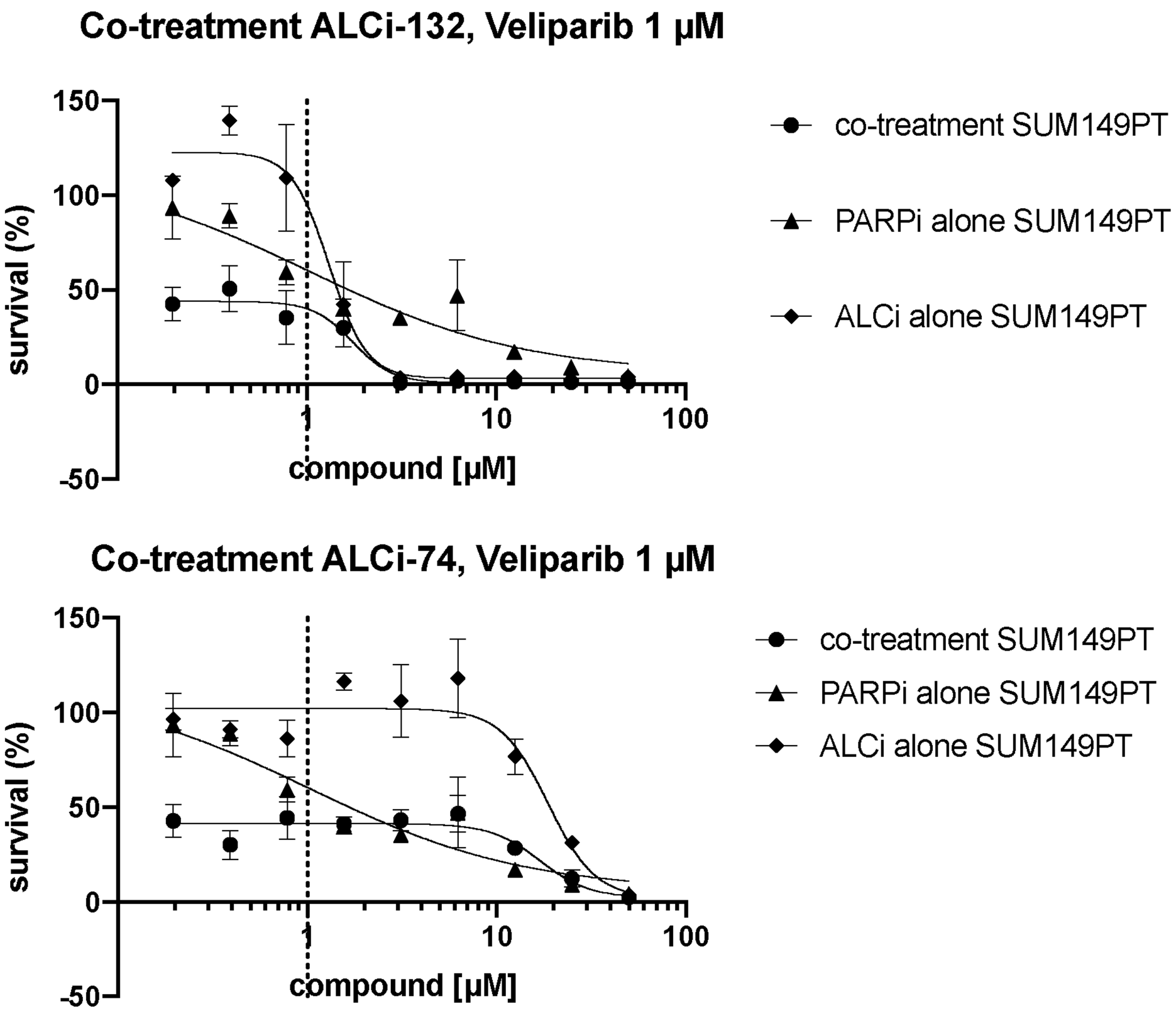
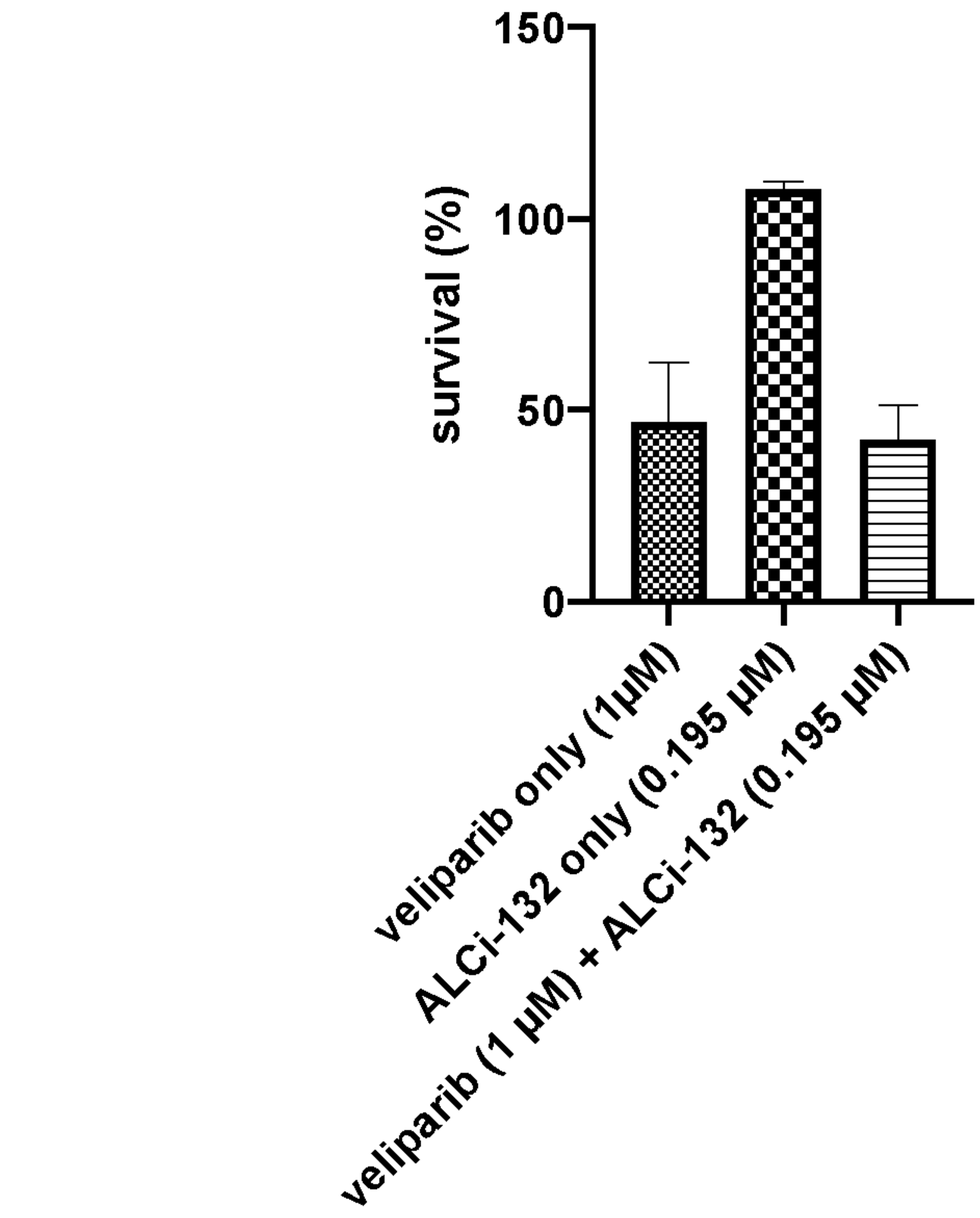


Figure 9, part 2



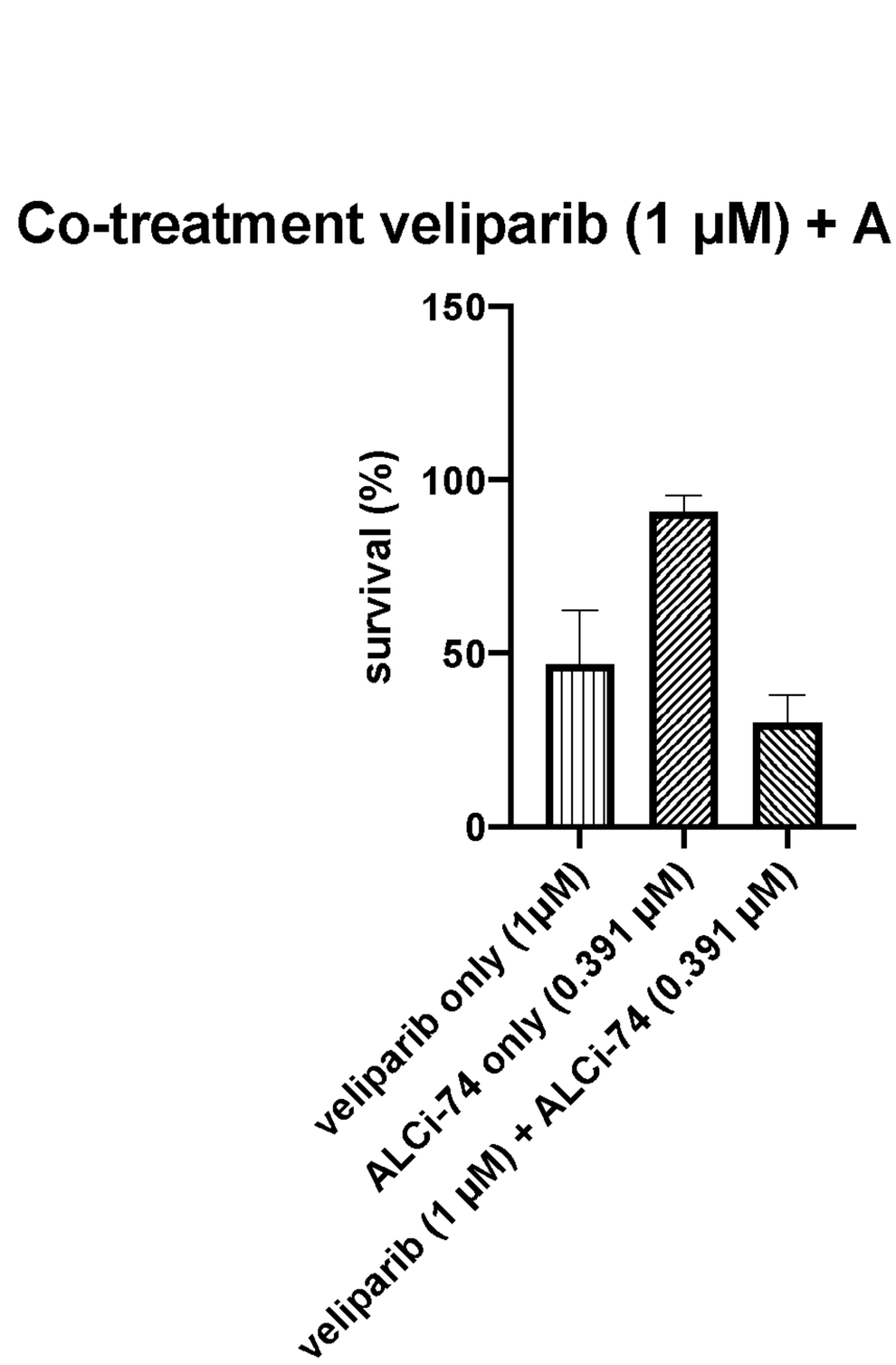


Figure 10

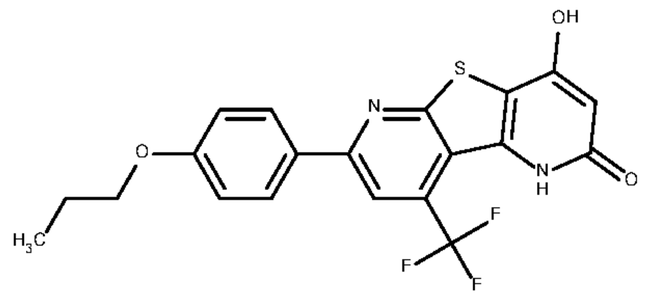
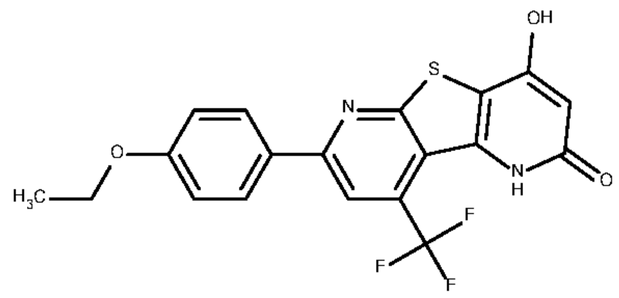
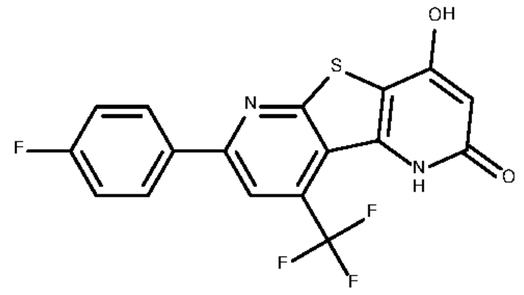
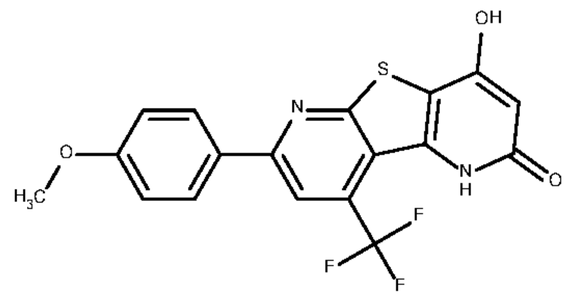
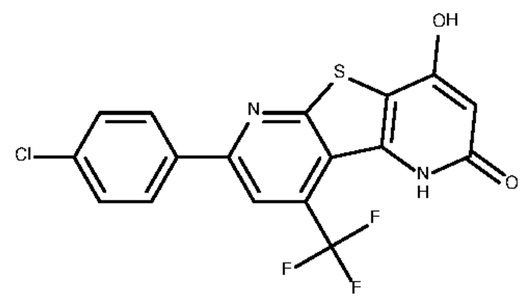
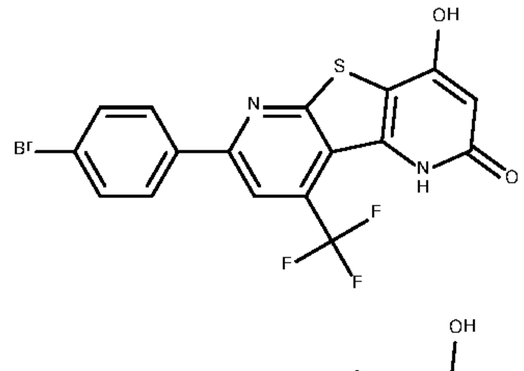
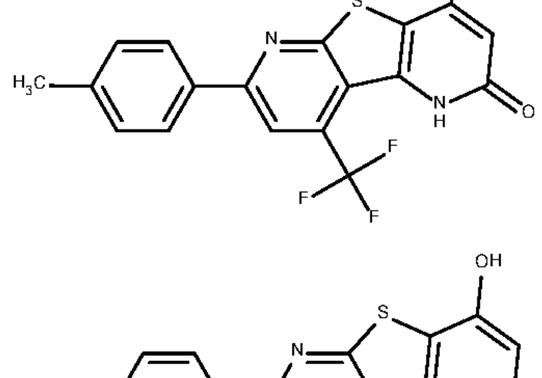
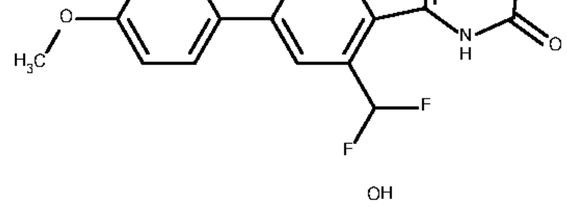
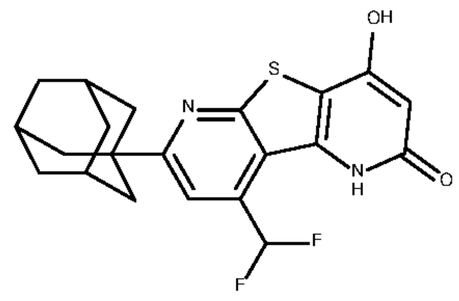
Structure	Molecule Name
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	ALCi-3
	ALCi-4
	ALCi-5
	ALCi-6
	ALCi-7
	ALCi-8
	ALCi-9

Figure 10 (continued)

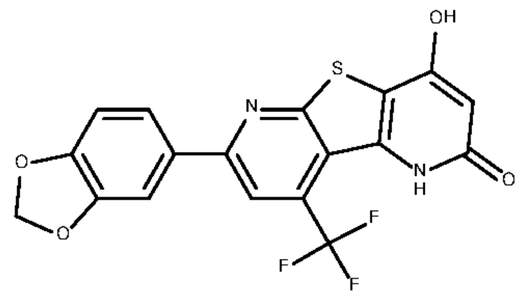
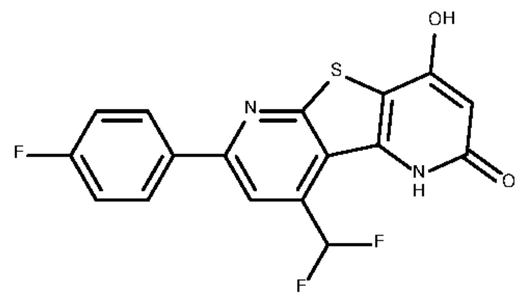
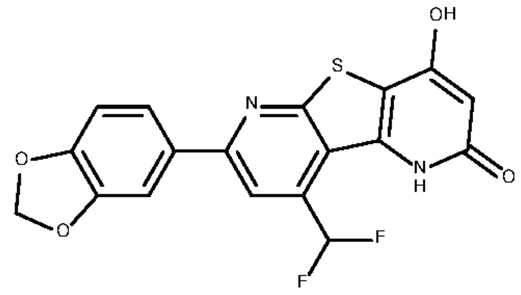
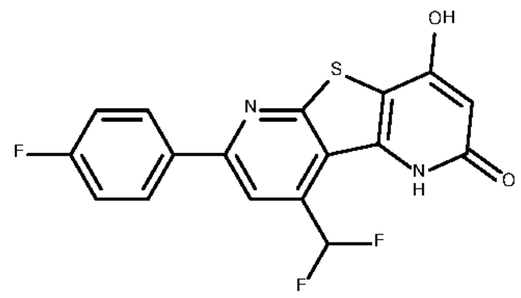
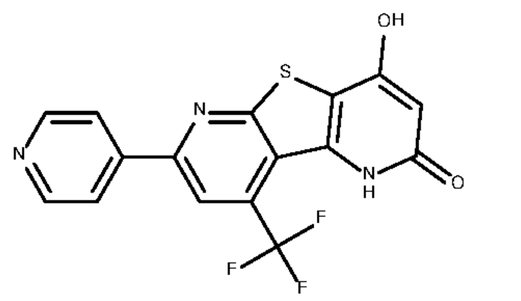
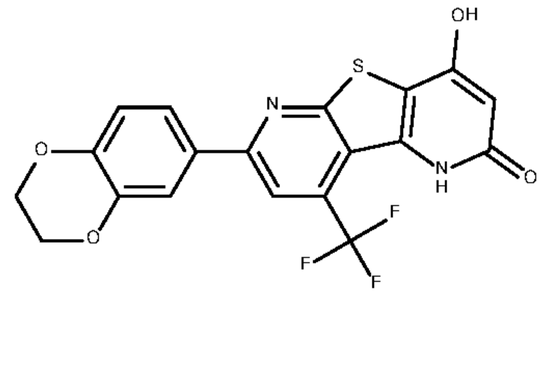
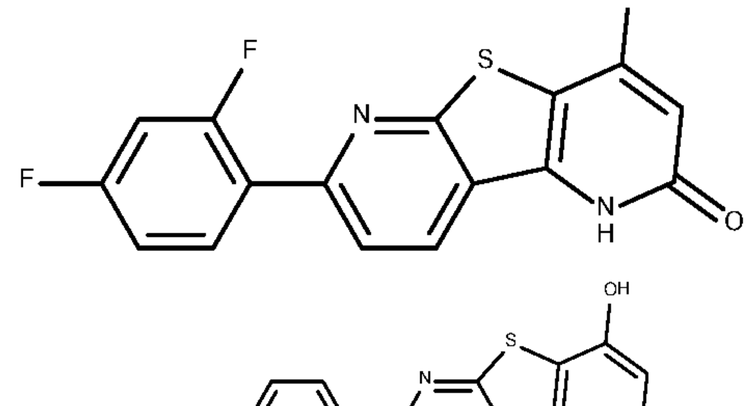
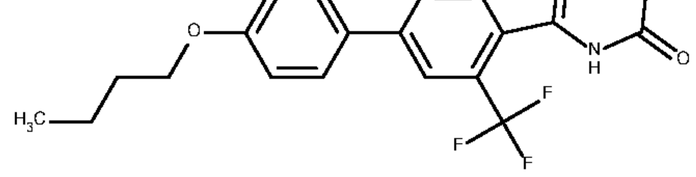
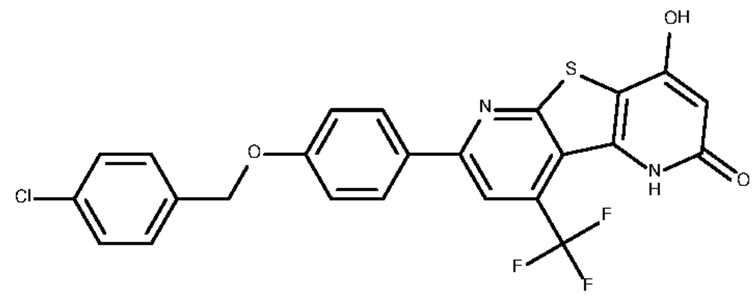
Structure	Molecule Name
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	ALCi-14
	ALCi-15
	ALCi-17
	ALCi-18
	ALCi-19
	ALCi-22
	ALCi-23

Figure 10 (continued)

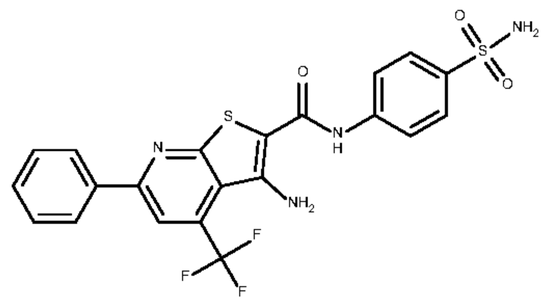
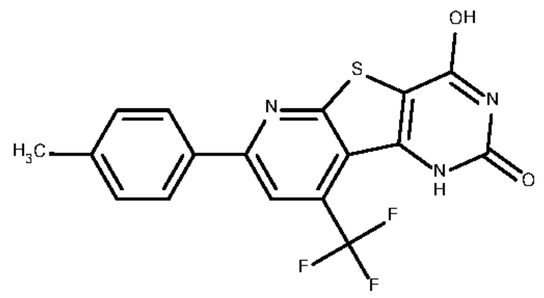
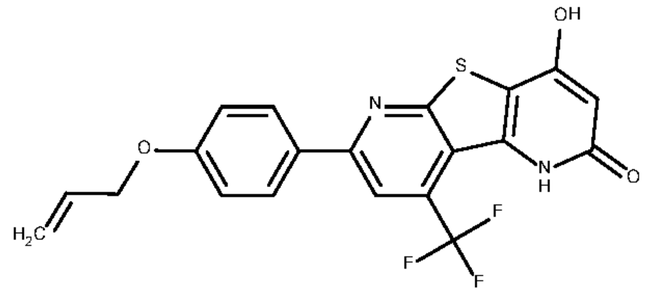
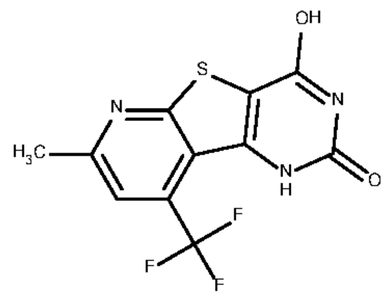
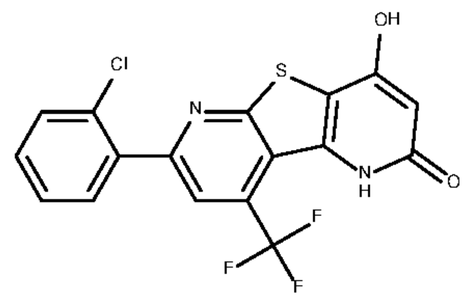
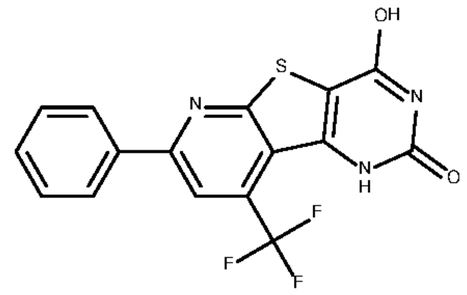
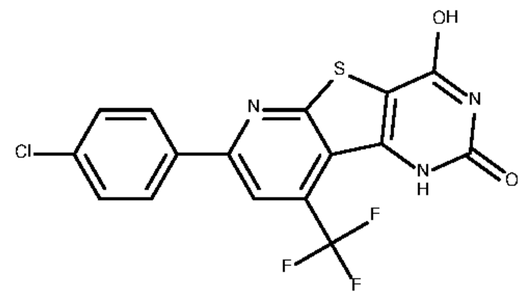
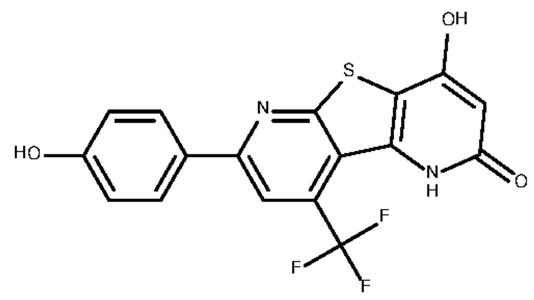
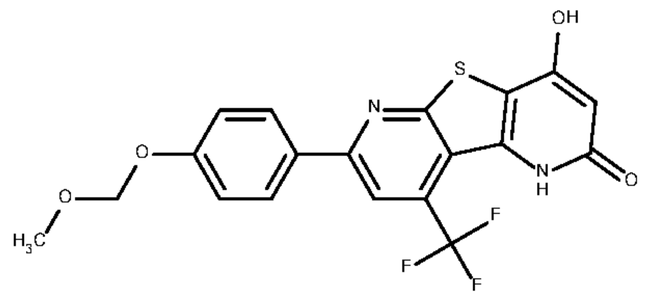
Structure	Molecule Name
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	ALCi-30
	ALCi-36
	ALCi-37
	ALCi-39
	ALCi-40
	ALCi-43
	ALCi-44

Figure 10 (continued)

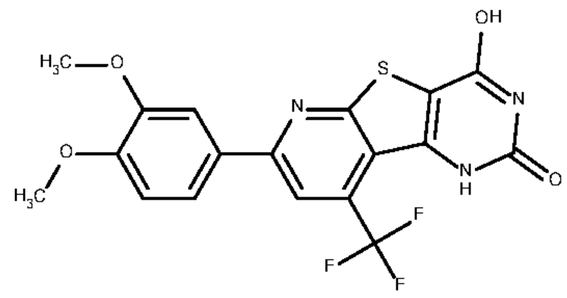
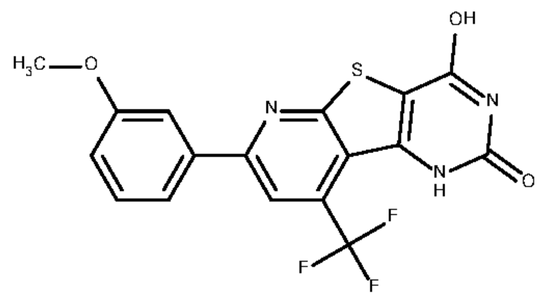
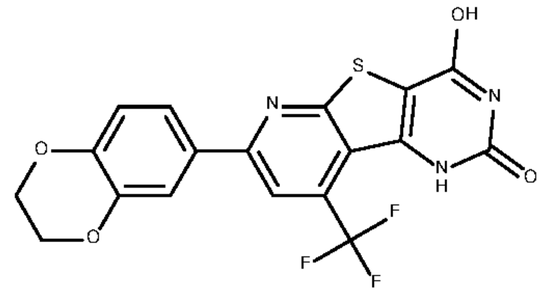
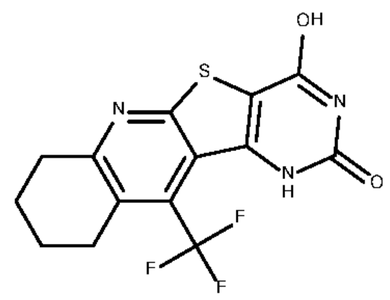
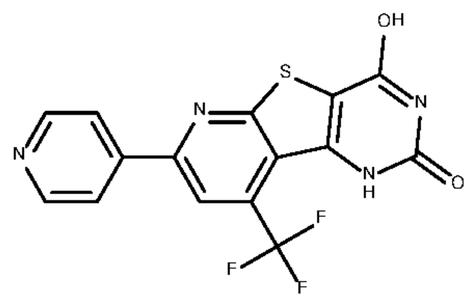
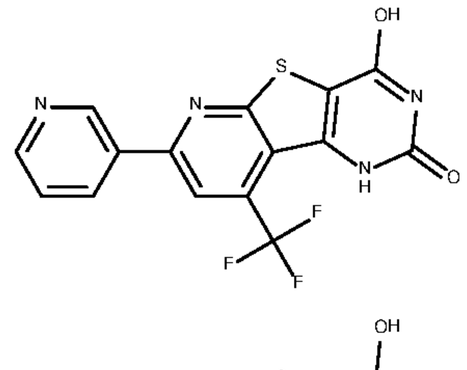
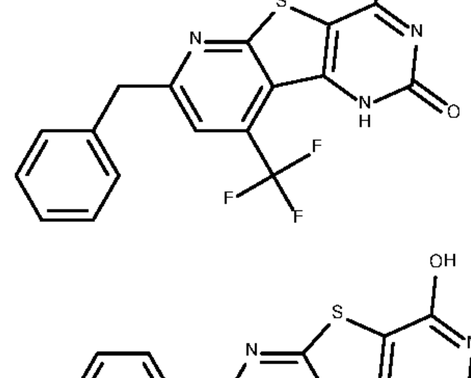
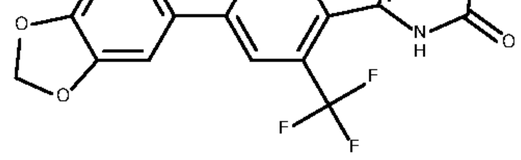
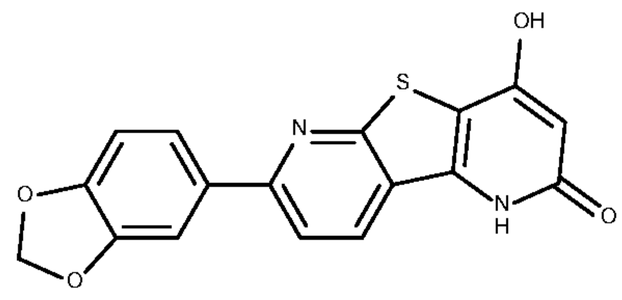
Structure	Molecule Name
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	ALCi-47
	ALCi-48
	ALCi-50
	ALCi-51
	ALCi-52
	ALCi-53
	ALCi-54
	ALCi-55

Figure 10 (continued)

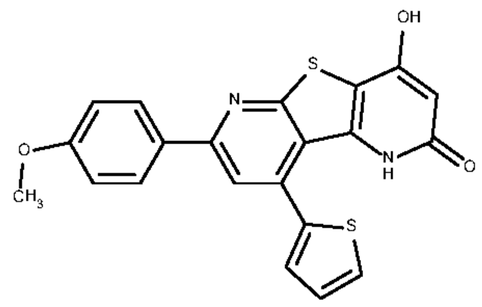
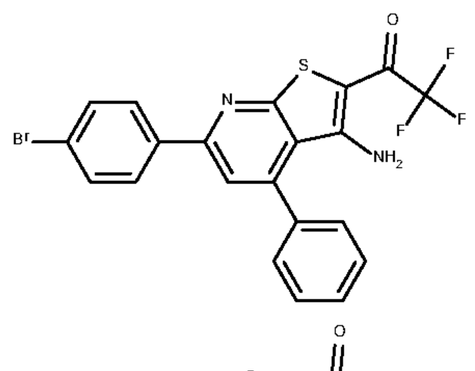
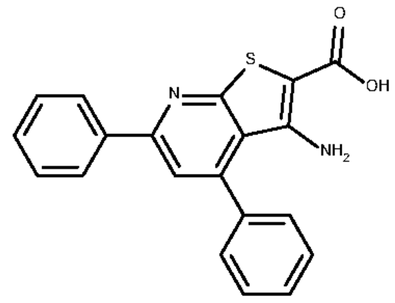
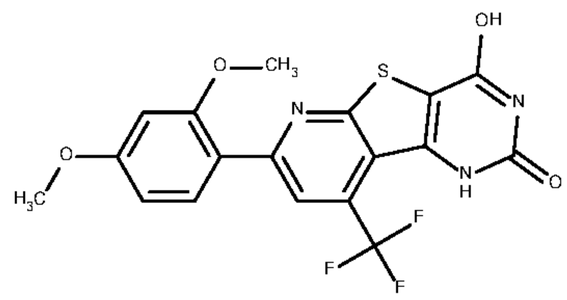
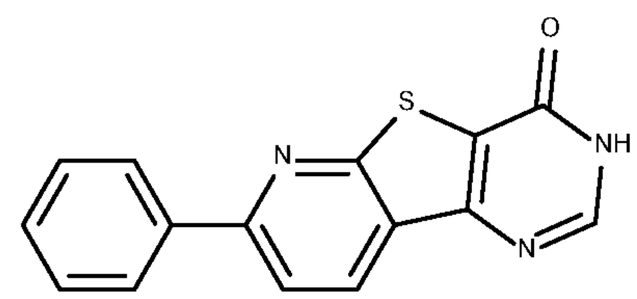
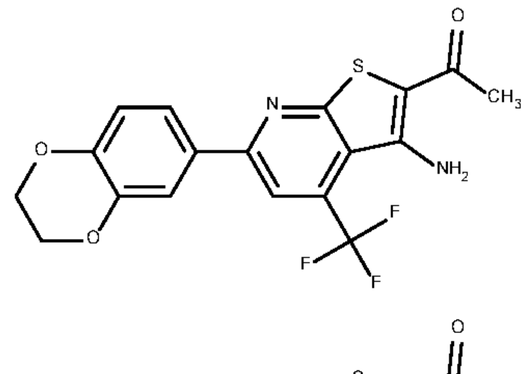
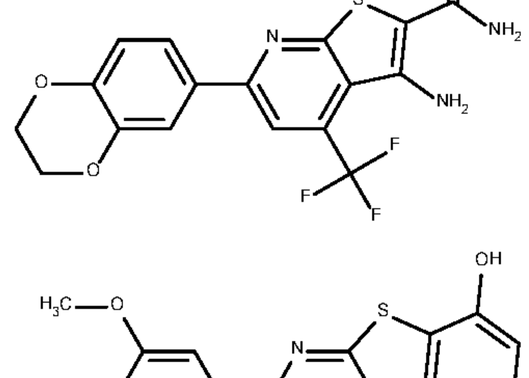
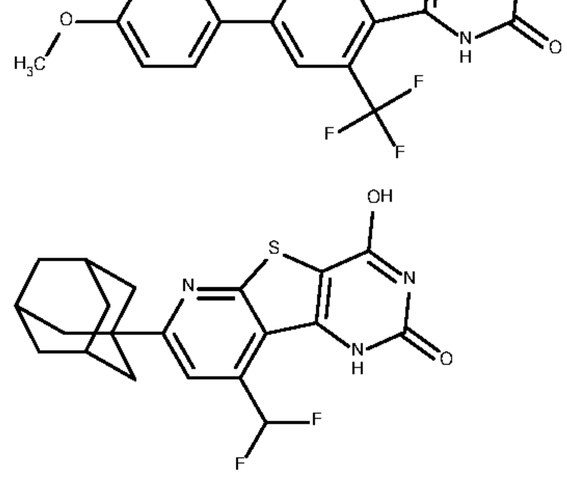
Structure	Molecule Name
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	ALCi-58
	ALCi-60
	ALCi-61
	ALCi-62
	ALCi-63
	ALCi-64
	ALCi-65

Figure 10 (continued)

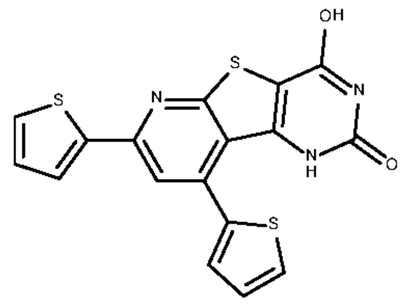
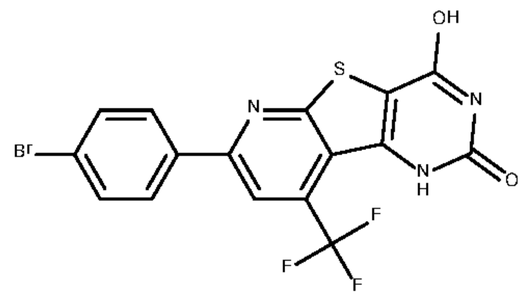
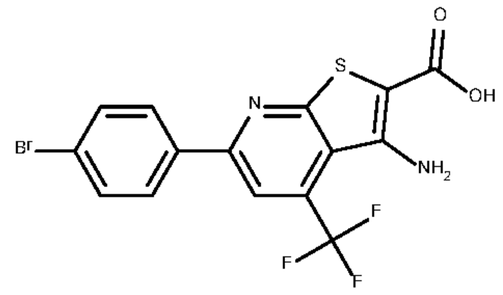
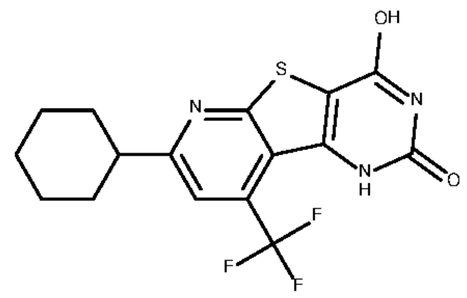
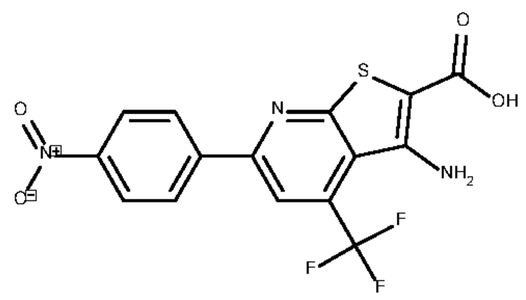
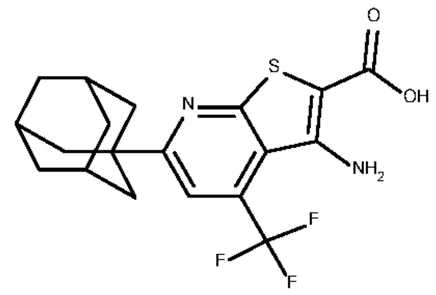
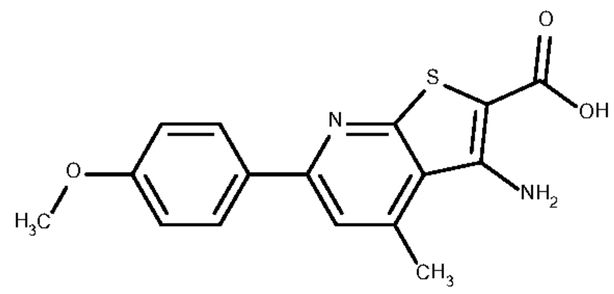
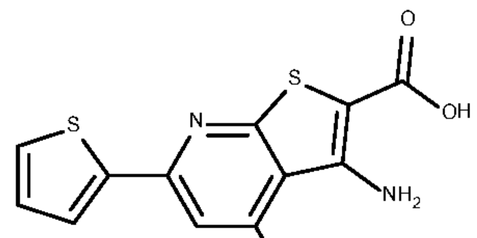
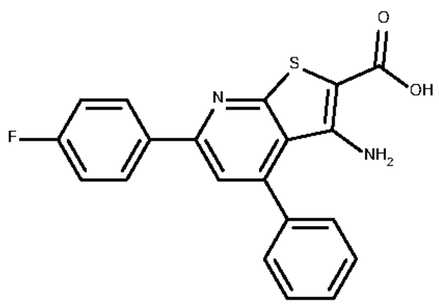
Structure	Molecule Name
	ALCi-70
	ALCi-72
	ALCi-74
	ALCi-75
	ALCi-77
	ALCi-79
	ALCi-81
	ALCi-82
	ALCi-87

Figure 10 (continued)

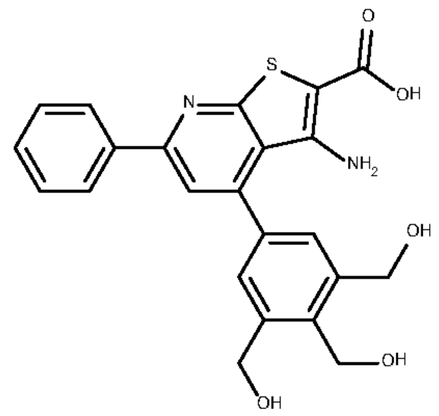
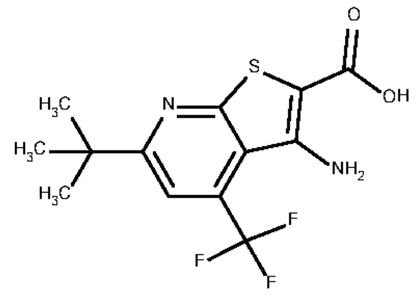
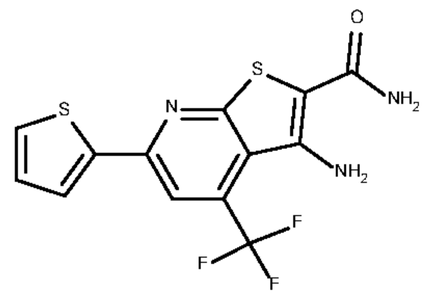
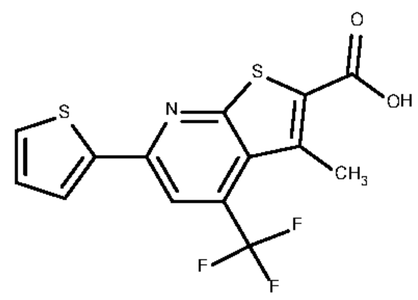
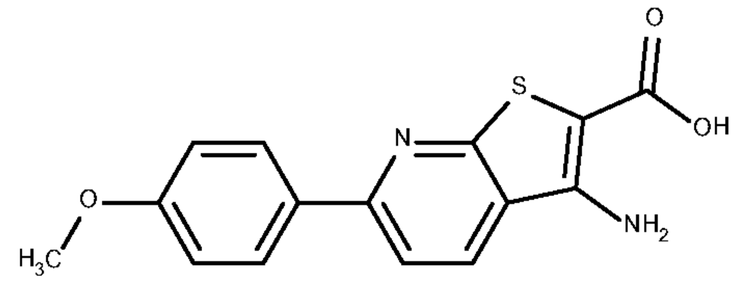
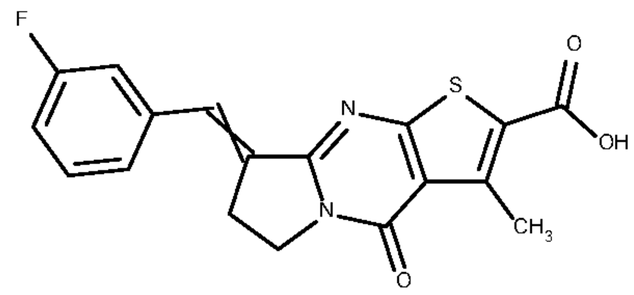
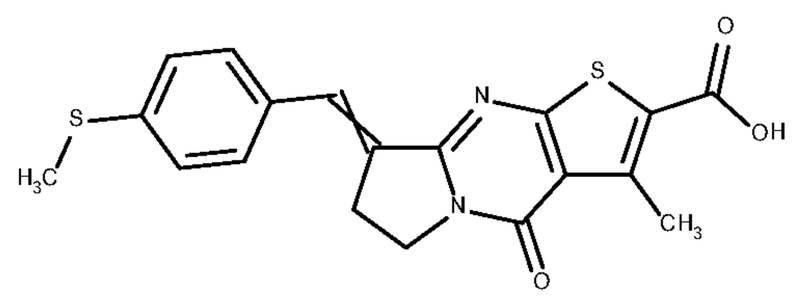
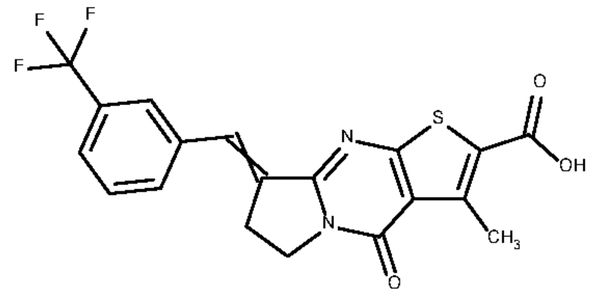
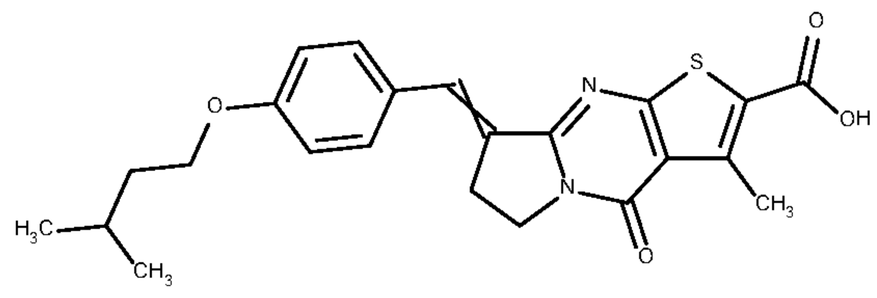
Structure	Molecule Name
	ALCi-90
	ALCi-93
	ALCi-94
	ALCi-97
	ALCi-101
	ALCi-120
	ALCi-123
	ALCi-124
	ALCi-125

Figure 10 (continued)

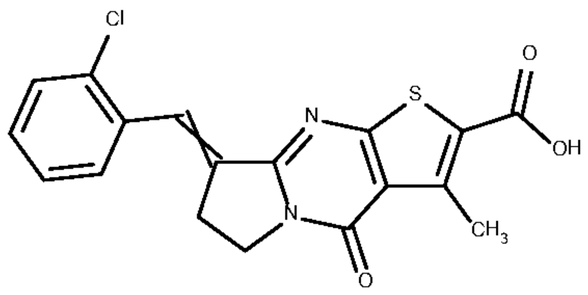
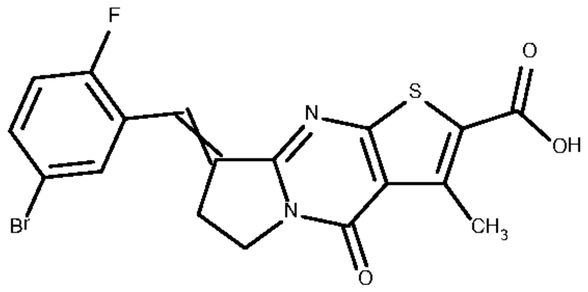
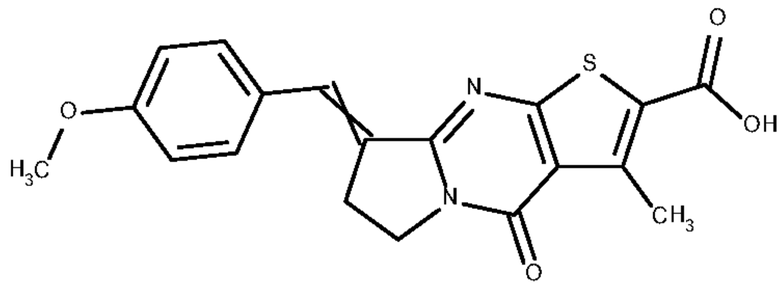
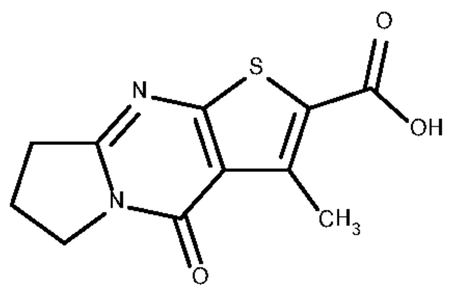
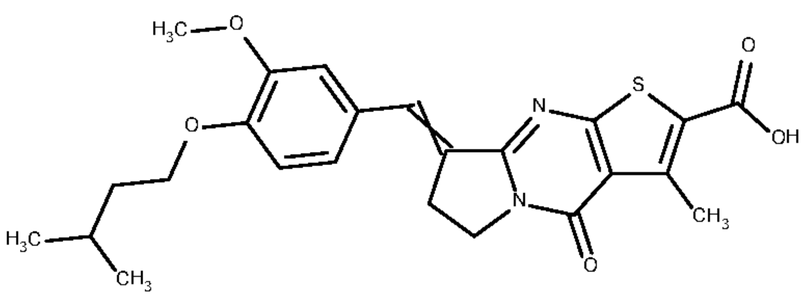
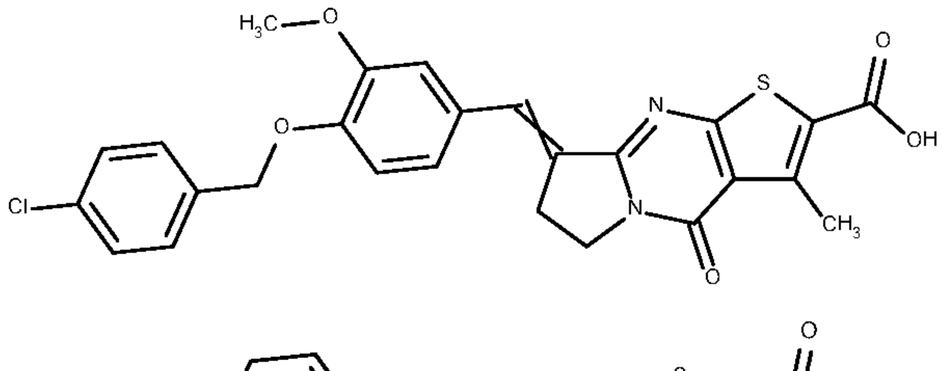
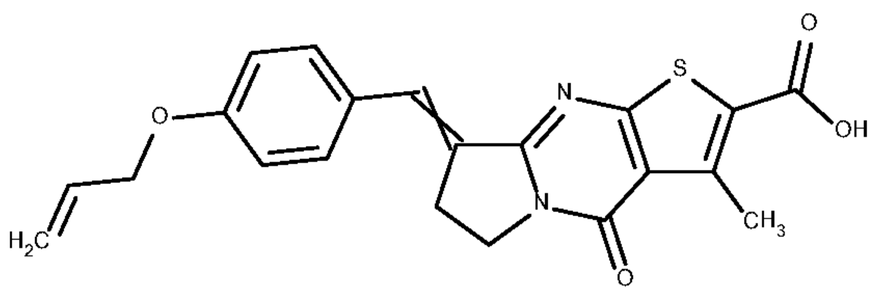
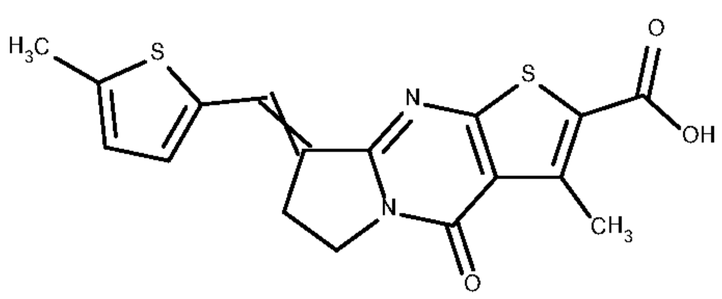
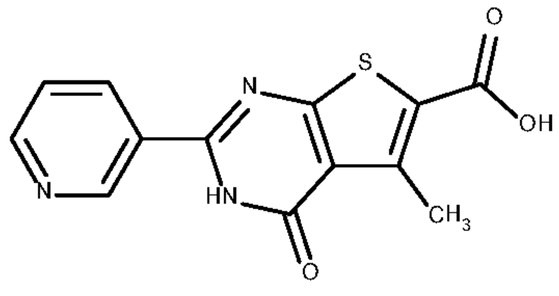
Structure	Molecule Name
	ALCi-127
	ALCi-128
	ALCi-129
	ALCi-130
	ALCi-131
	ALCi-132
	ALCi-133
	ALCi-134
	ALCi-135

Figure 10 (continued)

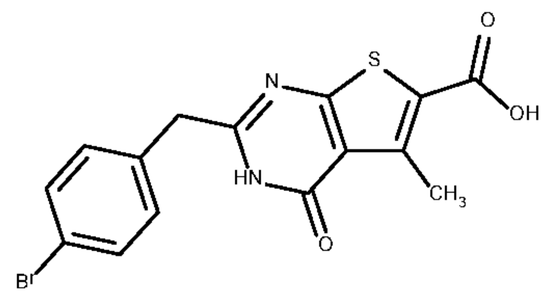
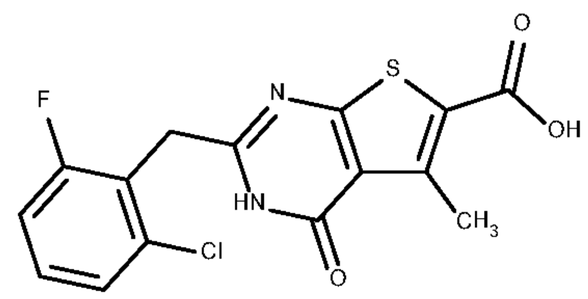
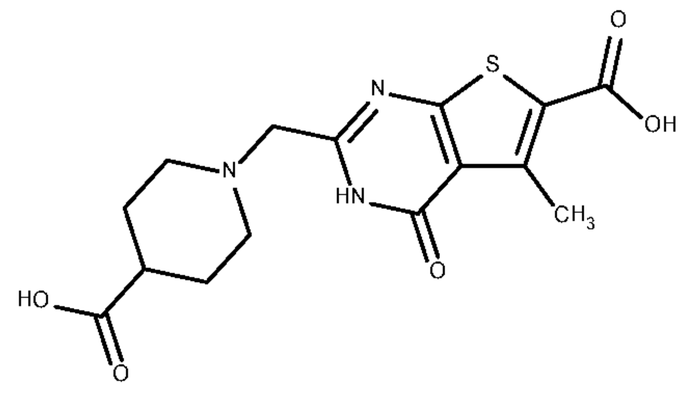
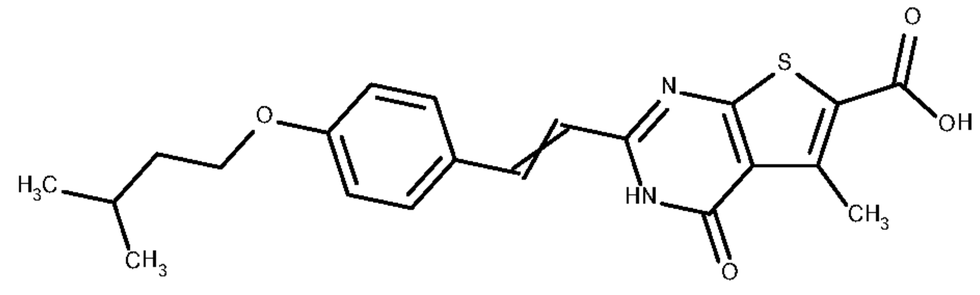
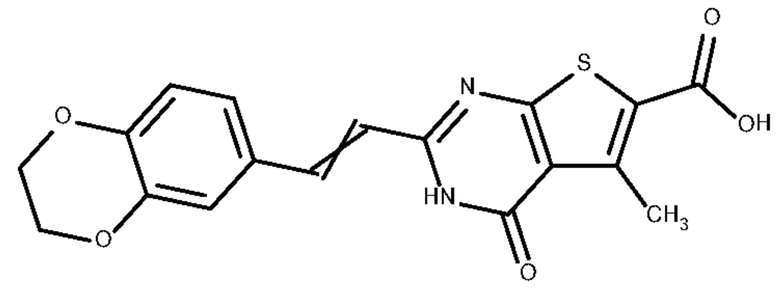
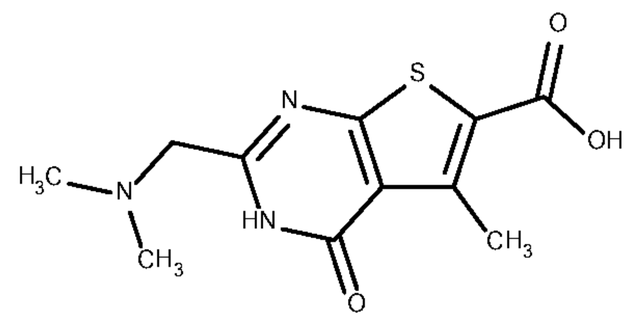
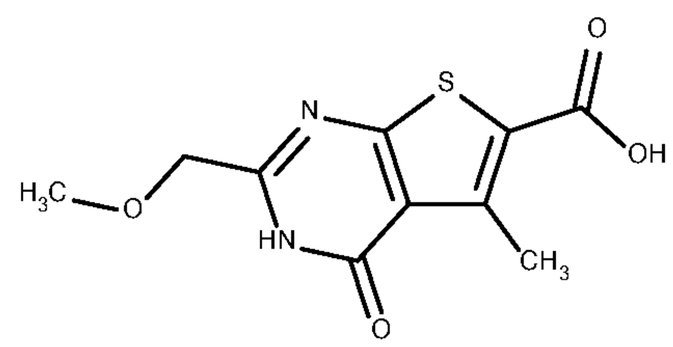
Structure	Molecule Name
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	ALCi-137
	ALCi-138
	ALCi-146
	ALCi-147
	ALCi-150
	ALCi-151

Figure 10 (continued)

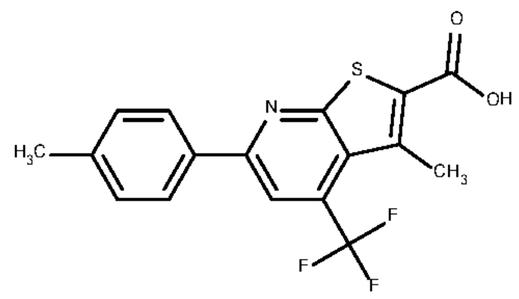
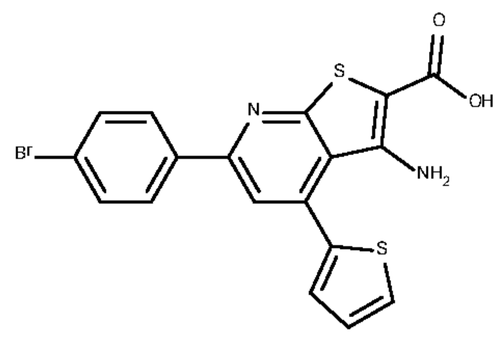
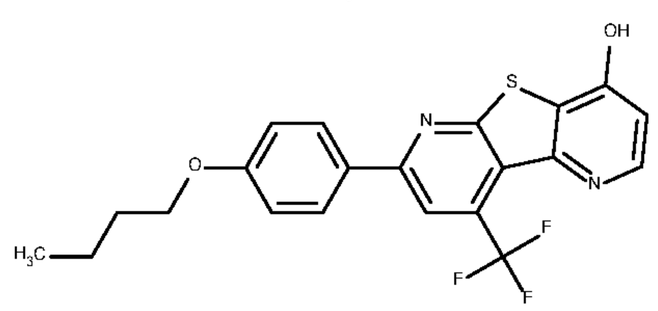
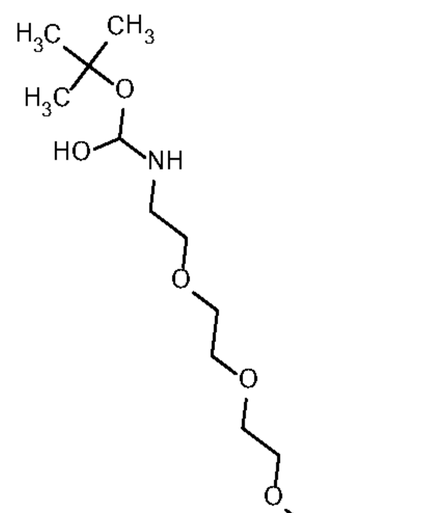
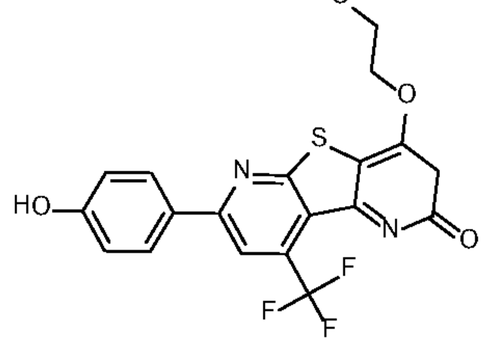
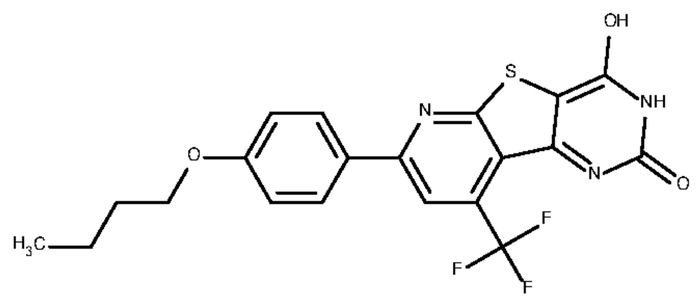
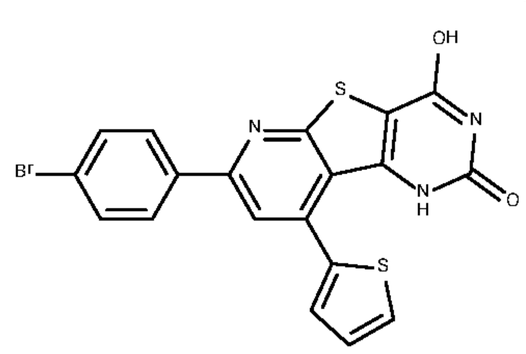
Structure	Molecule Name
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	ALCi-157
	ALCi-158
	ALCi-160
	ALCi-162
	ALCi-163
	ALCi-164

Figure 10 (continued)

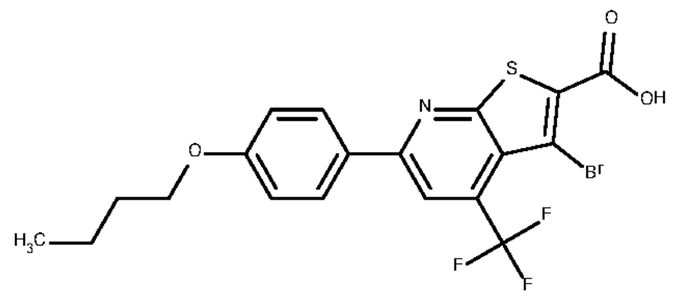
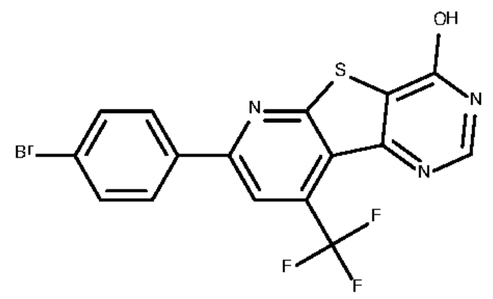
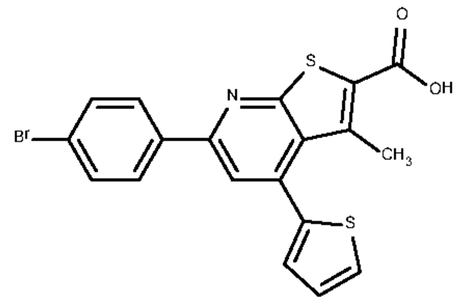
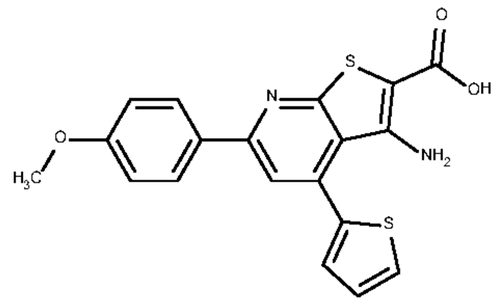
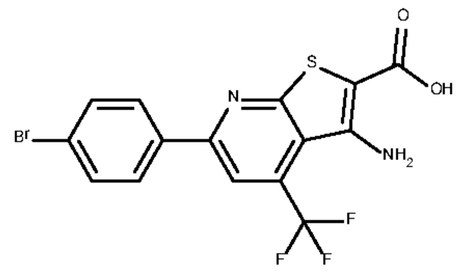
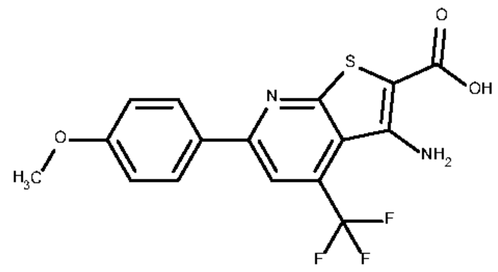
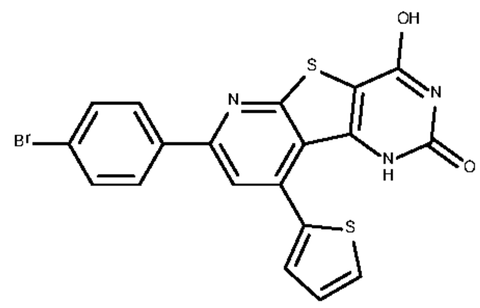
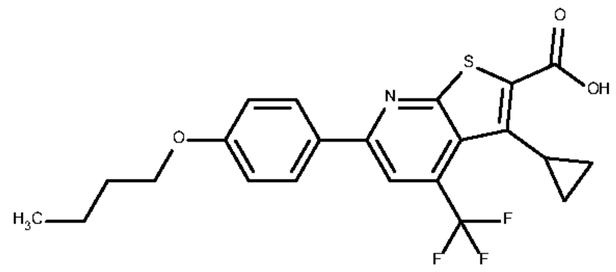
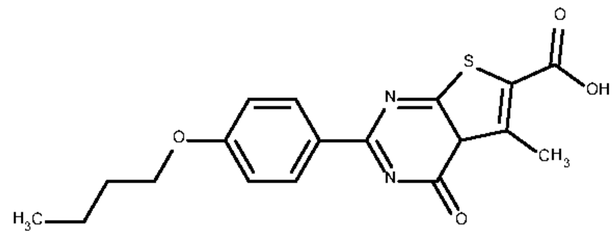
Structure	Molecule Name
	ALCi-166
	ALCi-167
	ALCi-171
	ALCi-172
	ALCi-177
	ALCi-178
	ALCi-179
	ALCi-180
	ALCi-183

Figure 10 (continued)

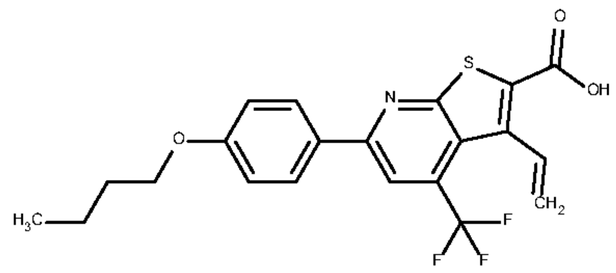
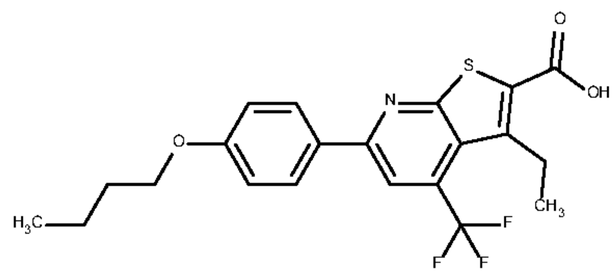
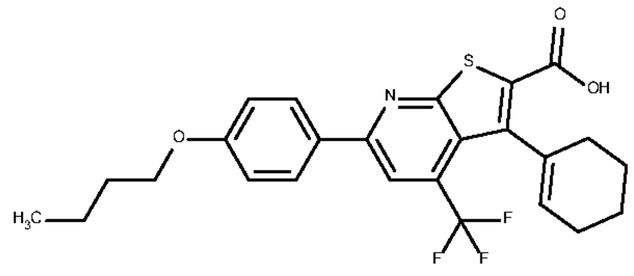
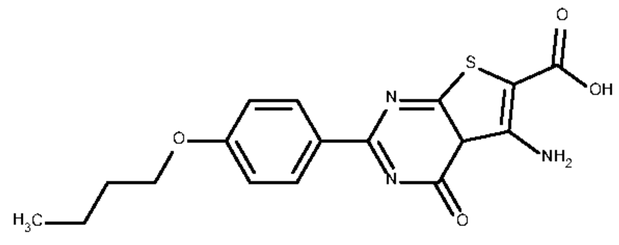
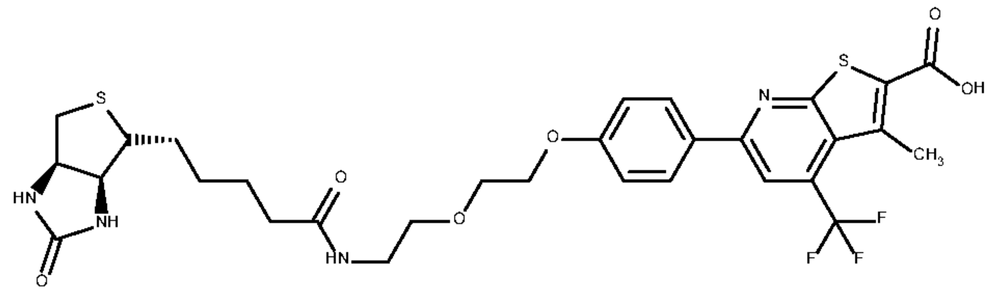
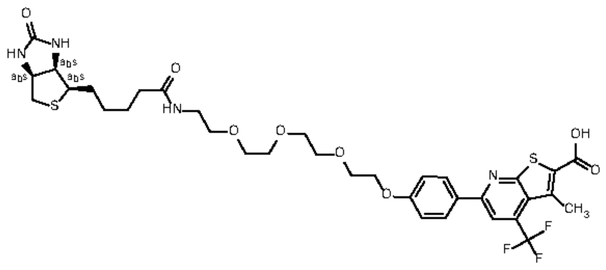
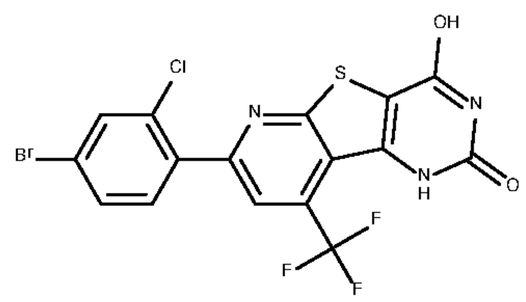
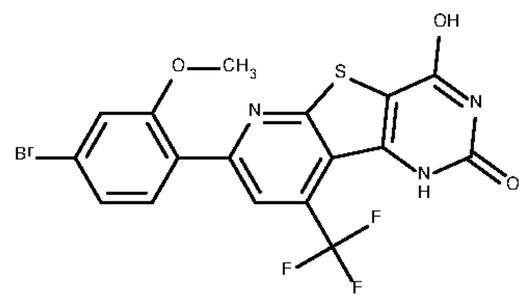
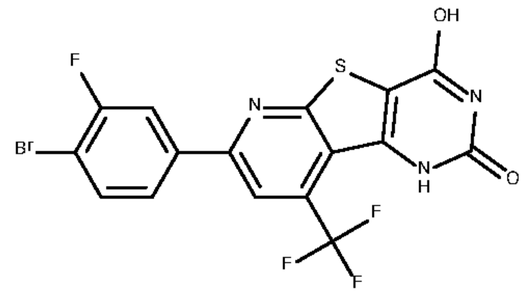
Structure	Molecule Name
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	ALCi-185
	ALCi-186
	ALCi-187
	ALCi-188
	ALCi-189
	ALCi-190
	ALCi-191
	ALCi-192

Figure 10 (continued)

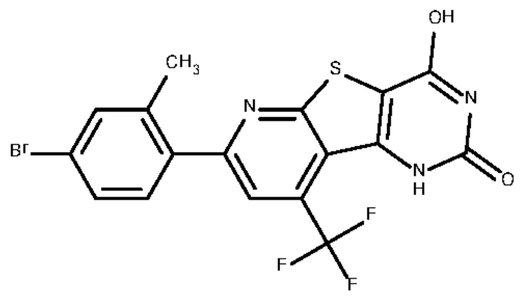
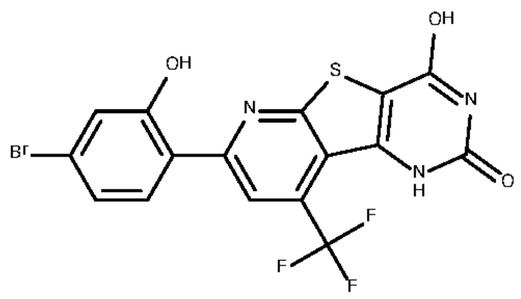
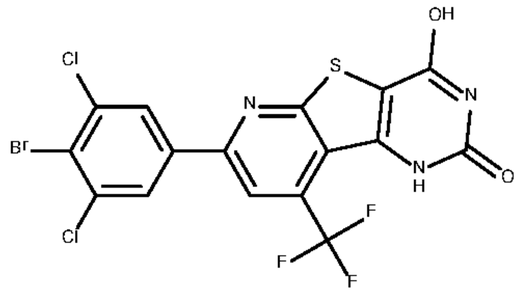
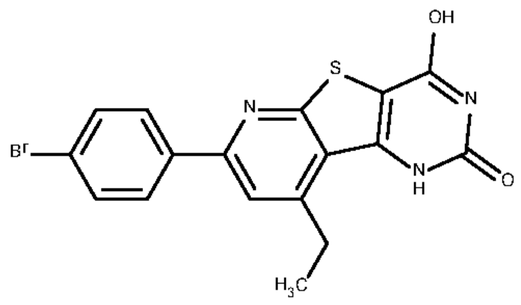
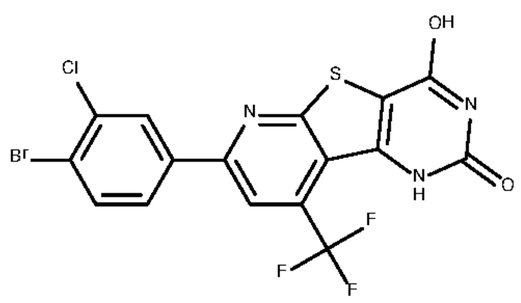
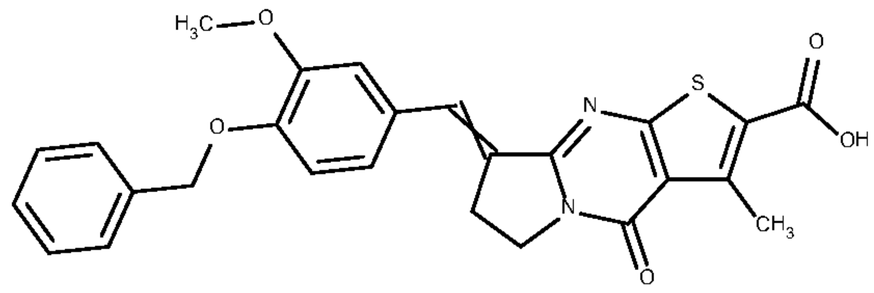
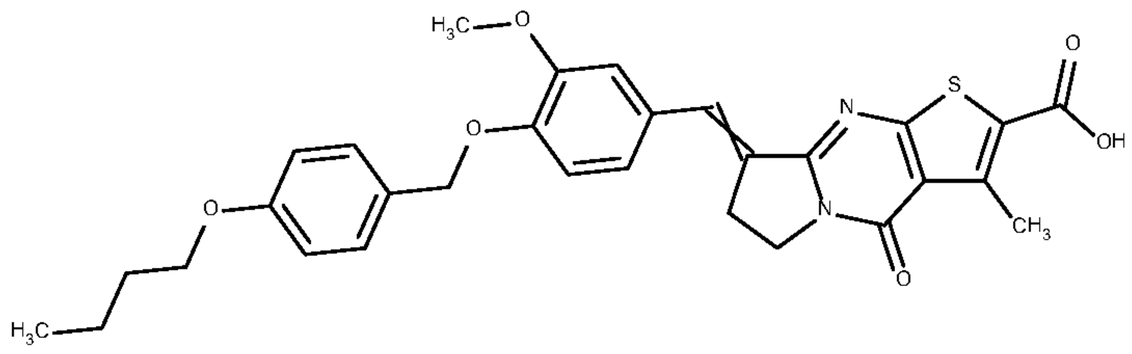
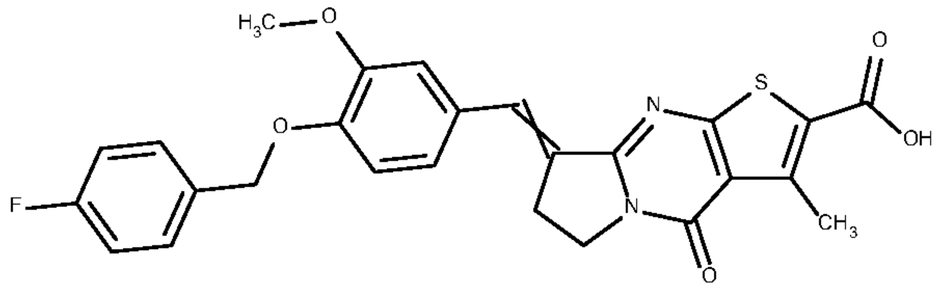
Structure	Molecule Name
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	ALCi-194
	ALCi-195
	ALCi-196
	ALCi-197
	ALCi-198
	ALCi-199
	ALCi-200

Figure 10 (continued)

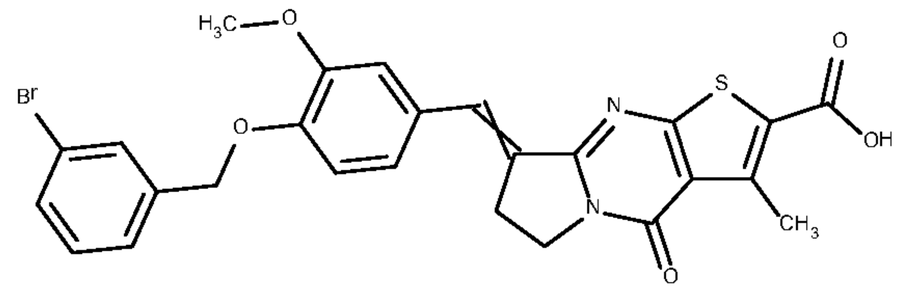
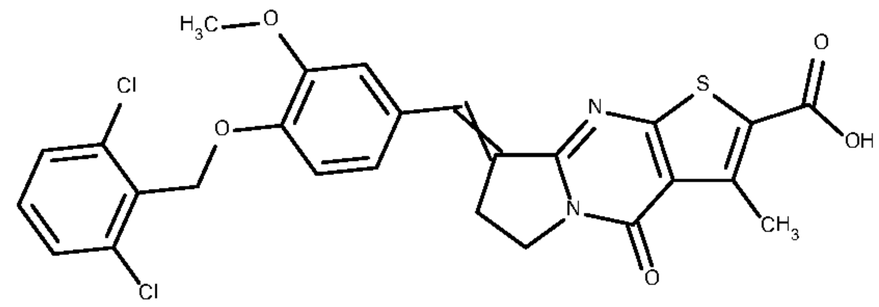
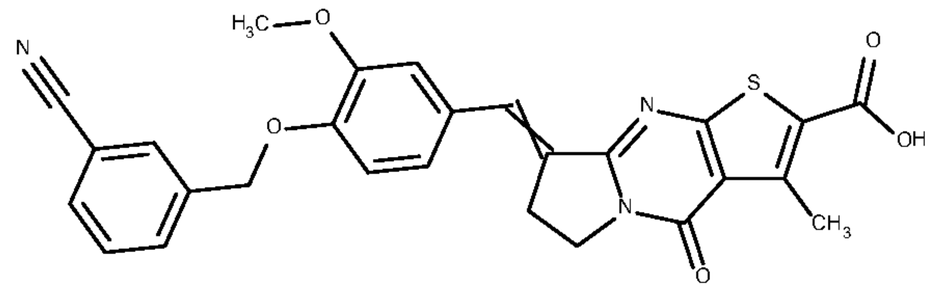
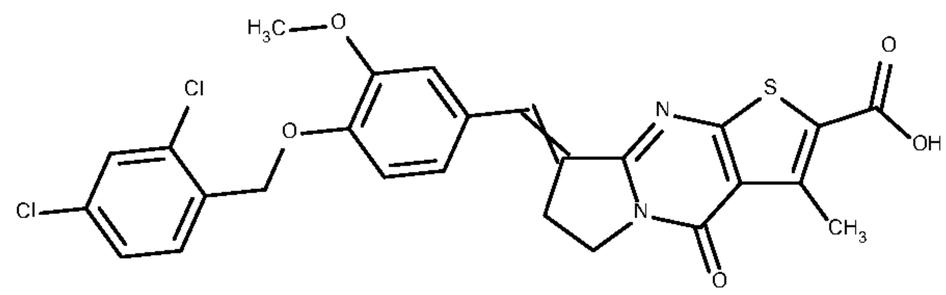
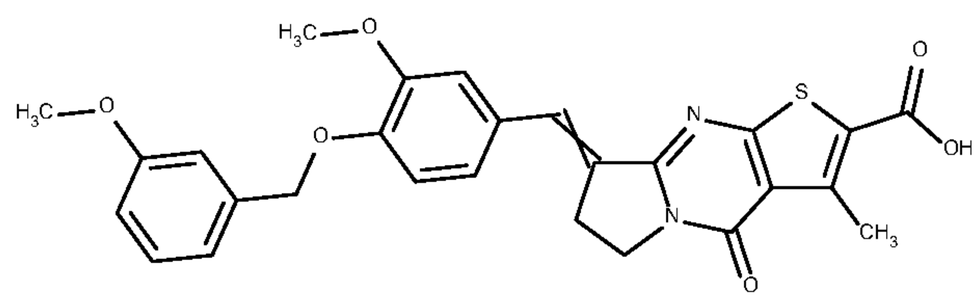
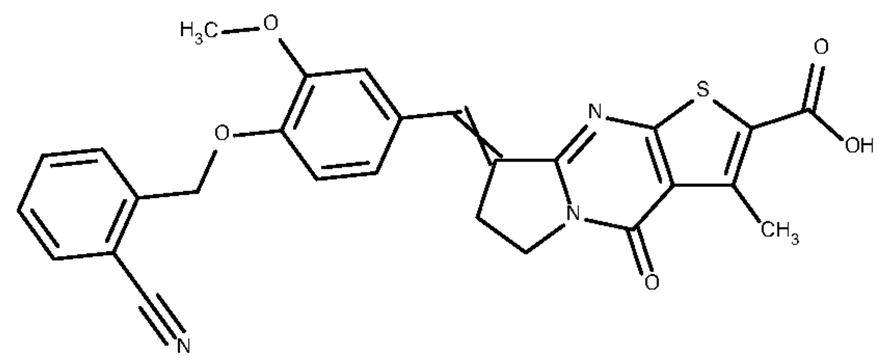
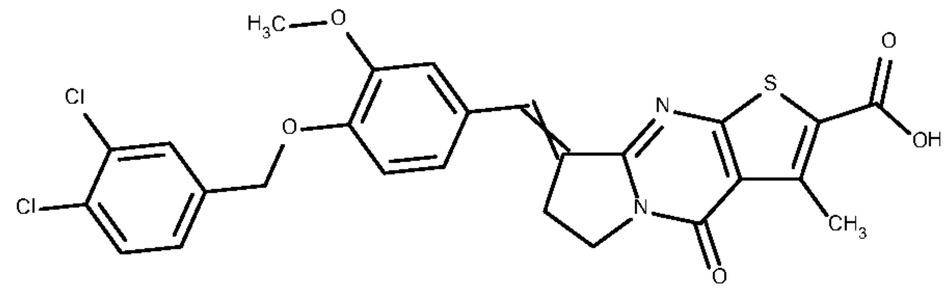
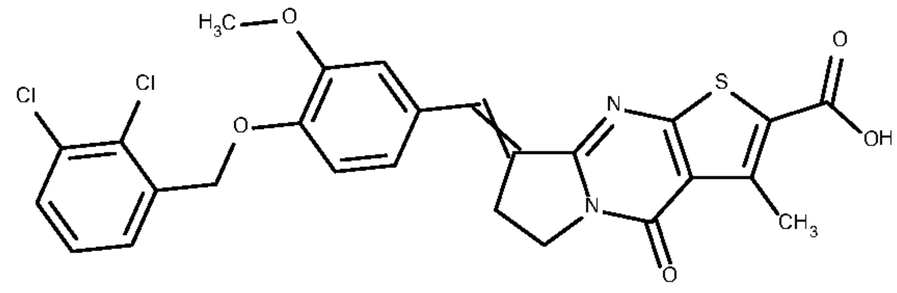
Structure	Molecule Name
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	ALCi-202
	ALCi-203
	ALCi-204
	ALCi-205
	ALCi-206
	ALCi-207
	ALCi-208

Figure 10 (continued)

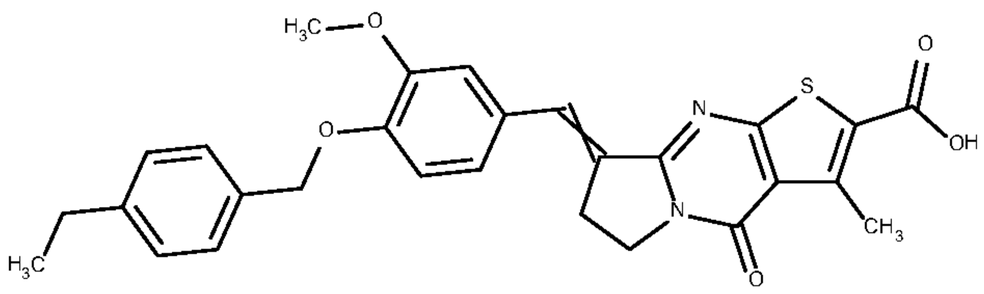
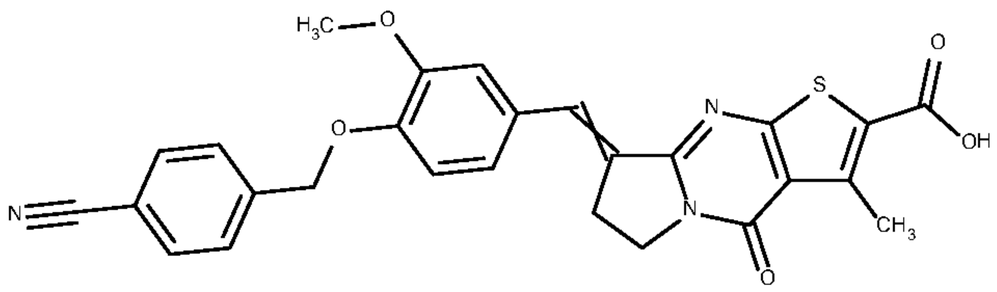
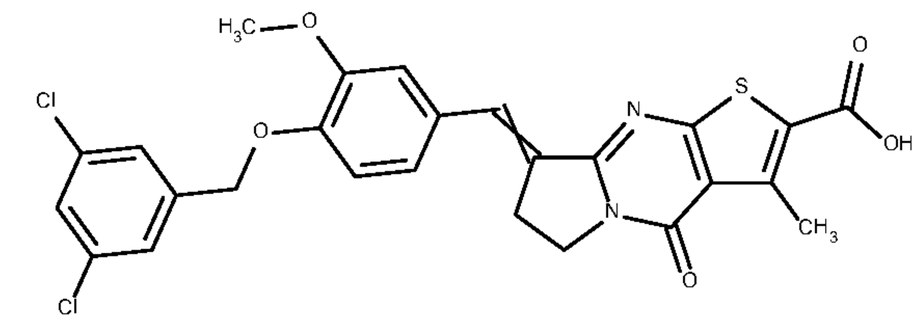
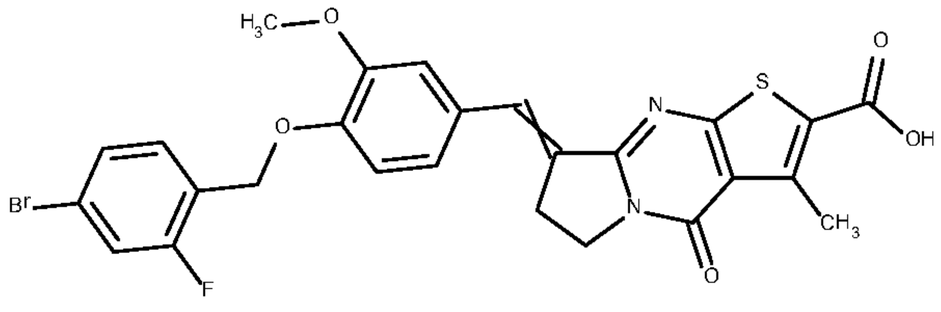
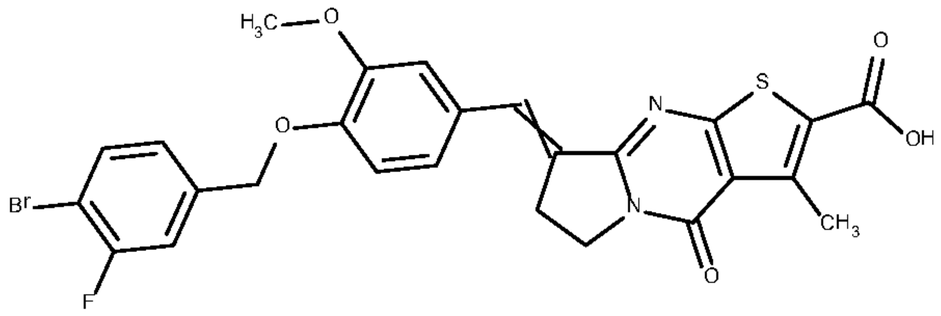
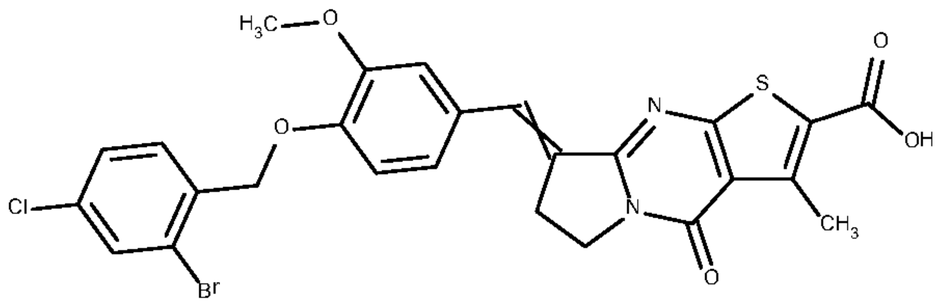
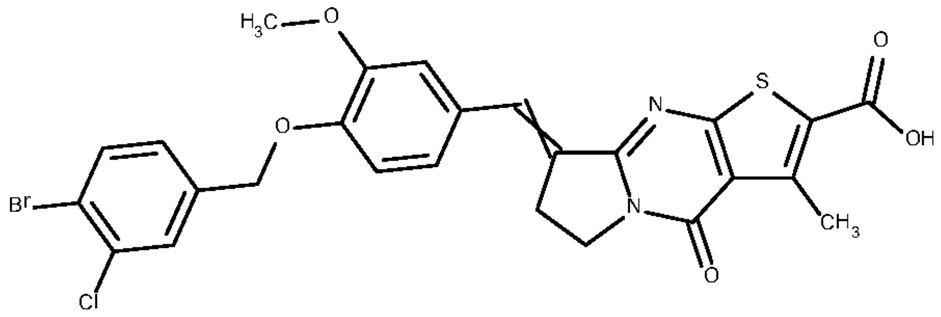
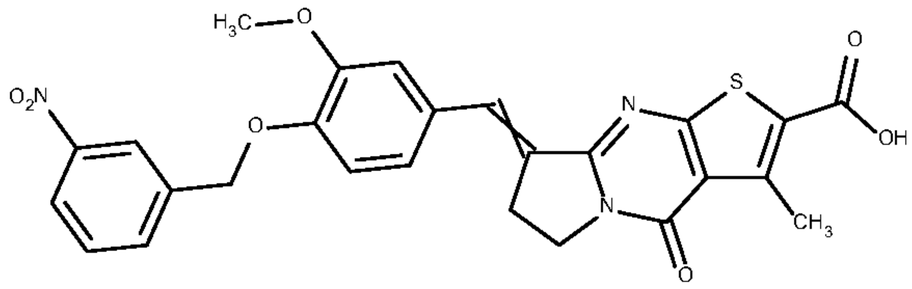
Structure	Molecule Name
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	ALCi-210
	ALCi-211
	ALCi-212
	ALCi-213
	ALCi-214
	ALCi-215
	ALCi-216

Figure 10 (continued)

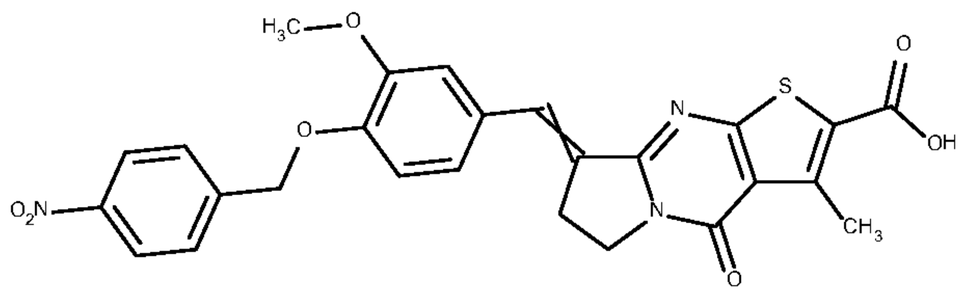
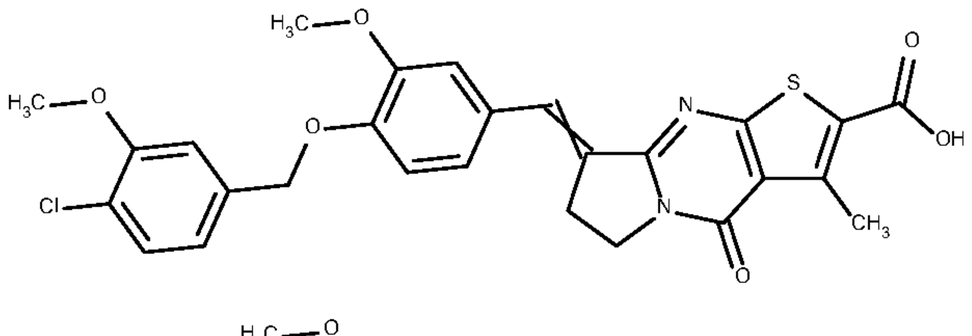
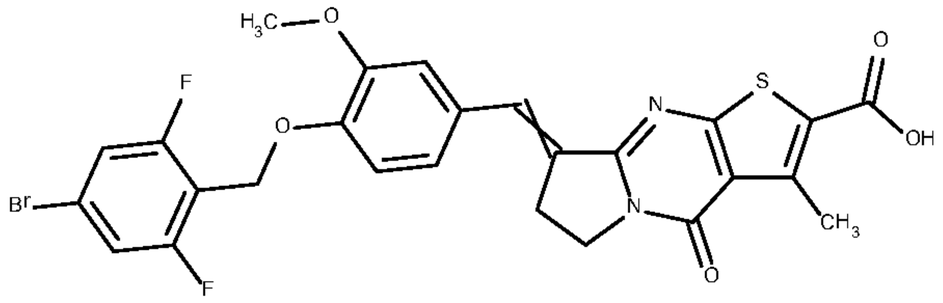
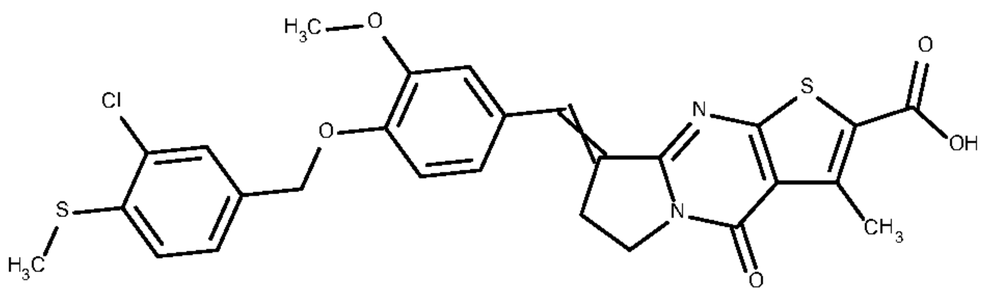
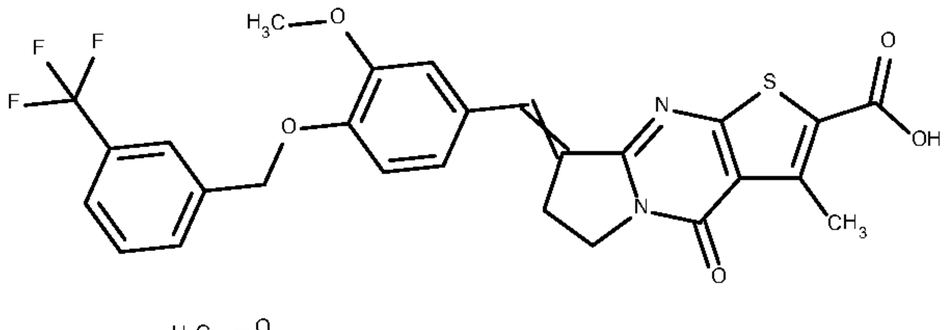
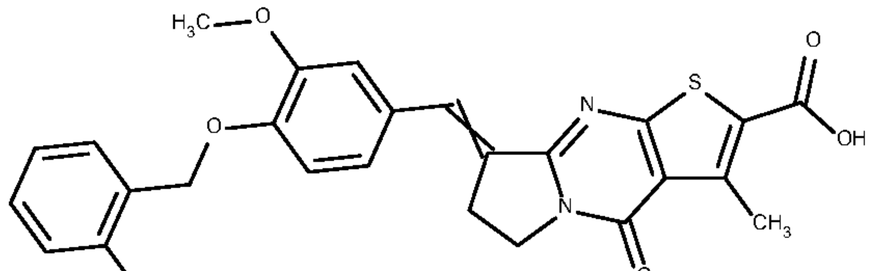
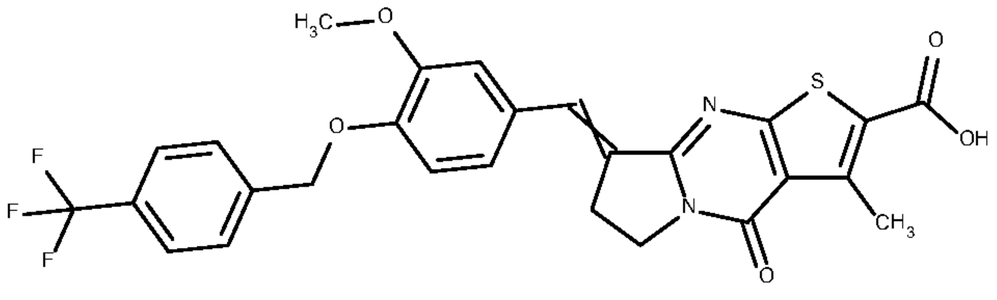
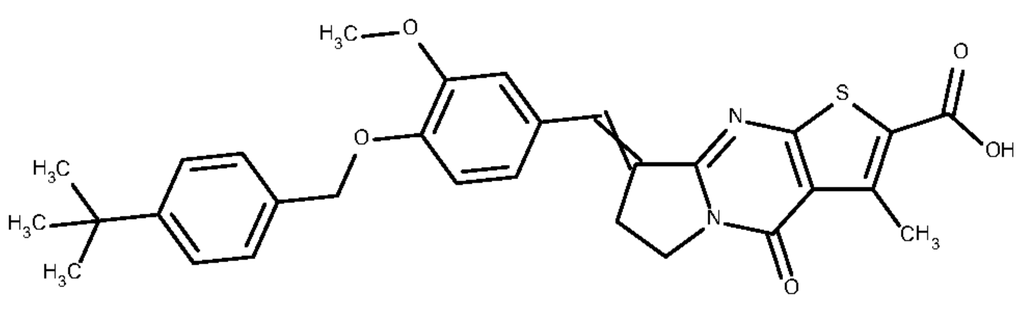
Structure	Molecule Name
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	ALCi-218
	ALCi-219
	ALCi-220
	ALCi-221
	ALCi-222
	ALCi-223
	ALCi-224

Figure 10 (continued)

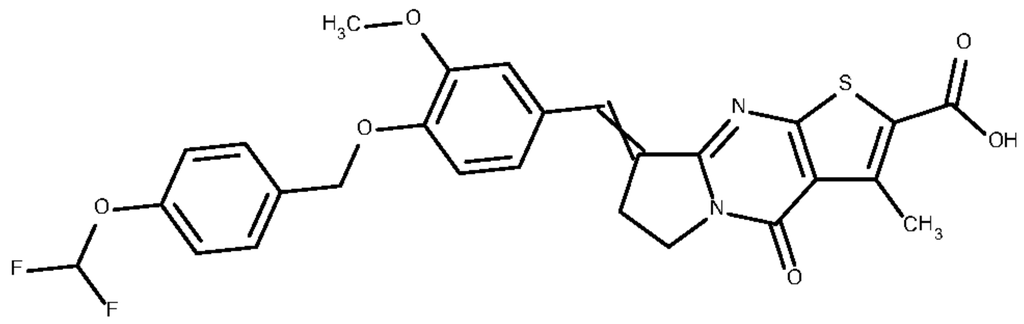
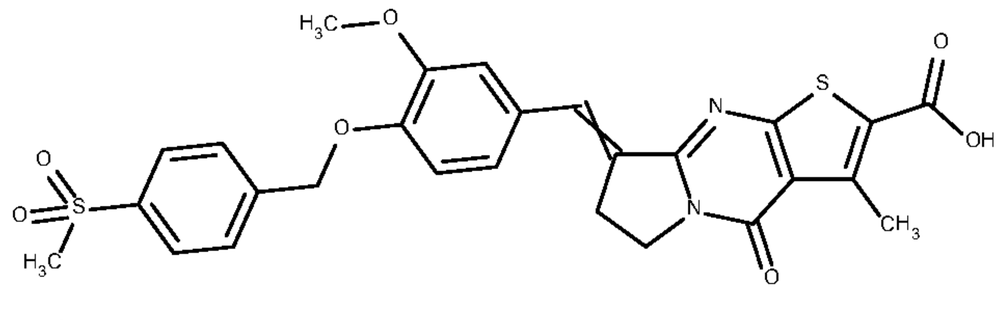
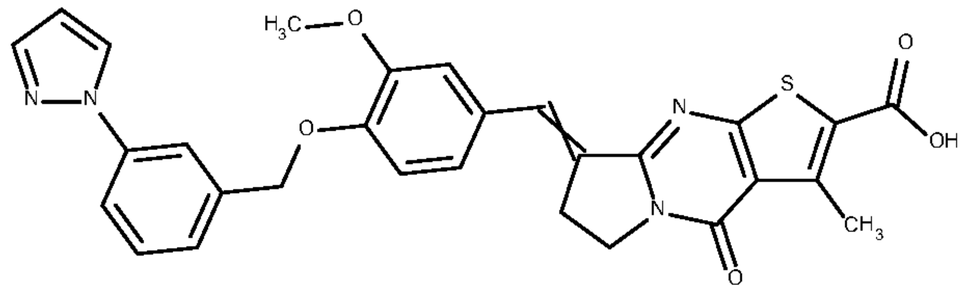
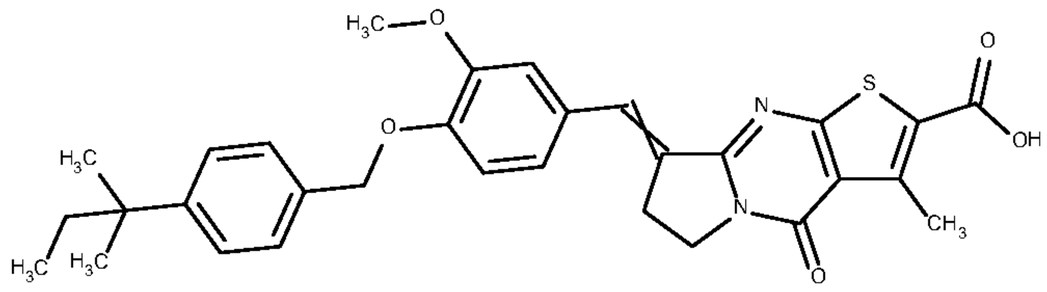
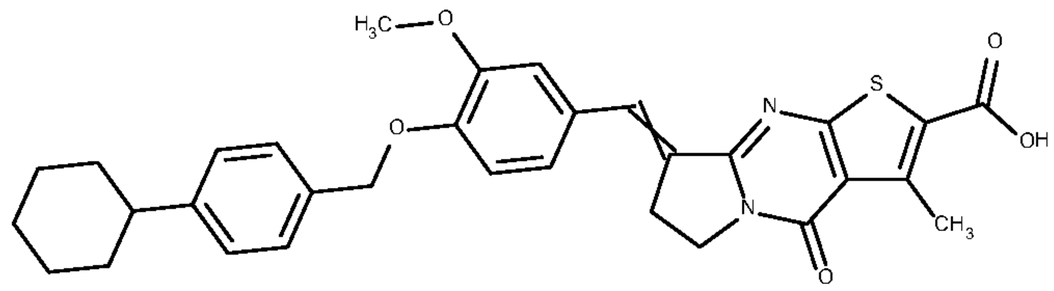
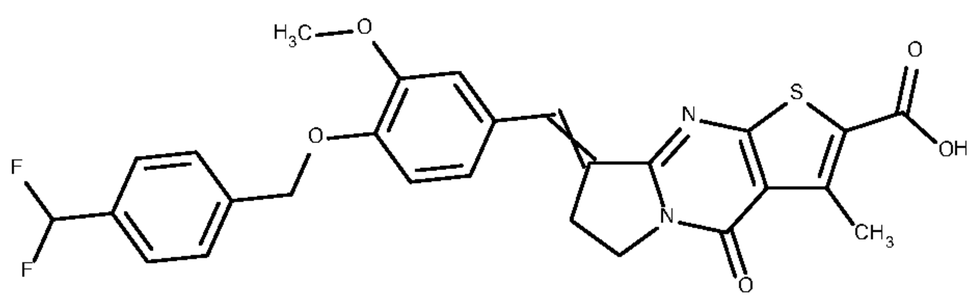
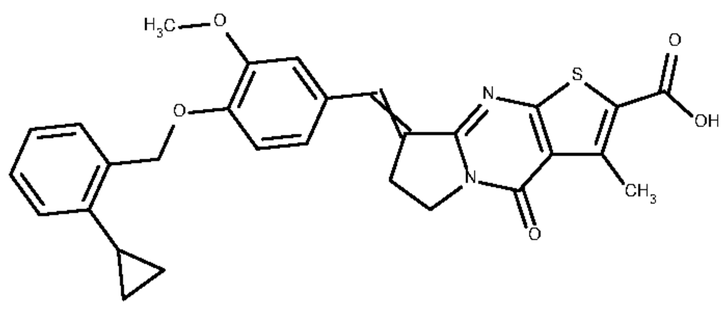
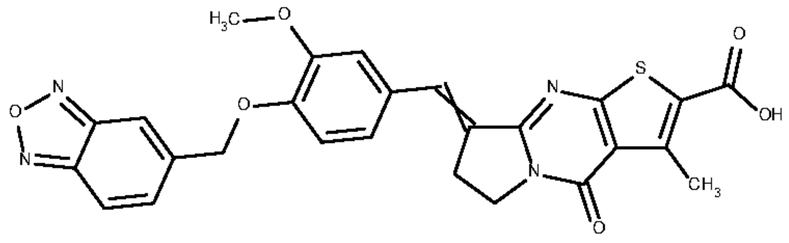
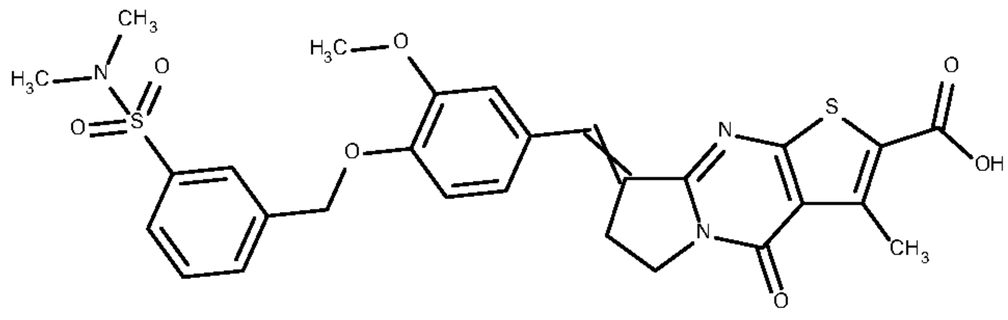
Structure	Molecule Name
	ALCi-225
	ALCi-226
	ALCi-227
	ALCi-228
	ALCi-229
	ALCi-230
	ALCi-231
	ALCi-232
	ALCi-233

Figure 10 (continued)

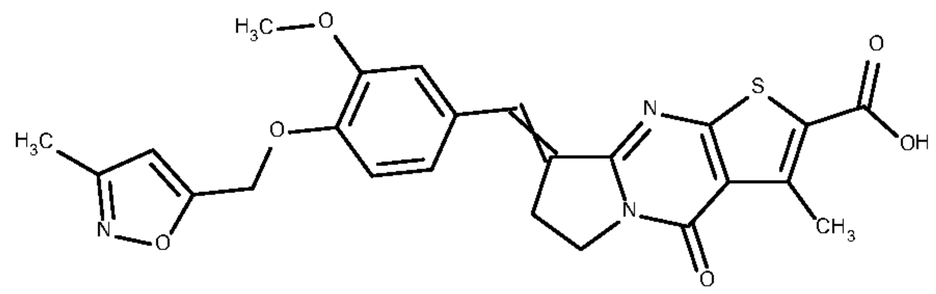
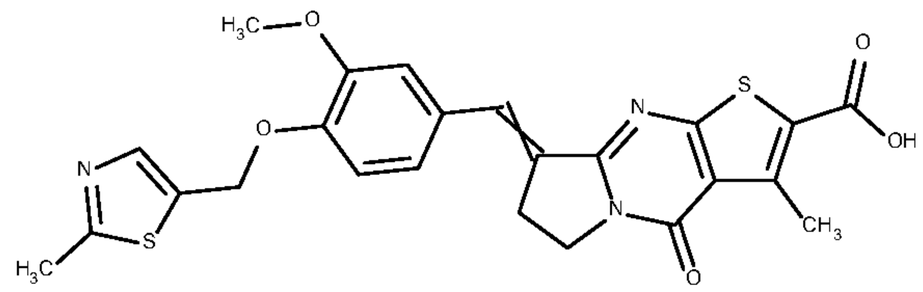
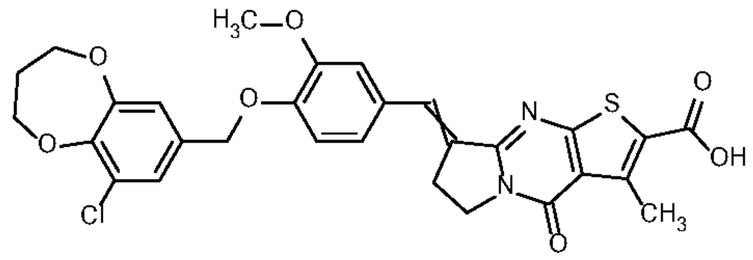
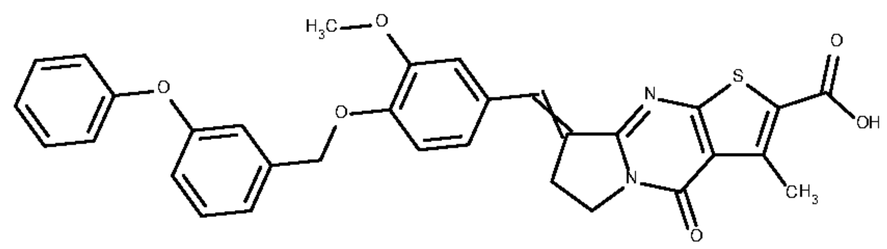
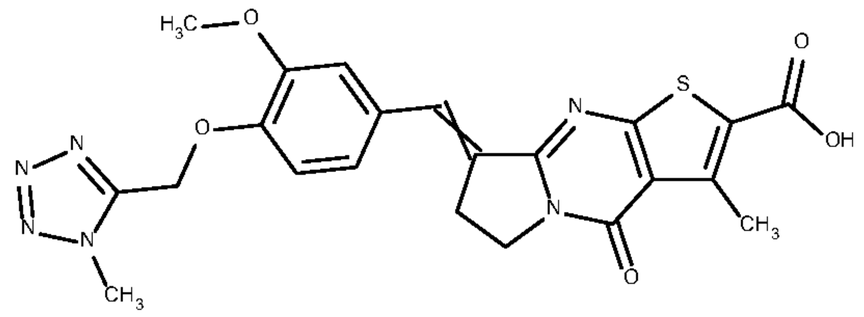
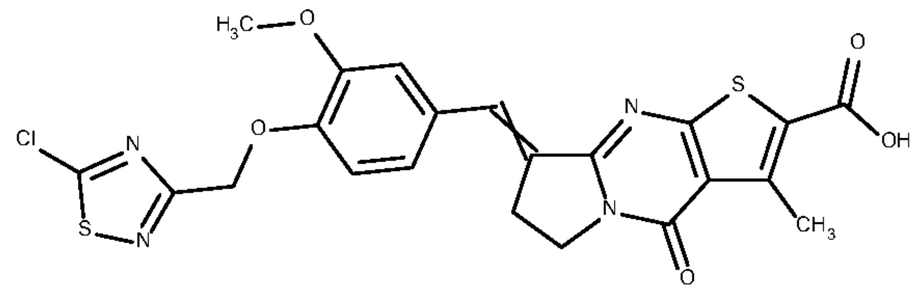
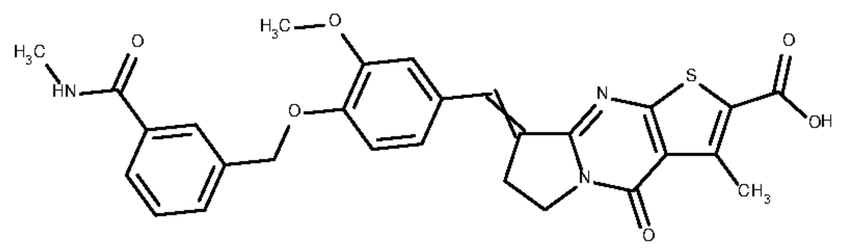
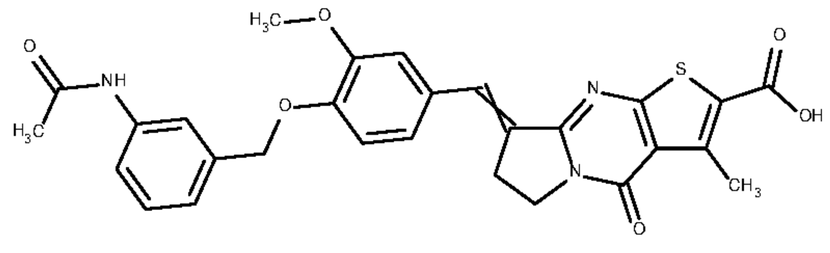
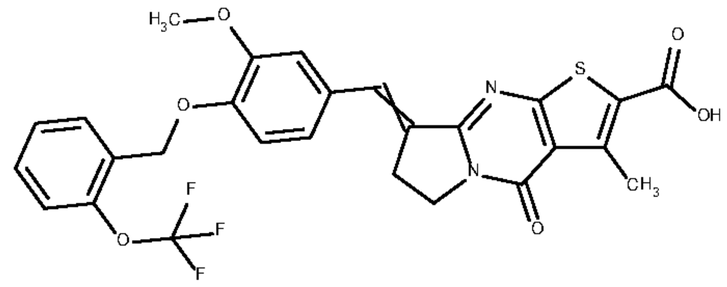
Structure	Molecule Name
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	ALCi-236
	ALCi-237
	ALCi-238
	ALCi-239
	ALCi-240
	ALCi-241
	ALCi-242

Figure 10 (continued)

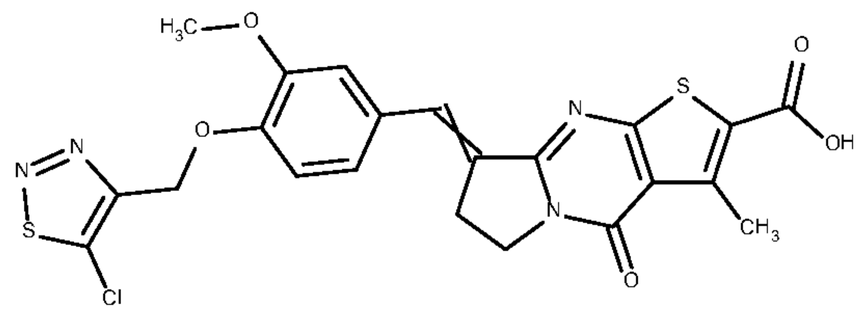
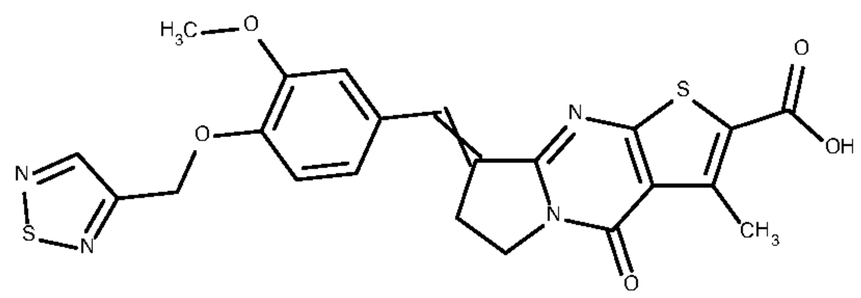
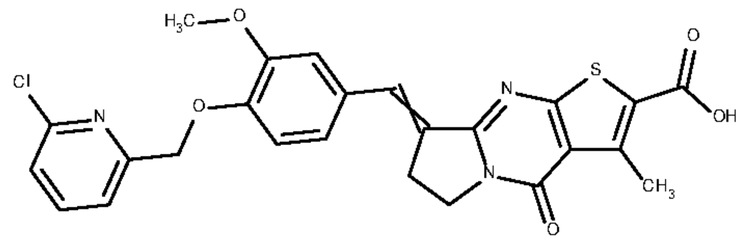
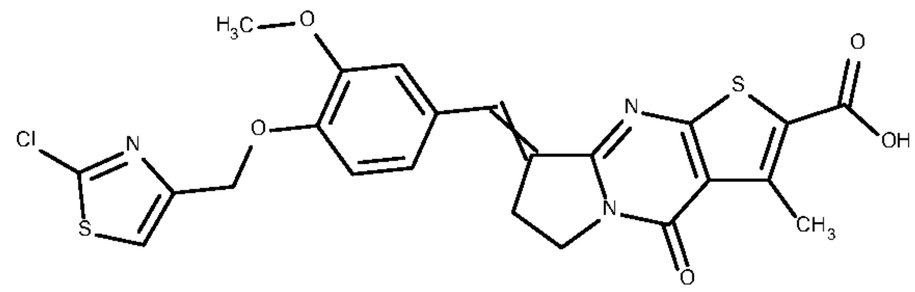
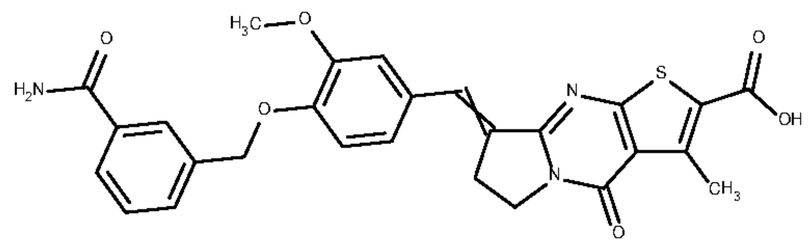
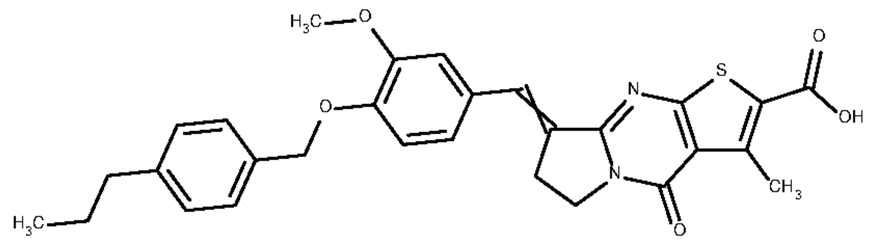
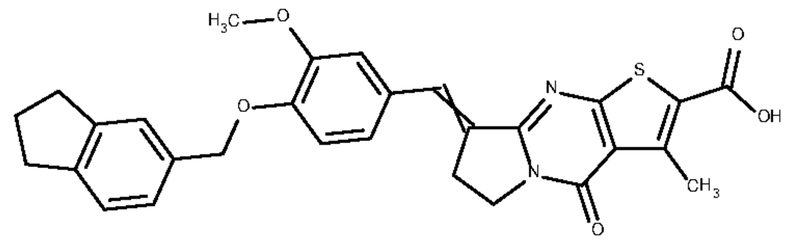
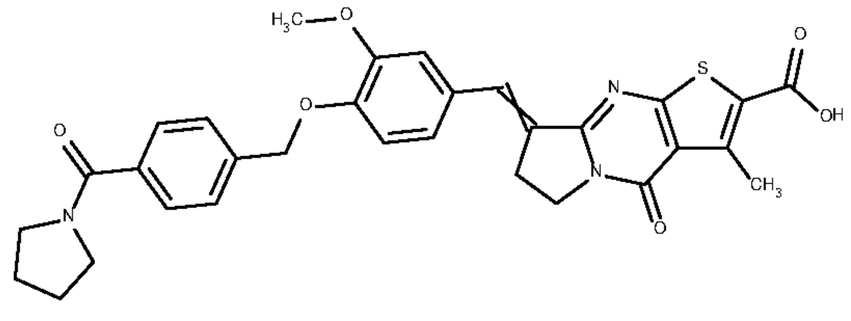
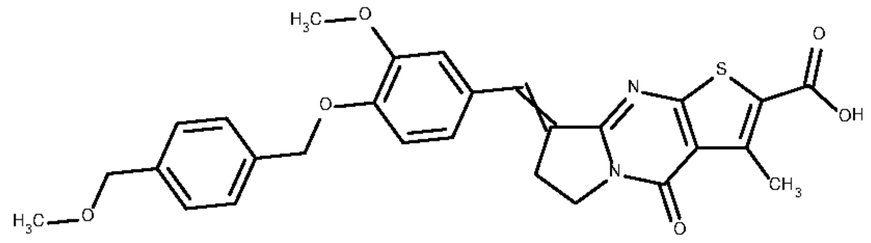
Structure	Molecule Name
	ALCi-245
	ALCi-246
	ALCi-247
	ALCi-248
	ALCi-250
	ALCi-251
	ALCi-252
	ALCi-253
	ALCi-254

Figure 10 (continued)

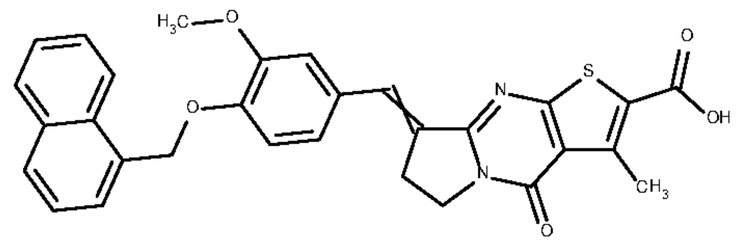
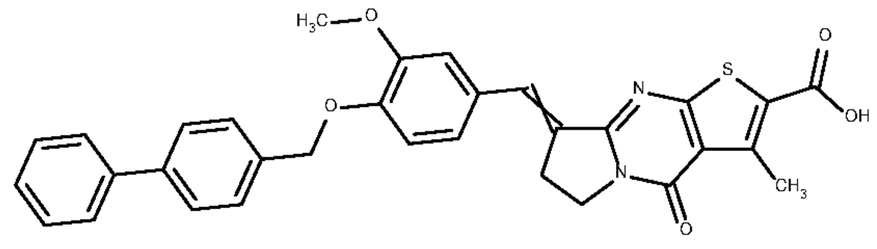
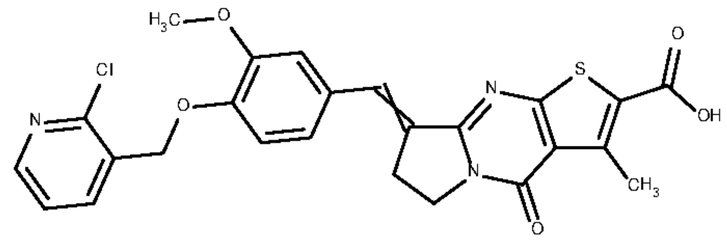
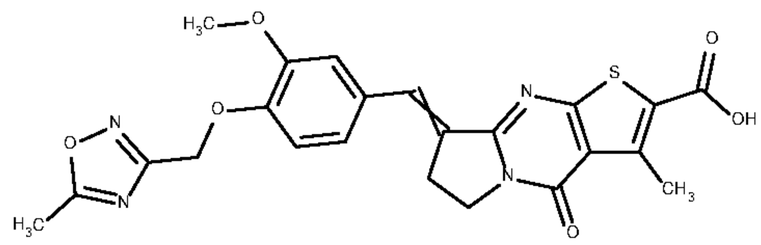
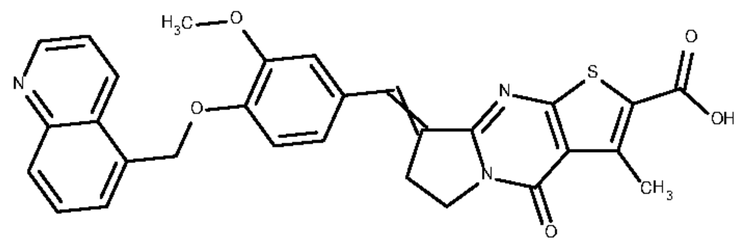
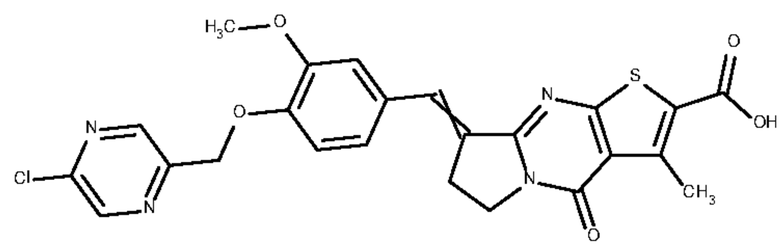
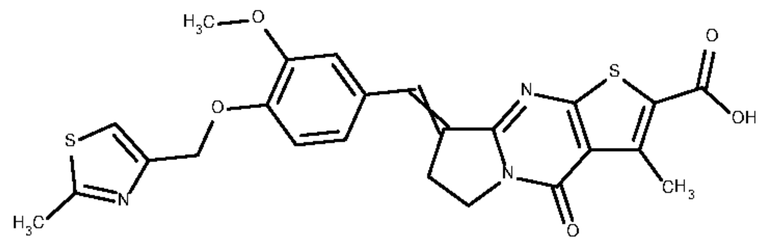
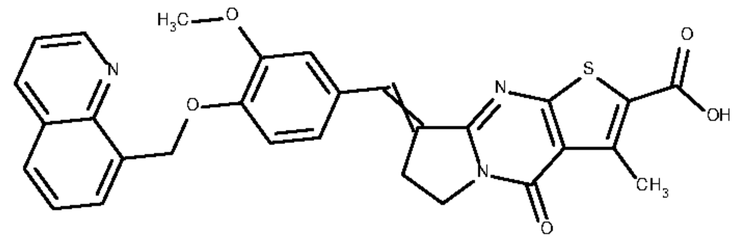
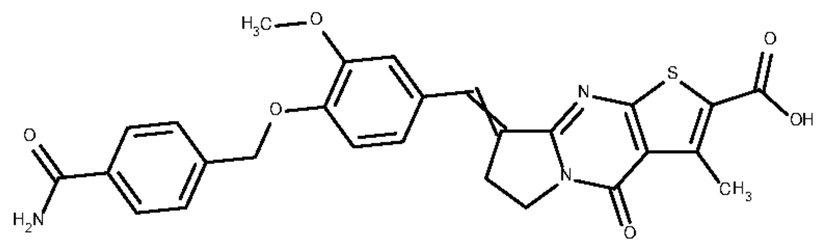
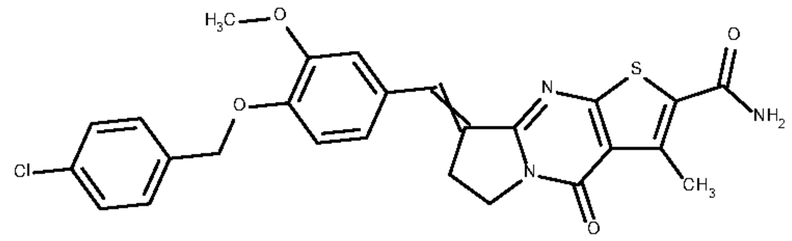
Structure	Molecule Name
	ALCi-255
	ALCi-256
	ALCi-257
	ALCi-258
	ALCi-259
	ALCi-260
	ALCi-261
	ALCi-262
	ALCi-263
	ALCi-264

Figure 10 (continued)

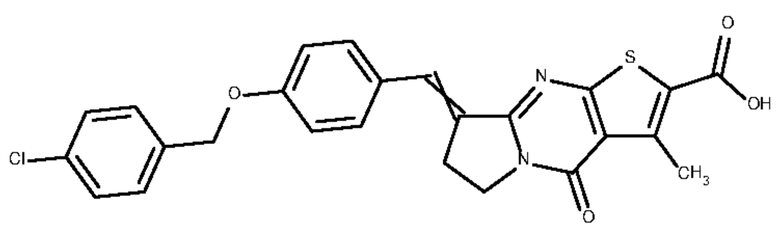
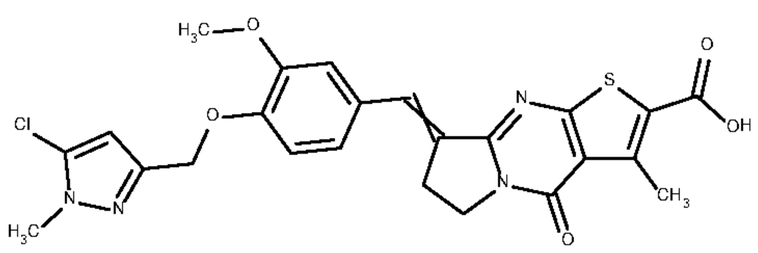
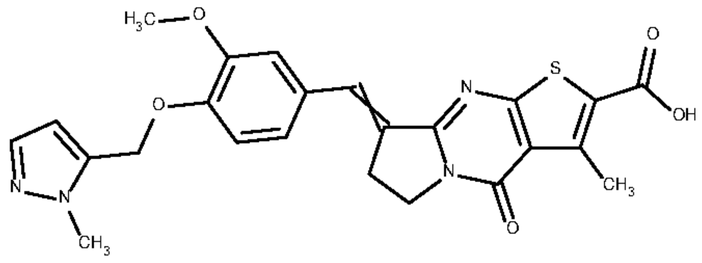
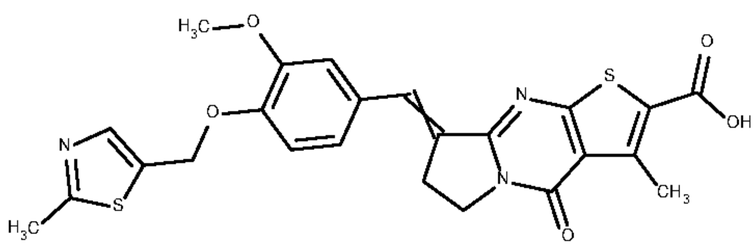
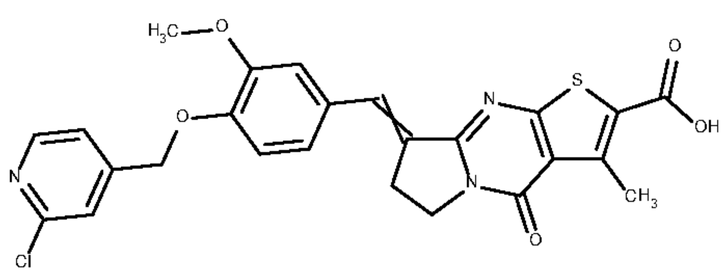
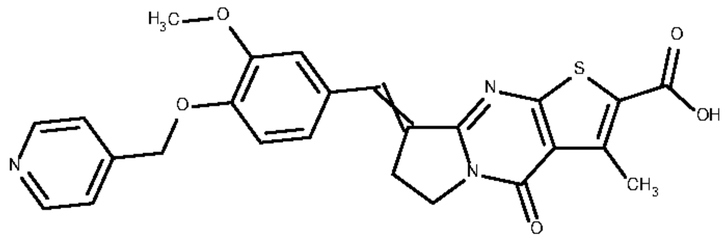
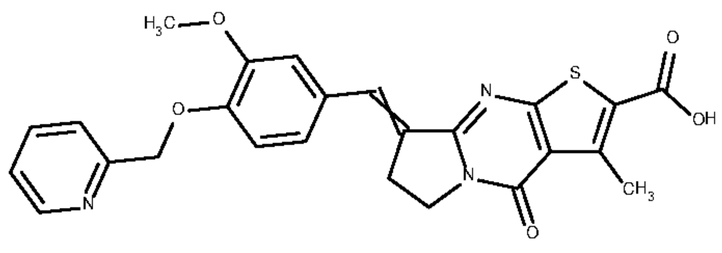
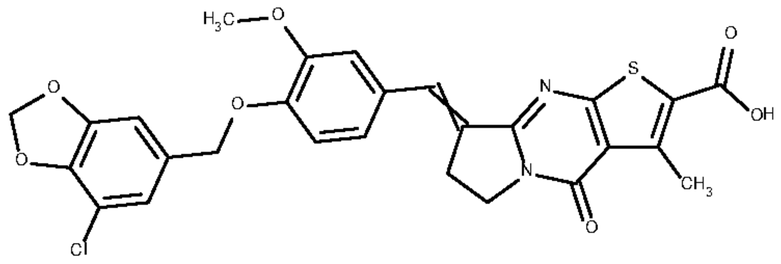
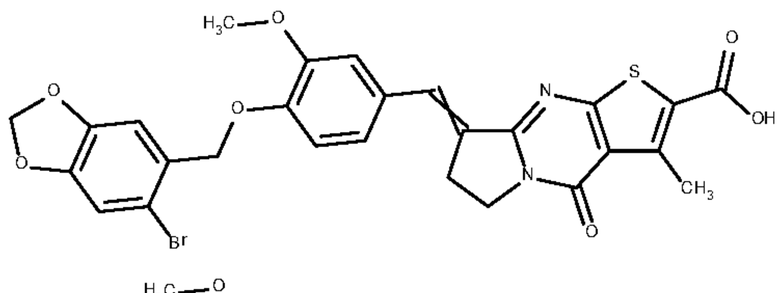
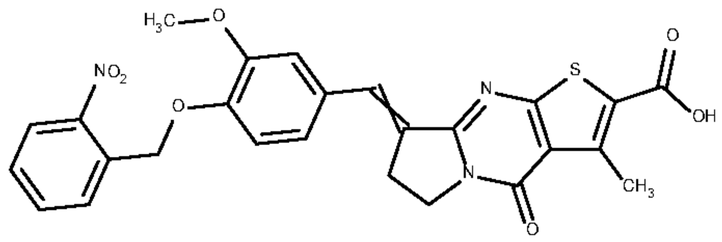
Structure	Molecule Name
	ALCi-265
	ALCi-266
	ALCi-267
	ALCi-268
	ALCi-269
	ALCi-270
	ALCi-271
	ALCi-272
	ALCi-273
	ALCi-274

Figure 10 (continued)

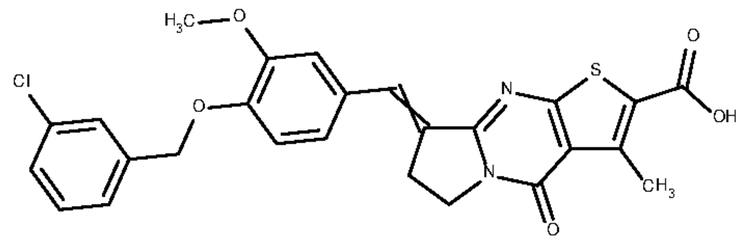
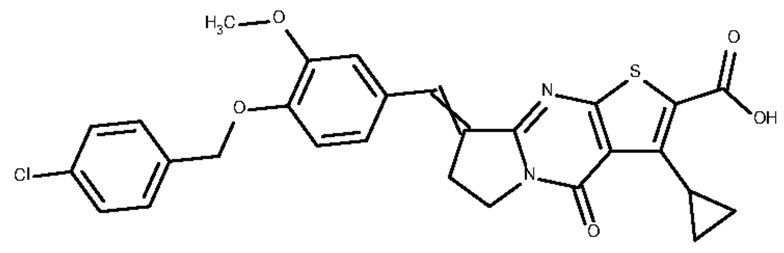
Structure	Molecule Name
	ALCi-275
	ALCi-278

Figure 11

Compound Code	Nucleosome Remodeling Inhibition IC_{50}	Compound Code	Nucleosome Remodeling Inhibition IC50
ALCi-1	+++	ALCi-65	++
ALCi-2	++	ALCi-70	+++
ALCi-3	++	ALCi-72	++
ALCi-4	++	ALCi-74	++
ALCi-5	++	ALCi-75	++
ALCi-6	+++	ALCi-77	+++
ALCi-7	++	ALCi-79	+++
ALCi-8	++	ALCi-81	++
ALCi-9	++	ALCi-82	++
ALCi-10	+++	ALCi-87	++
ALCi-11	++	ALCi-90	+
ALCi-14	++	ALCi-93	++
ALCi-15	++	ALCi-94	++
ALCi-17	++	ALCi-97	+
ALCi-18	++	ALCi-101	++
ALCi-19	+	ALCi-120	++
ALCi-22	+++	ALCi-123	+++
ALCi-23	+++	ALCi-124	++
ALCi-24	++	ALCi-125	+++
ALCi-29	+++	ALCi-127	++
ALCi-30	+++	ALCi-128	+++
ALCi-36	+	ALCi-129	+
ALCi-37	++	ALCi-130	+++
ALCi-39	+++	ALCi-131	++
ALCi-40	++	ALCi-132	+++
ALCi-43	++	ALCi-133	++
ALCi-44	++	ALCi-134	++
ALCi-46	+	ALCi-135	+
ALCi-47	++	ALCi-136	++
ALCi-48	+	ALCi-137	+
ALCi-50	+	ALCi-146	+++
ALCi-51	+	ALCi-147	++
ALCi-52	+	ALCi-149	+++
ALCi-53	+	ALCi-150	+++
ALCi-54	++	ALCi-151	+
ALCi-55	++	ALCi-152	++
ALCi-56	+++	ALCi-157	++
ALCi-57	++	ALCi-158	+++
ALCi-58	++	ALCi-160	++
ALCi-60	++	ALCi-162	+
ALCi-61	+	ALCi-163	+++
ALCi-62	++	ALCi-164	+++
ALCi-63	++	ALCi-166	+++
ALCi-64	++	ALCi-167	++

Figure 11 (continued)

Compound Code	Nucleosome Remodeling Inhibition IC_{50}	Compound Code	Nucleosome Remodeling Inhibition IC50
ALCi-171	+++	ALCi-222	+++
ALCi-172	++	ALCi-223	+++
ALCi-177	++	ALCi-224	+++
ALCi-178	+	ALCi-225	+++
ALCi-179	++	ALCi-226	++
ALCi-180	+++	ALCi-227	+++
ALCi-183	++	ALCi-228	+++
ALCi-184	+++	ALCi-229	+++
ALCi-185	+++	ALCi-230	+++
ALCi-186	+++	ALCi-231	+++
ALCi-187	++	ALCi-232	+++
ALCi-188	++	ALCi-233	+++
ALCi-189	+	ALCi-234	++
ALCi-190	+++	ALCi-235	+++
ALCi-191	++	ALCi-236	+++
ALCi-192	+++	ALCi-237	+++
ALCi-193	++	ALCi-238	++
ALCi-194	+++	ALCi-239	+++
ALCi-195	+++	ALCi-240	++
ALCi-196	++	ALCi-241	+++
ALCi-197	+++	ALCi-242	+++
ALCi-198	+++	ALCi-245	++
ALCi-199	+++	ALCi-246	++
ALCi-200	+++	ALCi-247	+++
ALCi-201	+++	ALCi-248	++
ALCi-202	+++	ALCi-250	++
ALCi-203	+++	ALCi-251	+++
ALCi-204	+++	ALCi-252	+++
ALCi-205	+++	ALCi-253	++
ALCi-206	+++	ALCi-254	+++
ALCi-207	+++	ALCi-255	+++
ALCi-208	+++	ALCi-256	+++
ALCi-209	+++	ALCi-257	+++
ALCi-210	+++	ALCi-258	++
ALCi-211	+++	ALCi-259	+++
ALCi-212	+++	ALCi-260	+++
ALCi-213	+++	ALCi-261	+++
ALCi-214	+++	ALCi-262	+++
ALCi-215	+++	ALCi-263	+
ALCi-216	+++	ALCi-264	+++
ALCi-217	+++	ALCi-265	+++
ALCi-218	+++	ALCi-266	++
ALCi-219	+++	ALCi-267	++
ALCi-220	+++	ALCi-268	+++
ALCi-221	+++	ALCi-269	++

Figure 11 (continued)

Compound Code	Nucleosome Remodeling Inhibition IC50
ALCi-270	+++
ALCi-271	+
ALCi-272	+++
ALCi-273	+++
ALCi-274	+++
ALCi-275	+++
ALCi-278	+++

Figure 12

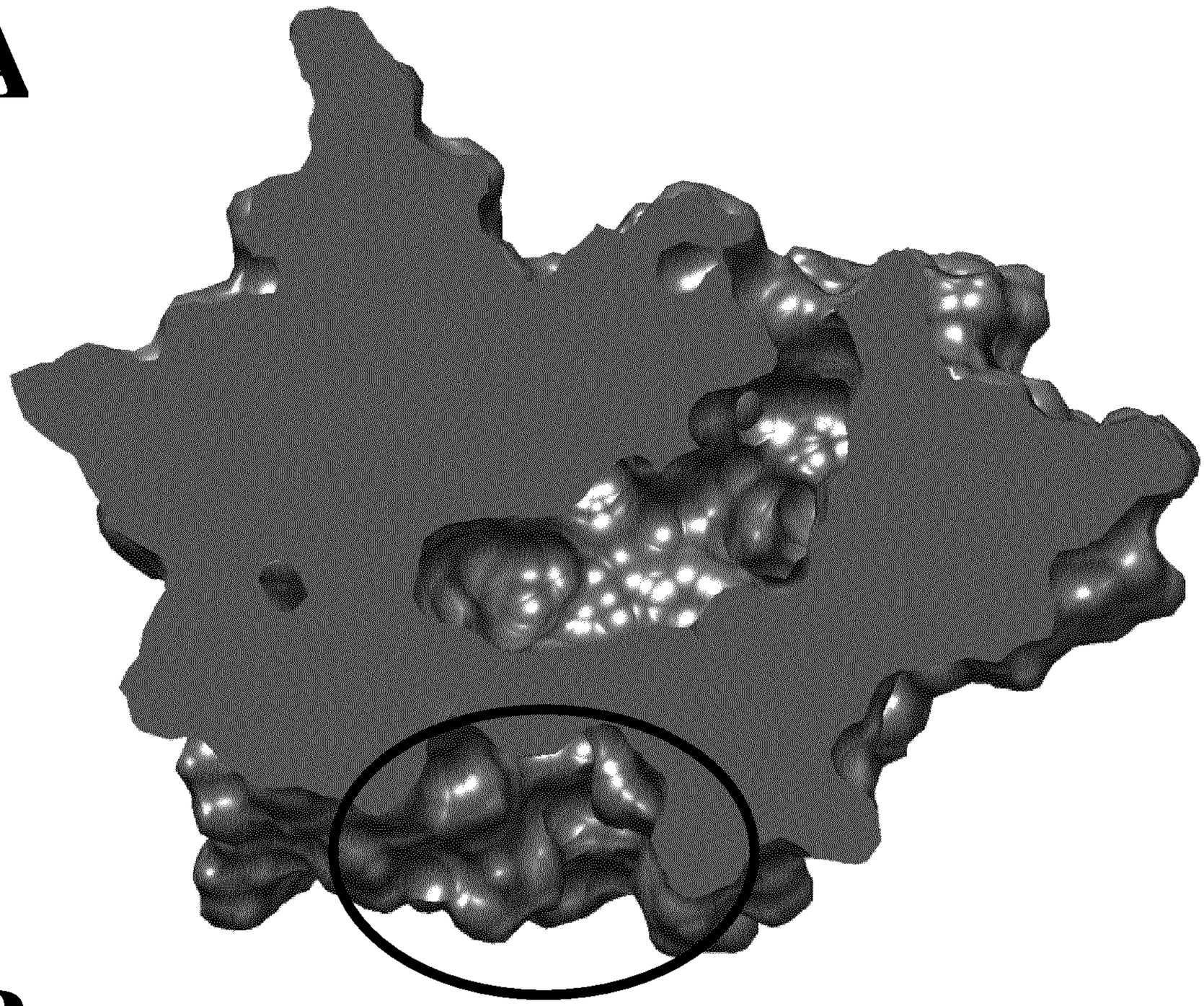
Compound Code	MDA-MB-231 (WT)	SUM-149PT (-)	Compound Code	MDA-MB-231 (WT)	SUM-149PT (-)
ALCi-1	+	++	ALCi-131	-	+++
ALCi-3	-	+	ALCi-132	-	+++
ALCi-4	+	++	ALCi-133	-	+++
ALCi-5	+	++	ALCi-146	-	++
ALCi-6	+	++	ALCi-149	-	+++
ALCi-7	-	++	ALCi-151	n.d.	n.d.
ALCi-9	+	++	ALCi-152	-	++
ALCi-10	+	++	ALCi-157	-	+
ALCi-14	+	+++	ALCi-160	+	+
ALCi-15	+	++	ALCi-162	-	+
ALCi-18	+	++	ALCi-164	+	+
ALCi-22	+	++	ALCi-166	+	+++
ALCi-29	+	+	ALCi-167	++	+++
ALCi-39	+	+	ALCi-171	+	++
ALCi-40	-	++	ALCi-177	-	++
ALCi-43	-	+	ALCi-178	n.d.	n.d.
ALCi-44	-	+	ALCi-179	+	+
ALCi-46	-	+	ALCi-180	-	++
ALCi-48	++	+++	ALCi-184	-	++
ALCi-50	-	+	ALCi-185	-	++
ALCi-52	-	+	ALCi-186	-	+++
ALCi-54	+++	+++	ALCi-187	-	+
ALCi-56	-	++	ALCi-189	-	+
ALCi-58	-	++	ALCi-190	-	+
ALCi-65	-	++	ALCi-192	+	+++
ALCi-72	++	+++	ALCi-193	-	+
ALCi-74	-	++	ALCi-194	+++	+++
ALCi-75	-	++	ALCi-195	+	+++
ALCi-77	+	++	ALCi-196	-	+
ALCi-79	-	++	ALCi-197	n.d.	n.d.
ALCi-82	-	+	ALCi-198	-	++
ALCi-87	-	+	ALCi-199	+++	+++
ALCi-90	+	++	ALCi-200	++	+++
ALCi-97	-	+	ALCi-201	++	+++
ALCi-101	-	+	ALCi-202	-	+++
ALCi-120	-	++	ALCi-204	+	+++
ALCi-123	-	++	ALCi-205	-	+
ALCi-124	-	++	ALCi-206	+	+++
ALCi-125	+	++	ALCi-207	-	+++
ALCi-127	-	++	ALCi-208	-	+++
ALCi-128	-	+	ALCi-209	+	+++

Figure 12 (continued)

Compound Code	MDA-MB-231 (WT)	SUM-149PT (-)	Compound Code	MDA-MB-231 (WT)	SUM-149PT (-)
ALCi-210	+	++	ALCi-237	+++	+++
ALCi-211	-	+++	ALCi-239	+++	+++
ALCi-212	-	+++	ALCi-241	-	+
ALCi-213	-	++	ALCi-242	++	+++
ALCi-214	-	+++	ALCi-245	-	+
ALCi-215	-	+++	ALCi-246	-	++
ALCi-216	+++	+++	ALCi-247	-	+++
ALCi-217	-	+++	ALCi-248	+	++
ALCi-218	-	+++	ALCi-251	+	+++
ALCi-219	+	+++	ALCi-252	++	+++
ALCi-220	-	+++	ALCi-253	-	++
ALCi-221	+++	+++	ALCi-254	++	+++
ALCi-222	++	+++	ALCi-255	-	+++
ALCi-223	+++	+++	ALCi-256	+++	+++
ALCi-224	-	+++	ALCi-259	-	+++
ALCi-225	+	+++	ALCi-260	-	++
ALCi-227	-	+++	ALCi-261	-	++
ALCi-228	+	+++	ALCi-262	-	+++
ALCi-229	-	+++	ALCi-265	-	+++
ALCi-230	+	+++	ALCi-266	+	+
ALCi-231	+	+++	ALCi-272	-	+++
ALCi-233	-	++	ALCi-273	-	+++
ALCi-234	-	+	ALCi-274	-	+++
ALCi-235	-	+++	ALCi-275	-	+++
ALCi-236	+++	+++	ALCi-278	n.d.	n.d.

Figure 13

A



B

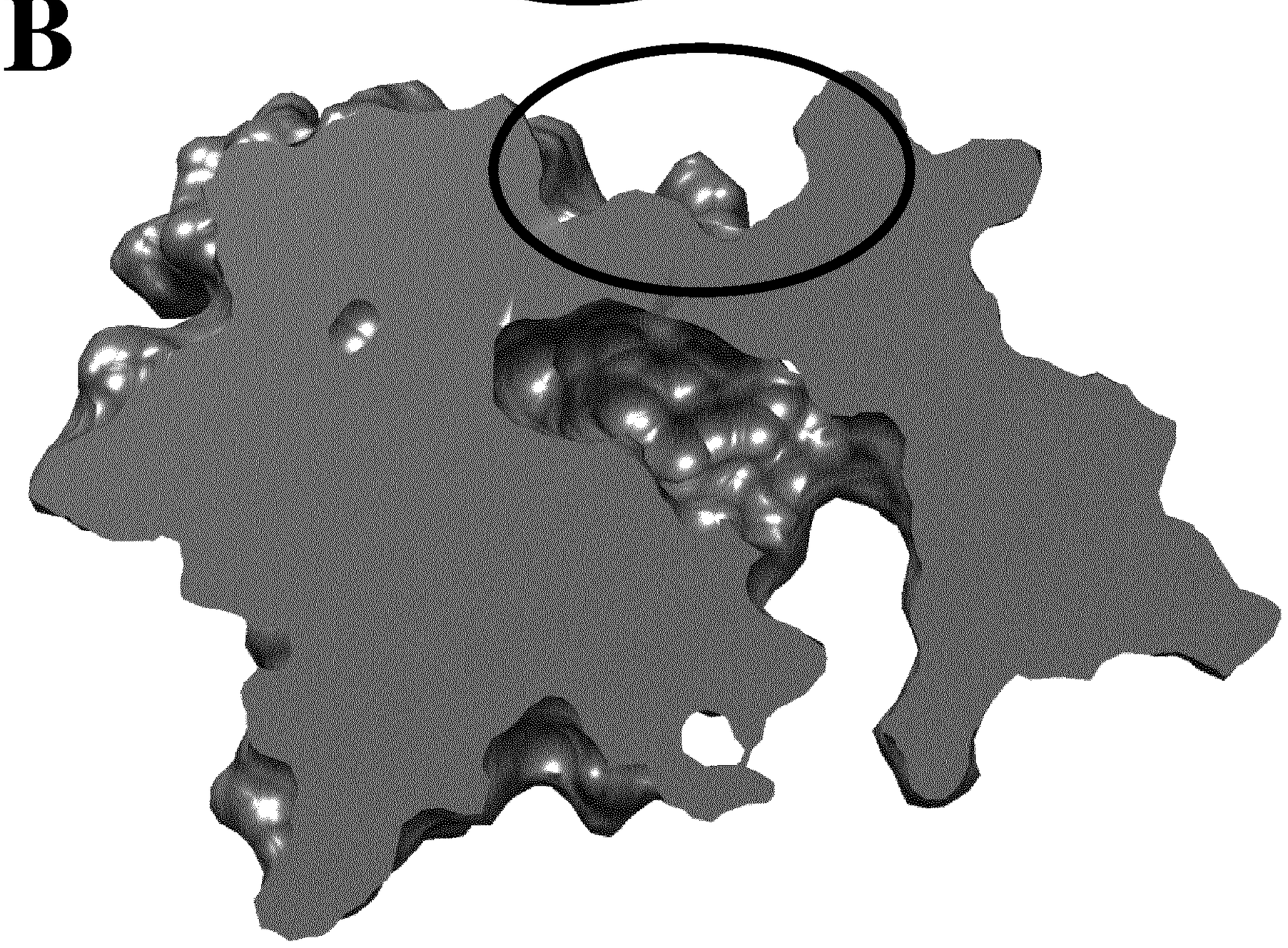


Figure 14

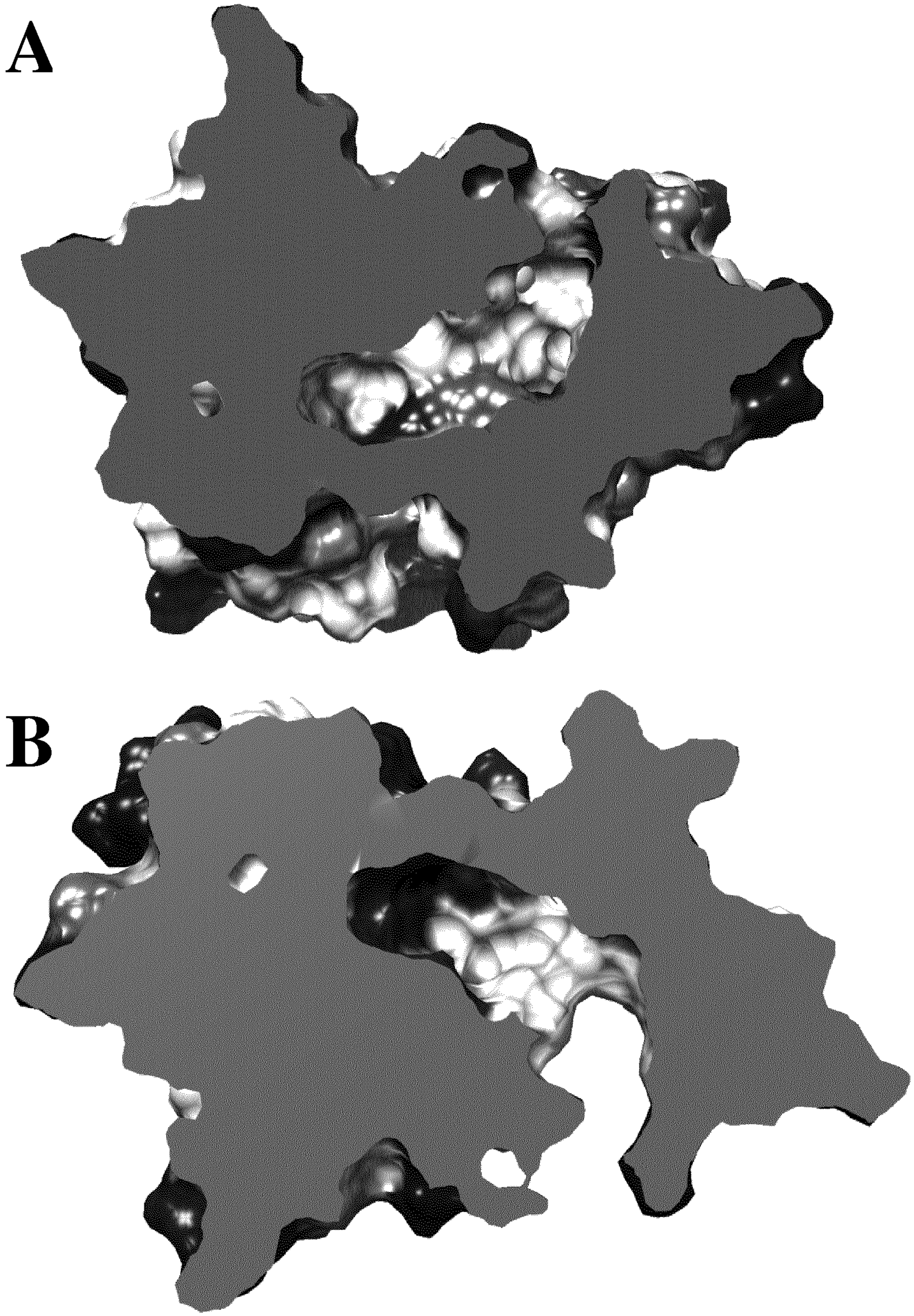


Figure 15

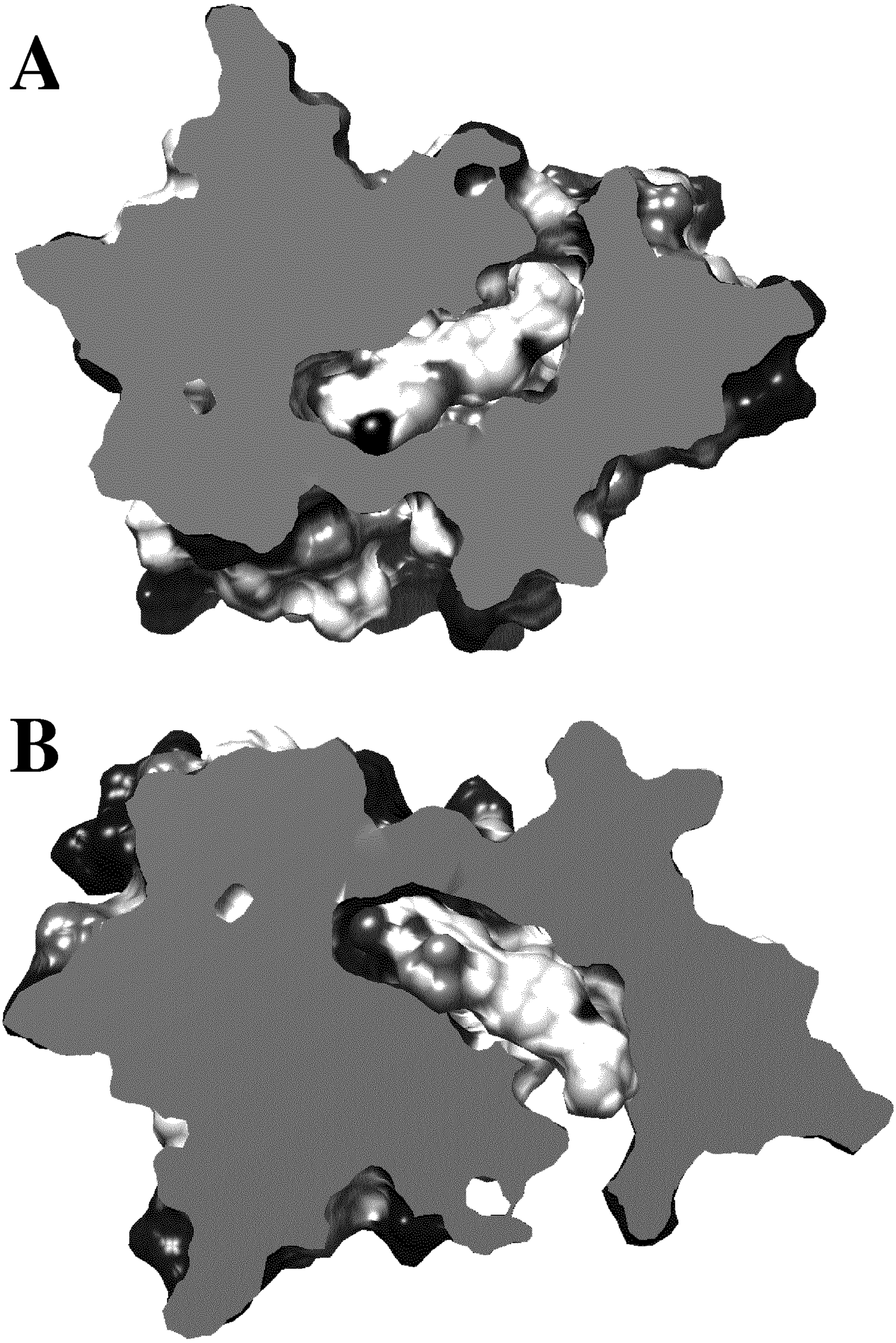
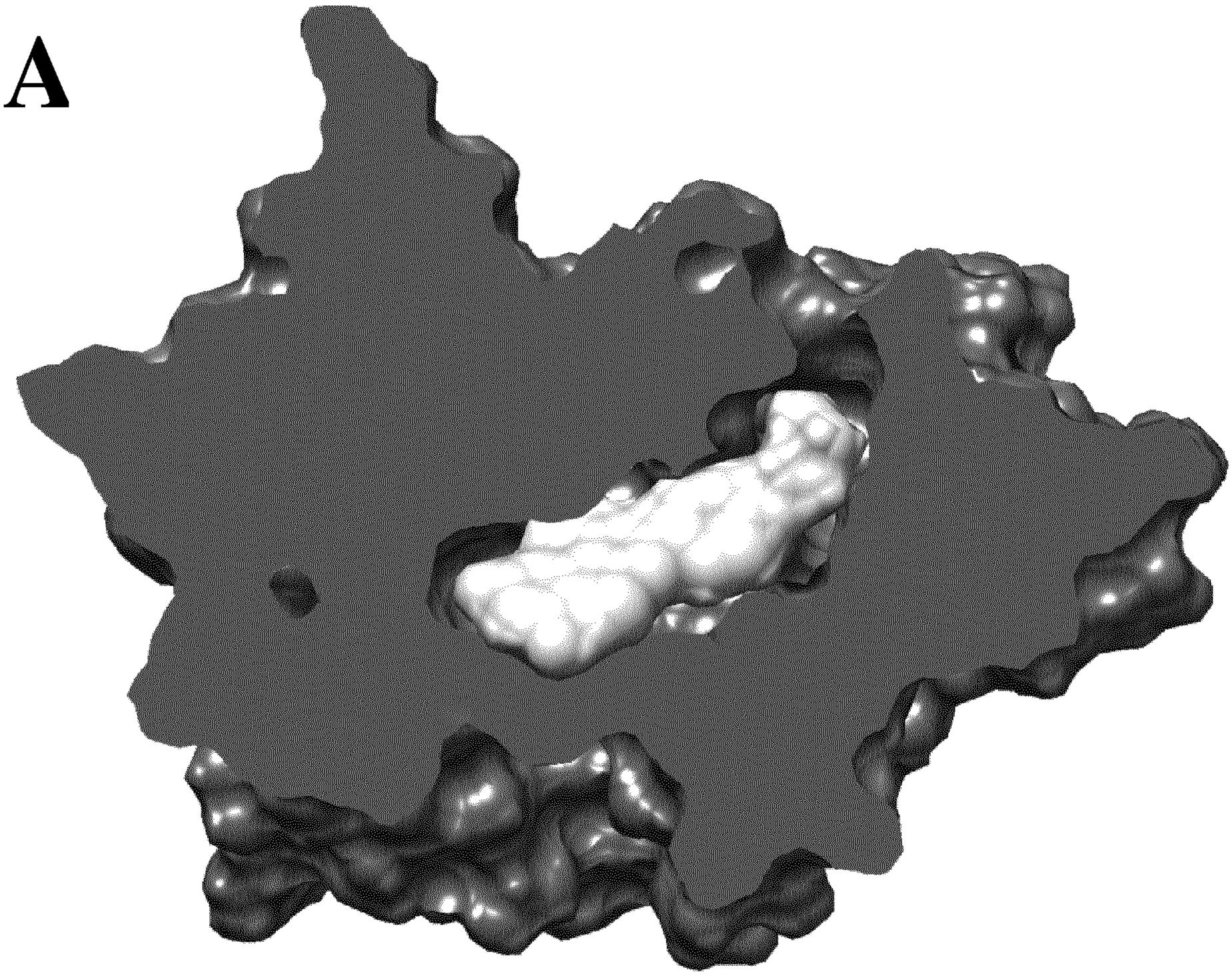


Figure 16

A



B

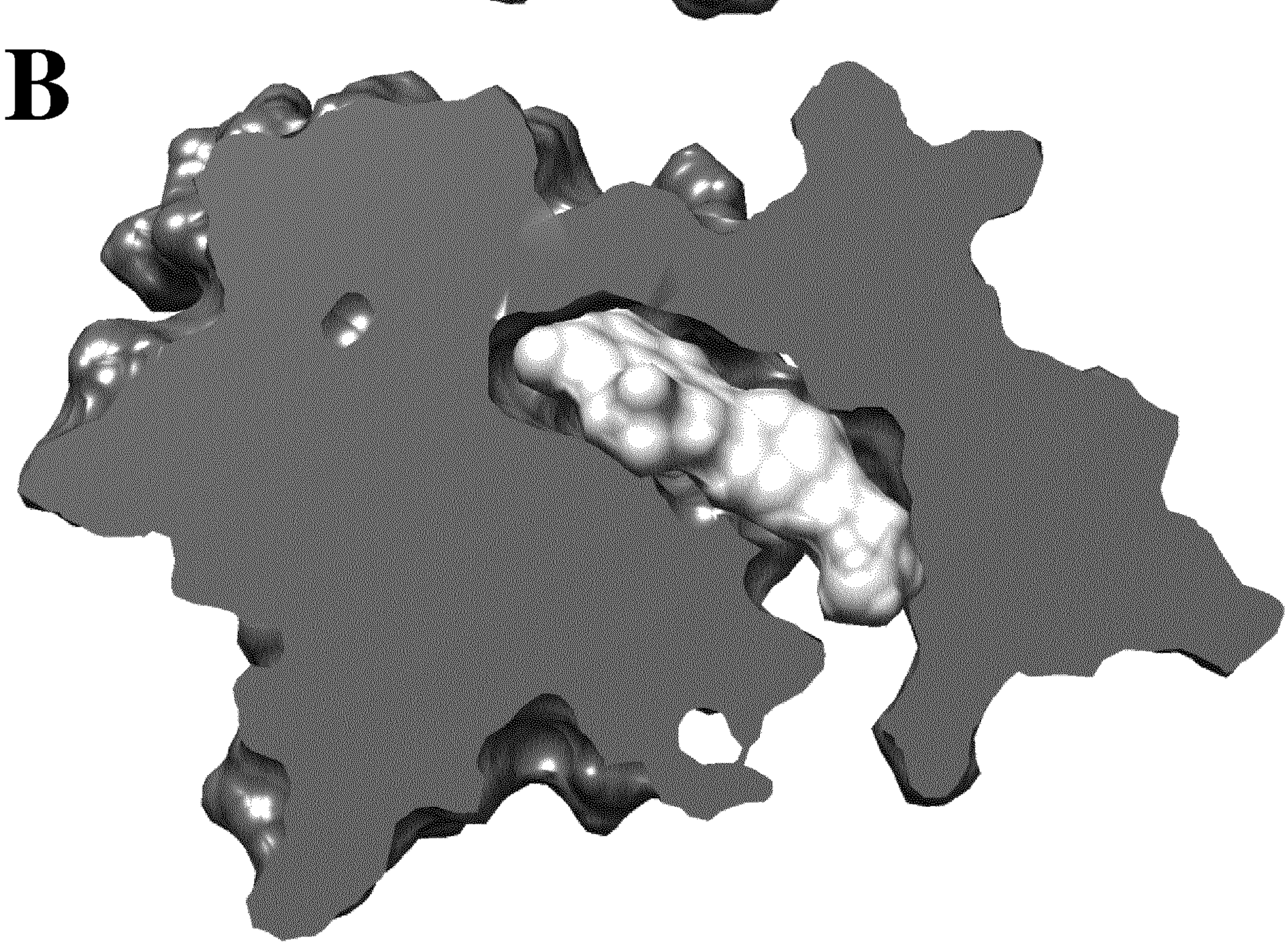
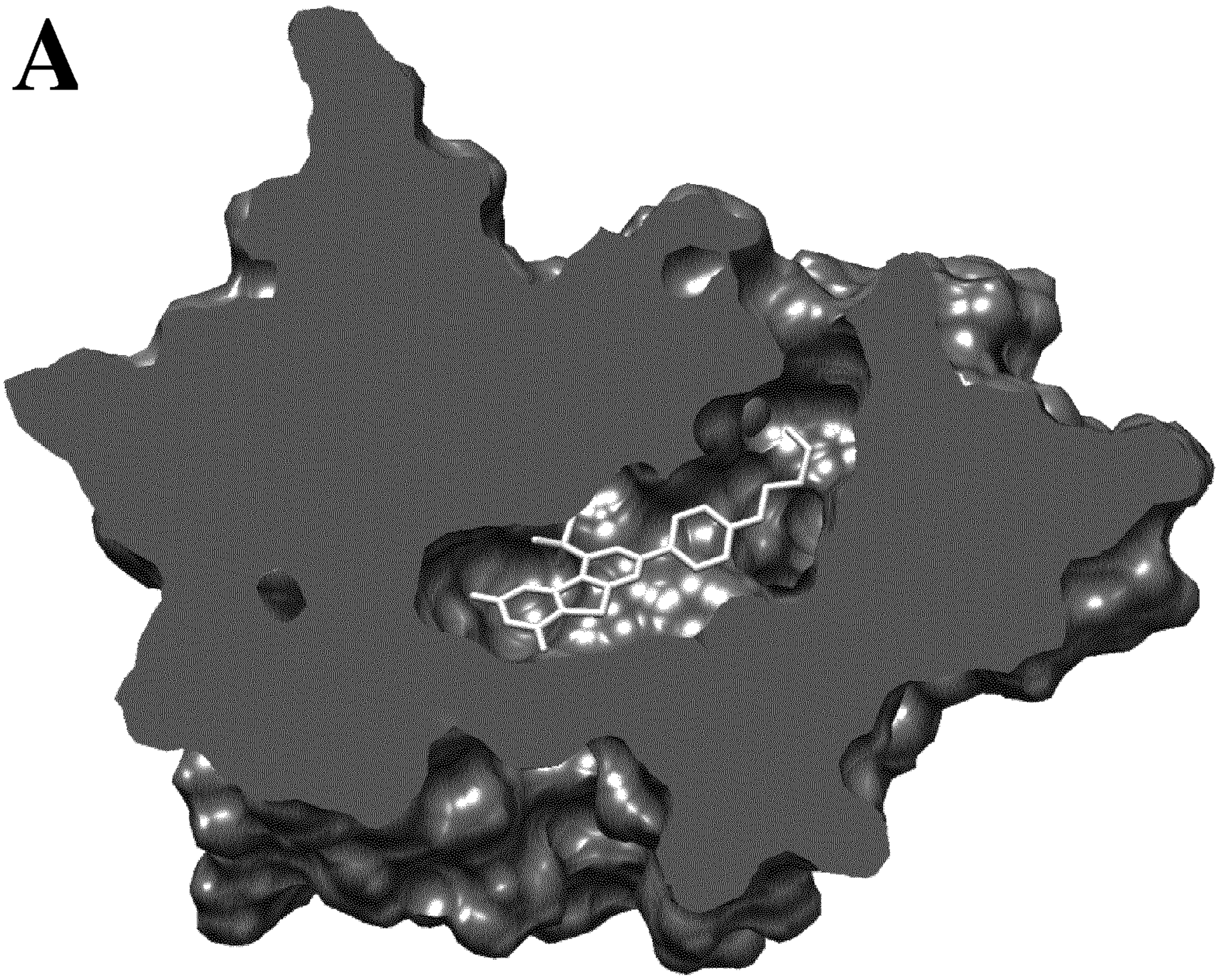


Figure 17

A



B

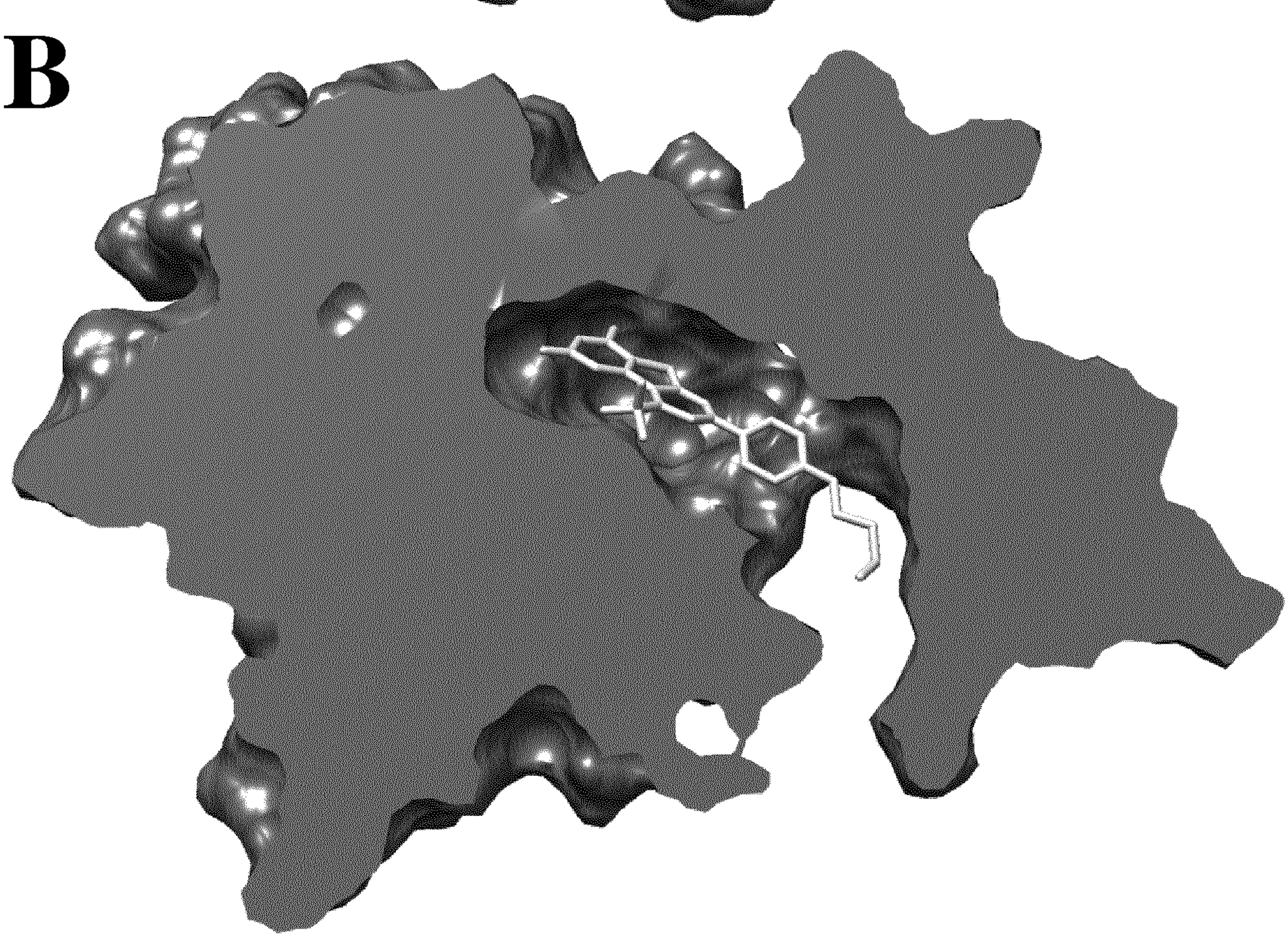


Figure 18

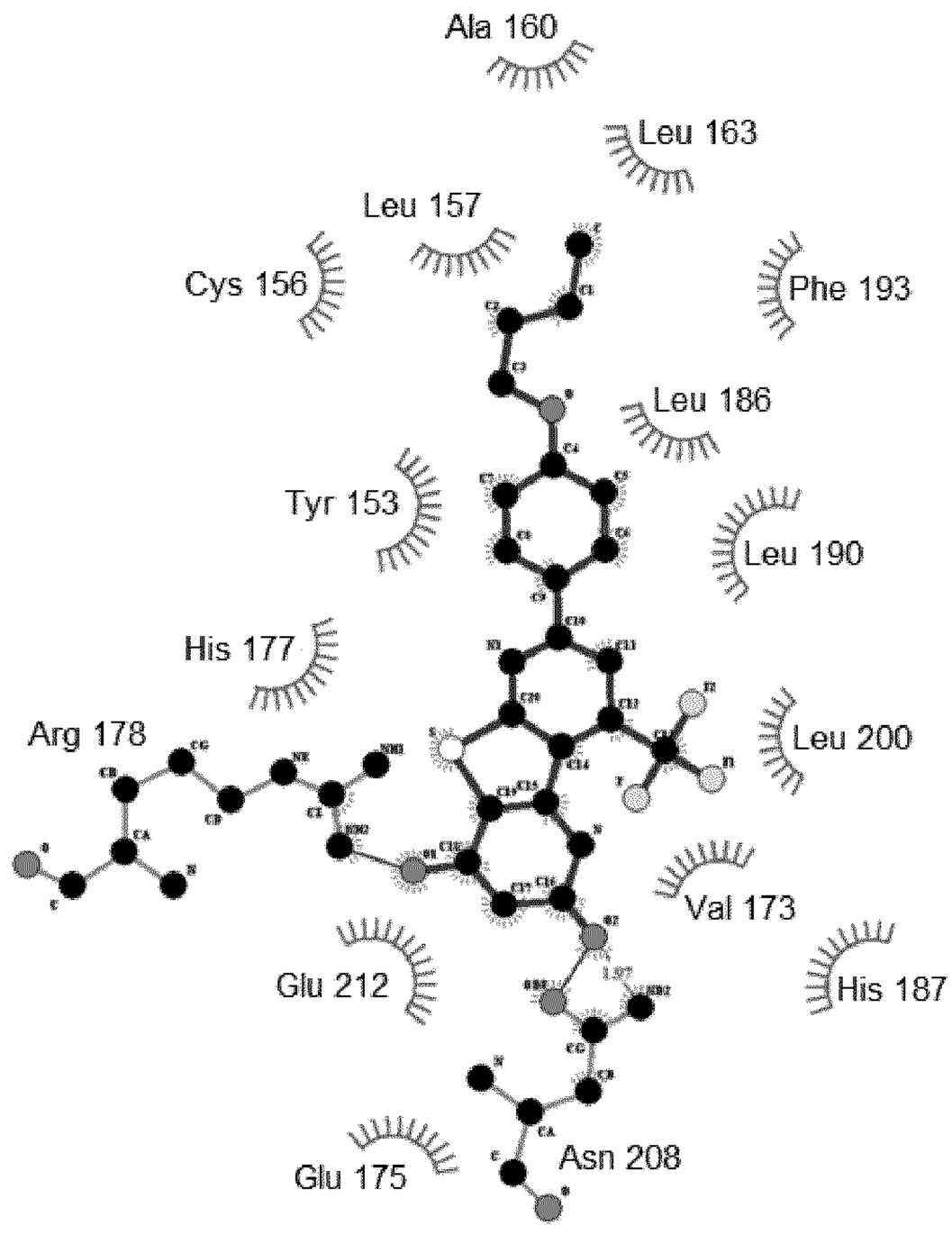


Figure 19

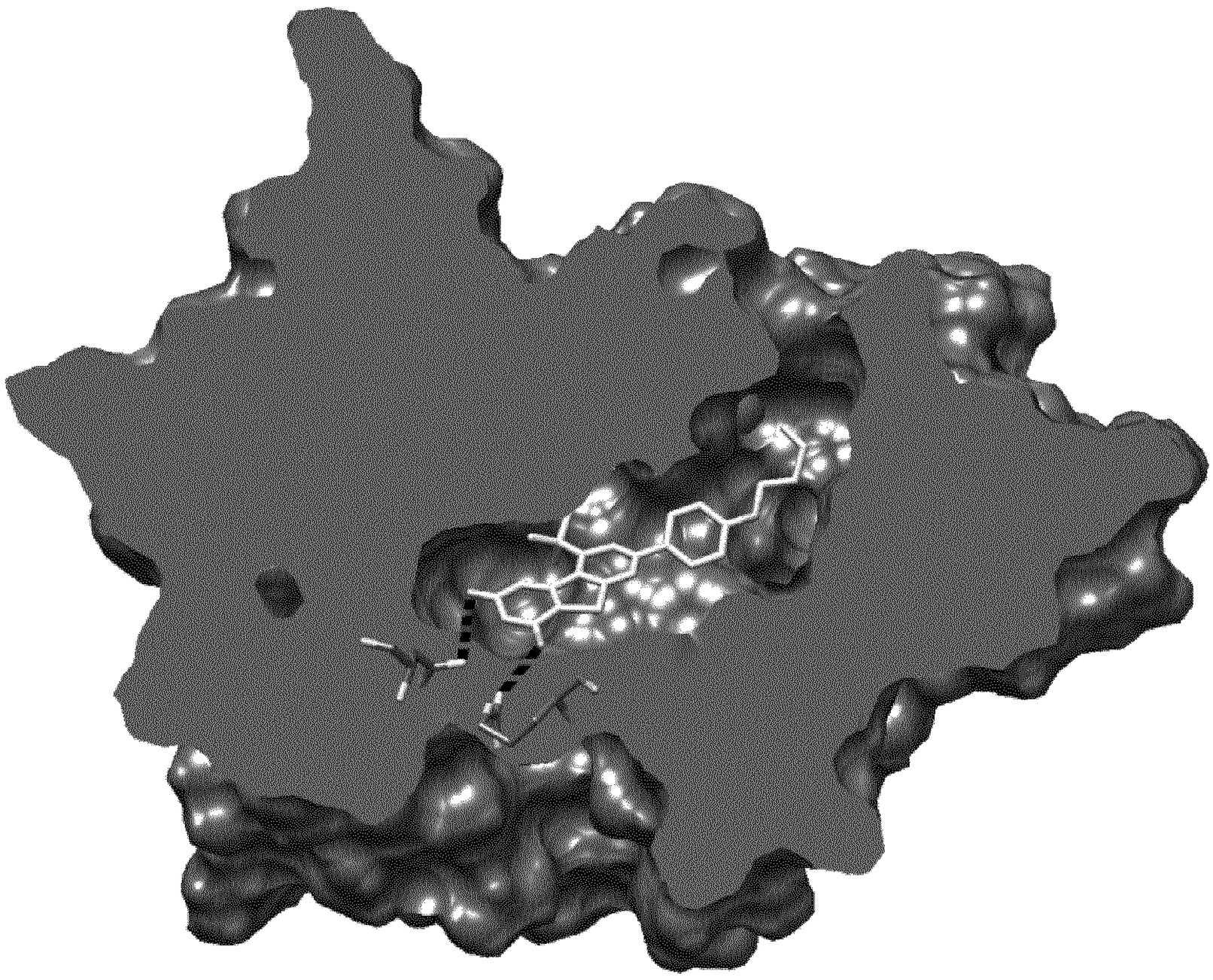


Fig. 20

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ATOM      1  N   PHE A  98     169.877 143.882  29.856  1.00  0.00           N
ATOM      2  CA  PHE A  98     169.117 143.348  30.987  1.00  0.00           C
ATOM      3  CB  PHE A  98     168.906 144.429  32.063  1.00  0.00           C
ATOM      4  CG  PHE A  98     170.155 144.850  32.830  1.00  0.00           C
ATOM      5  CD1 PHE A  98     170.352 144.442  34.165  1.00  0.00           C
ATOM      6  CE1 PHE A  98     171.487 144.867  34.882  1.00  0.00           C
ATOM      7  CZ  PHE A  98     172.440 145.696  34.265  1.00  0.00           C
ATOM      8  CE2 PHE A  98     172.257 146.097  32.932  1.00  0.00           C
ATOM      9  CD2 PHE A  98     171.117 145.677  32.221  1.00  0.00           C
ATOM     10  C   PHE A  98     167.789 142.746  30.504  1.00  0.00           C
ATOM     11  O   PHE A  98     166.896 143.459  30.030  1.00  0.00           O
ATOM     12  N   LEU A  99     167.639 141.428  30.673  1.00  0.00           N
ATOM     13  CA  LEU A  99     166.407 140.700  30.356  1.00  0.00           C
ATOM     14  CB  LEU A  99     166.775 139.359  29.689  1.00  0.00           C
ATOM     15  CG  LEU A  99     165.646 138.655  28.908  1.00  0.00           C
ATOM     16  CD1 LEU A  99     166.229 137.483  28.114  1.00  0.00           C
ATOM     17  CD2 LEU A  99     164.533 138.105  29.798  1.00  0.00           C
ATOM     18  C   LEU A  99     165.520 140.595  31.600  1.00  0.00           C
ATOM     19  O   LEU A  99     165.929 140.038  32.617  1.00  0.00           O
ATOM     20  N   ILE A 100     164.341 141.216  31.536  1.00  0.00           N
ATOM     21  CA  ILE A 100     163.363 141.283  32.624  1.00  0.00           C
ATOM     22  CB  ILE A 100     162.714 142.682  32.673  1.00  0.00           C
ATOM     23  CG2 ILE A 100     161.541 142.747  33.670  1.00  0.00           C
ATOM     24  CG1 ILE A 100     163.749 143.768  33.047  1.00  0.00           C
ATOM     25  CD1 ILE A 100     163.388 145.107  32.409  1.00  0.00           C
ATOM     26  C   ILE A 100     162.326 140.174  32.459  1.00  0.00           C
ATOM     27  O   ILE A 100     161.547 140.170  31.501  1.00  0.00           O
ATOM     28  N   LEU A 101     162.267 139.301  33.462  1.00  0.00           N
ATOM     29  CA  LEU A 101     161.210 138.323  33.672  1.00  0.00           C
ATOM     30  CB  LEU A 101     161.825 137.030  34.240  1.00  0.00           C
ATOM     31  CG  LEU A 101     163.051 136.452  33.516  1.00  0.00           C
ATOM     32  CD1 LEU A 101     163.469 135.156  34.215  1.00  0.00           C
ATOM     33  CD2 LEU A 101     162.749 136.127  32.053  1.00  0.00           C
ATOM     34  C   LEU A 101     160.169 138.902  34.642  1.00  0.00           C
ATOM     35  O   LEU A 101     160.473 139.104  35.818  1.00  0.00           O
ATOM     36  N   CYS A 102     158.956 139.184  34.162  1.00  0.00           N
ATOM     37  CA  CYS A 102     157.863 139.705  34.992  1.00  0.00           C
ATOM     38  CB  CYS A 102     158.054 141.224  35.191  1.00  0.00           C
ATOM     39  SG  CYS A 102     157.910 142.170  33.649  1.00  0.00           S
ATOM     40  C   CYS A 102     156.473 139.320  34.436  1.00  0.00           C
ATOM     41  O   CYS A 102     156.358 138.944  33.261  1.00  0.00           O
ATOM     42  N   PRO A 103     155.418 139.289  35.276  1.00  0.00           N
ATOM     43  CD  PRO A 103     155.421 139.595  36.705  1.00  0.00           C
ATOM     44  CG  PRO A 103     153.960 139.586  37.151  1.00  0.00           C
ATOM     45  CB  PRO A 103     153.281 138.680  36.124  1.00  0.00           C
ATOM     46  CA  PRO A 103     154.064 138.958  34.837  1.00  0.00           C
ATOM     47  C   PRO A 103     153.455 140.104  34.016  1.00  0.00           C
ATOM     48  O   PRO A 103     153.757 141.278  34.240  1.00  0.00           O
TER      49      PRO A 103
ATOM     50  N   HIS A 147     168.604 147.438  24.842  1.00  0.00           N
ATOM     51  CA  HIS A 147     169.154 147.494  26.207  1.00  0.00           C
ATOM     52  CB  HIS A 147     169.369 148.969  26.580  1.00  0.00           C
ATOM     53  CG  HIS A 147     170.308 149.721  25.673  1.00  0.00           C
ATOM     54  ND1 HIS A 147     170.153 151.058  25.293  1.00  0.00           N
ATOM     55  CE1 HIS A 147     171.259 151.356  24.586  1.00  0.00           C
ATOM     56  NE2 HIS A 147     172.078 150.293  24.501  1.00  0.00           N
ATOM     57  CD2 HIS A 147     171.496 149.253  25.187  1.00  0.00           C
ATOM     58  C   HIS A 147     168.270 146.826  27.267  1.00  0.00           C
ATOM     59  O   HIS A 147     168.774 146.395  28.304  1.00  0.00           O
TER      60      HIS A 147
ATOM     61  N   THR A 152     157.279 138.380  29.184  1.00  0.00           N
ATOM     62  CA  THR A 152     156.210 137.778  30.000  1.00  0.00           C
ATOM     63  CB  THR A 152     154.946 137.556  29.149  1.00  0.00           C
ATOM     64  CG2 THR A 152     154.191 138.842  28.827  1.00  0.00           C
ATOM     65  OG1 THR A 152     155.298 136.934  27.931  1.00  0.00           O
ATOM     66  C   THR A 152     156.635 136.423  30.569  1.00  0.00           C
ATOM     67  O   THR A 152     156.889 135.496  29.789  1.00  0.00           O
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ATOM     68  N   TYR A 153     156.419 136.219  31.871  1.00  0.00           N
ATOM     69  CA  TYR A 153     156.452 134.891  32.500  1.00  0.00           C
ATOM     70  CB  TYR A 153     156.105 135.029  33.999  1.00  0.00           C
ATOM     71  CG  TYR A 153     157.205 135.470  34.959  1.00  0.00           C
ATOM     72  CD1 TYR A 153     158.503 134.933  34.856  1.00  0.00           C
ATOM     73  CE1 TYR A 153     159.453 135.177  35.865  1.00  0.00           C
ATOM     74  CZ  TYR A 153     159.138 135.993  36.966  1.00  0.00           C
ATOM     75  OH  TYR A 153     160.071 136.157  37.938  1.00  0.00           O
ATOM     76  CE2 TYR A 153     157.853 136.566  37.059  1.00  0.00           C
ATOM     77  CD2 TYR A 153     156.885 136.282  36.069  1.00  0.00           C
ATOM     78  C   TYR A 153     155.469 133.901  31.837  1.00  0.00           C
ATOM     79  O   TYR A 153     155.785 132.723  31.659  1.00  0.00           O
ATOM     80  N   GLU A 154     154.325 134.393  31.361  1.00  0.00           N
ATOM     81  CA  GLU A 154     153.181 133.607  30.888  1.00  0.00           C
ATOM     82  CB  GLU A 154     152.018 134.557  30.549  1.00  0.00           C
ATOM     83  CG  GLU A 154     151.364 135.250  31.759  1.00  0.00           C
ATOM     84  CD  GLU A 154     152.094 136.488  32.315  1.00  0.00           C
ATOM     85  OE1 GLU A 154     153.182 136.851  31.814  1.00  0.00           O
ATOM     86  OE2 GLU A 154     151.511 137.150  33.199  1.00  0.00           O
ATOM     87  C   GLU A 154     153.467 132.730  29.659  1.00  0.00           C
ATOM     88  O   GLU A 154     152.942 131.618  29.573  1.00  0.00           O
ATOM     89  N   ILE A 155     154.285 133.196  28.705  1.00  0.00           N
ATOM     90  CA  ILE A 155     154.668 132.361  27.552  1.00  0.00           C
ATOM     91  CB  ILE A 155     155.156 133.216  26.353  1.00  0.00           C
ATOM     92  CG2 ILE A 155     156.536 133.859  26.585  1.00  0.00           C
ATOM     93  CG1 ILE A 155     155.249 132.410  25.035  1.00  0.00           C
ATOM     94  CD1 ILE A 155     153.901 131.884  24.526  1.00  0.00           C
ATOM     95  C   ILE A 155     155.686 131.287  27.962  1.00  0.00           C
ATOM     96  O   ILE A 155     155.610 130.153  27.495  1.00  0.00           O
ATOM     97  N   CYS A 156     156.579 131.604  28.901  1.00  0.00           N
ATOM     98  CA  CYS A 156     157.781 130.818  29.171  1.00  0.00           C
ATOM     99  CB  CYS A 156     158.913 131.806  29.471  1.00  0.00           C
ATOM    100  SG  CYS A 156     160.501 131.068  29.008  1.00  0.00           S
ATOM    101  C   CYS A 156     157.595 129.755  30.273  1.00  0.00           C
ATOM    102  O   CYS A 156     158.172 128.676  30.164  1.00  0.00           O
ATOM    103  N   LEU A 157     156.592 129.935  31.147  1.00  0.00           N
ATOM    104  CA  LEU A 157     155.997 128.880  31.991  1.00  0.00           C
ATOM    105  CB  LEU A 157     154.981 129.531  32.959  1.00  0.00           C
ATOM    106  CG  LEU A 157     155.606 130.365  34.095  1.00  0.00           C
ATOM    107  CD1 LEU A 157     154.527 131.215  34.769  1.00  0.00           C
ATOM    108  CD2 LEU A 157     156.243 129.475  35.166  1.00  0.00           C
ATOM    109  C   LEU A 157     155.298 127.767  31.179  1.00  0.00           C
ATOM    110  O   LEU A 157     154.934 126.730  31.733  1.00  0.00           O
ATOM    111  N   LYS A 158     155.054 128.003  29.883  1.00  0.00           N
ATOM    112  CA  LYS A 158     154.371 127.101  28.940  1.00  0.00           C
ATOM    113  CB  LYS A 158     153.148 127.873  28.415  1.00  0.00           C
ATOM    114  CG  LYS A 158     152.479 127.247  27.188  1.00  0.00           C
ATOM    115  CD  LYS A 158     151.228 128.053  26.832  1.00  0.00           C
ATOM    116  CE  LYS A 158     150.667 127.565  25.496  1.00  0.00           C
ATOM    117  NZ  LYS A 158     149.373 128.221  25.197  1.00  0.00           N
ATOM    118  C   LYS A 158     155.288 126.584  27.824  1.00  0.00           C
ATOM    119  O   LYS A 158     155.108 125.456  27.373  1.00  0.00           O
ATOM    120  N   ASP A 159     156.245 127.390  27.372  1.00  0.00           N
ATOM    121  CA  ASP A 159     157.195 127.085  26.310  1.00  0.00           C
ATOM    122  CB  ASP A 159     156.625 127.521  24.953  1.00  0.00           C
ATOM    123  CG  ASP A 159     157.645 127.388  23.819  1.00  0.00           C
ATOM    124  OD1 ASP A 159     157.582 128.234  22.894  1.00  0.00           O
ATOM    125  OD2 ASP A 159     158.594 126.577  23.941  1.00  0.00           O
ATOM    126  C   ASP A 159     158.552 127.753  26.587  1.00  0.00           C
ATOM    127  O   ASP A 159     158.806 128.905  26.229  1.00  0.00           O
ATOM    128  N   ALA A 160     159.425 127.014  27.265  1.00  0.00           N
ATOM    129  CA  ALA A 160     160.735 127.482  27.697  1.00  0.00           C
ATOM    130  CB  ALA A 160     161.141 126.627  28.911  1.00  0.00           C
ATOM    131  C   ALA A 160     161.819 127.497  26.594  1.00  0.00           C
ATOM    132  O   ALA A 160     162.973 127.774  26.919  1.00  0.00           O
ATOM    133  N   SER A 161     161.529 127.093  25.344  1.00  0.00           N
ATOM    134  CA  SER A 161     162.559 126.656  24.375  1.00  0.00           C
ATOM    135  CB  SER A 161     161.923 126.331  23.015  1.00  0.00           C
ATOM    136  OG  SER A 161     161.550 127.519  22.350  1.00  0.00           O
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ATOM    137  C   SER A 161     163.703 127.660  24.170  1.00  0.00           C
ATOM    138  O   SER A 161     164.863 127.292  24.302  1.00  0.00           O
ATOM    139  N   PHE A 162     163.377 128.940  23.993  1.00  0.00           N
ATOM    140  CA  PHE A 162      164.311 130.010  23.641  1.00  0.00           C
ATOM    141  CB  PHE A 162      163.507 131.275  23.295  1.00  0.00           C
ATOM    142  CG  PHE A 162      162.727 131.923  24.430  1.00  0.00           C
ATOM    143  CD1 PHE A 162      163.130 133.176  24.931  1.00  0.00           C
ATOM    144  CE1 PHE A 162      162.417 133.789  25.976  1.00  0.00           C
ATOM    145  CZ  PHE A 162     161.279 133.162  26.508  1.00  0.00           C
ATOM    146  CE2 PHE A 162      160.854 131.926  25.988  1.00  0.00           C
ATOM    147  CD2 PHE A 162      161.589 131.296  24.974  1.00  0.00           C
ATOM    148  C   PHE A 162     165.390 130.249  24.711  1.00  0.00           C
ATOM    149  O   PHE A 162     166.563 129.982  24.455  1.00  0.00           O
ATOM    150  N   LEU A 163     165.004 130.563  25.953  1.00  0.00           N
ATOM    151  CA  LEU A 163      165.948 130.771  27.063  1.00  0.00           C
ATOM    152  CB  LEU A 163      165.242 131.635  28.130  1.00  0.00           C
ATOM    153  CG  LEU A 163      166.032 131.985  29.406  1.00  0.00           C
ATOM    154  CD1 LEU A 163      167.336 132.758  29.187  1.00  0.00           C
ATOM    155  CD2 LEU A 163      165.133 132.835  30.316  1.00  0.00           C
ATOM    156  C   LEU A 163     166.542 129.445  27.595  1.00  0.00           C
ATOM    157  O   LEU A 163     167.653 129.449  28.118  1.00  0.00           O
ATOM    158  N   LYS A 164     165.915 128.292  27.305  1.00  0.00           N
ATOM    159  CA  LYS A 164      166.480 126.939  27.507  1.00  0.00           C
ATOM    160  CB  LYS A 164      165.306 125.945  27.600  1.00  0.00           C
ATOM    161  CG  LYS A 164      165.685 124.519  28.020  1.00  0.00           C
ATOM    162  CD  LYS A 164      164.431 123.643  28.173  1.00  0.00           C
ATOM    163  CE  LYS A 164      164.755 122.262  28.761  1.00  0.00           C
ATOM    164  NZ  LYS A 164      165.775 121.537  27.961  1.00  0.00           N
ATOM    165  C   LYS A 164     167.515 126.523  26.445  1.00  0.00           C
ATOM    166  O   LYS A 164     168.297 125.611  26.705  1.00  0.00           O
ATOM    167  N   SER A 165     167.508 127.133  25.258  1.00  0.00           N
ATOM    168  CA  SER A 165      168.527 126.954  24.208  1.00  0.00           C
ATOM    169  CB  SER A 165      167.879 127.010  22.819  1.00  0.00           C
ATOM    170  OG  SER A 165      167.207 125.794  22.543  1.00  0.00           O
ATOM    171  C   SER A 165     169.641 128.000  24.284  1.00  0.00           C
ATOM    172  O   SER A 165     170.803 127.660  24.080  1.00  0.00           O
ATOM    173  N   PHE A 166     169.317 129.219  24.722  1.00  0.00           N
ATOM    174  CA  PHE A 166      170.266 130.308  24.957  1.00  0.00           C
ATOM    175  CB  PHE A 166      170.145 131.328  23.813  1.00  0.00           C
ATOM    176  CG  PHE A 166      170.741 130.874  22.494  1.00  0.00           C
ATOM    177  CD1 PHE A 166      169.925 130.289  21.507  1.00  0.00           C
ATOM    178  CE1 PHE A 166      170.483 129.888  20.280  1.00  0.00           C
ATOM    179  CZ  PHE A 166     171.855 130.076  20.035  1.00  0.00           C
ATOM    180  CE2 PHE A 166      172.670 130.667  21.015  1.00  0.00           C
ATOM    181  CD2 PHE A 166      172.113 131.065  22.243  1.00  0.00           C
ATOM    182  C   PHE A 166     170.050 130.928  26.355  1.00  0.00           C
ATOM    183  O   PHE A 166     169.438 131.997  26.463  1.00  0.00           O
ATOM    184  N   PRO A 167     170.622 130.309  27.413  1.00  0.00           N
ATOM    185  CD  PRO A 167      171.195 128.966  27.410  1.00  0.00           C
ATOM    186  CG  PRO A 167      171.166 128.501  28.862  1.00  0.00           C
ATOM    187  CB  PRO A 167      171.400 129.805  29.613  1.00  0.00           C
ATOM    188  CA  PRO A 167      170.643 130.843  28.780  1.00  0.00           C
ATOM    189  C   PRO A 167     171.297 132.229  28.872  1.00  0.00           C
ATOM    190  O   PRO A 167     172.137 132.569  28.033  1.00  0.00           O
ATOM    191  N   TRP A 168     170.896 133.057  29.839  1.00  0.00           N
ATOM    192  CA  TRP A 168      171.262 134.482  29.870  1.00  0.00           C
ATOM    193  CB  TRP A 168      170.039 135.337  30.235  1.00  0.00           C
ATOM    194  CG  TRP A 168      170.074 136.684  29.587  1.00  0.00           C
ATOM    195  CD1 TRP A 168      170.155 137.880  30.208  1.00  0.00           C
ATOM    196  NE1 TRP A 168      170.235 138.890  29.265  1.00  0.00           N
ATOM    197  CE2 TRP A 168      170.138 138.389  27.985  1.00  0.00           C
ATOM    198  CZ2 TRP A 168      170.132 138.982  26.718  1.00  0.00           C
ATOM    199  CH2 TRP A 168      169.999 138.173  25.578  1.00  0.00           C
ATOM    200  CZ3 TRP A 168      169.895 136.778  25.720  1.00  0.00           C
ATOM    201  CE3 TRP A 168      169.934 136.186  26.995  1.00  0.00           C
ATOM    202  CD2 TRP A 168      170.035 136.979  28.159  1.00  0.00           C
ATOM    203  C   TRP A 168     172.497 134.818  30.727  1.00  0.00           C
ATOM    204  O   TRP A 168     173.013 133.988  31.470  1.00  0.00           O
ATOM    205  N   SER A 169     173.038 136.025  30.545  1.00  0.00           N
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ATOM    206  CA  SER A 169     174.154 136.558  31.341  1.00  0.00           C
ATOM    207  CB  SER A 169     175.145 137.278  30.416  1.00  0.00           C
ATOM    208  OG  SER A 169     174.481 138.251  29.629  1.00  0.00           O
ATOM    209  C   SER A 169     173.684 137.493  32.463  1.00  0.00           C
ATOM    210  O   SER A 169     174.107 137.319  33.605  1.00  0.00           O
ATOM    211  N   VAL A 170     172.810 138.457  32.143  1.00  0.00           N
ATOM    212  CA  VAL A 170     172.474 139.613  32.996  1.00  0.00           C
ATOM    213  CB  VAL A 170     173.142 140.889  32.430  1.00  0.00           C
ATOM    214  CG1 VAL A 170     172.799 142.127  33.260  1.00  0.00           C
ATOM    215  CG2 VAL A 170     174.674 140.771  32.412  1.00  0.00           C
ATOM    216  C   VAL A 170     170.951 139.760  33.141  1.00  0.00           C
ATOM    217  O   VAL A 170     170.265 140.260  32.247  1.00  0.00           O
ATOM    218  N   LEU A 171     170.400 139.142  34.187  1.00  0.00           N
ATOM    219  CA  LEU A 171     168.977 138.820  34.338  1.00  0.00           C
ATOM    220  CB  LEU A 171     168.894 137.300  34.598  1.00  0.00           C
ATOM    221  CG  LEU A 171     167.494 136.673  34.478  1.00  0.00           C
ATOM    222  CD1 LEU A 171     167.019 136.640  33.023  1.00  0.00           C
ATOM    223  CD2 LEU A 171     167.529 135.233  34.996  1.00  0.00           C
ATOM    224  C   LEU A 171     168.294 139.651  35.445  1.00  0.00           C
ATOM    225  O   LEU A 171     168.869 139.896  36.507  1.00  0.00           O
ATOM    226  N   VAL A 172     167.011 139.971  35.256  1.00  0.00           N
ATOM    227  CA  VAL A 172     166.122 140.595  36.253  1.00  0.00           C
ATOM    228  CB  VAL A 172     165.755 142.035  35.837  1.00  0.00           C
ATOM    229  CG1 VAL A 172     164.729 142.673  36.782  1.00  0.00           C
ATOM    230  CG2 VAL A 172     166.987 142.947  35.768  1.00  0.00           C
ATOM    231  C   VAL A 172     164.876 139.727  36.449  1.00  0.00           C
ATOM    232  O   VAL A 172     164.305 139.250  35.469  1.00  0.00           O
ATOM    233  N   VAL A 173     164.466 139.498  37.701  1.00  0.00           N
ATOM    234  CA  VAL A 173     163.497 138.452  38.069  1.00  0.00           C
ATOM    235  CB  VAL A 173     164.235 137.206  38.610  1.00  0.00           C
ATOM    236  CG1 VAL A 173     163.283 136.014  38.724  1.00  0.00           C
ATOM    237  CG2 VAL A 173     165.425 136.763  37.745  1.00  0.00           C
ATOM    238  C   VAL A 173     162.492 138.980  39.100  1.00  0.00           C
ATOM    239  O   VAL A 173     162.861 139.264  40.239  1.00  0.00           O
ATOM    240  N   ASP A 174     161.245 139.190  38.676  1.00  0.00           N
ATOM    241  CA  ASP A 174     160.155 139.754  39.488  1.00  0.00           C
ATOM    242  CB  ASP A 174     159.162 140.444  38.537  1.00  0.00           C
ATOM    243  CG  ASP A 174     158.191 141.433  39.196  1.00  0.00           C
ATOM    244  OD1 ASP A 174     158.449 141.842  40.355  1.00  0.00           O
ATOM    245  OD2 ASP A 174     157.351 141.963  38.438  1.00  0.00           O
ATOM    246  C   ASP A 174     159.448 138.718  40.393  1.00  0.00           C
ATOM    247  O   ASP A 174     159.493 137.509  40.143  1.00  0.00           O
ATOM    248  N   GLU A 175     158.632 139.204  41.331  1.00  0.00           N
ATOM    249  CA  GLU A 175     157.536 138.438  41.944  1.00  0.00           C
ATOM    250  CB  GLU A 175     156.877 139.310  43.038  1.00  0.00           C
ATOM    251  CG  GLU A 175     155.457 138.962  43.539  1.00  0.00           C
ATOM    252  CD  GLU A 175     155.296 137.612  44.261  1.00  0.00           C
ATOM    253  OE1 GLU A 175     156.184 136.735  44.166  1.00  0.00           O
ATOM    254  OE2 GLU A 175     154.313 137.440  45.018  1.00  0.00           O
ATOM    255  C   GLU A 175     156.533 137.939  40.884  1.00  0.00           C
ATOM    256  O   GLU A 175     156.358 138.539  39.823  1.00  0.00           O
ATOM    257  N   ALA A 176     155.837 136.839  41.185  1.00  0.00           N
ATOM    258  CA  ALA A 176     154.807 136.286  40.303  1.00  0.00           C
ATOM    259  CB  ALA A 176     155.399 135.120  39.492  1.00  0.00           C
ATOM    260  C   ALA A 176     153.509 135.967  41.060  1.00  0.00           C
ATOM    261  O   ALA A 176     152.617 136.809  41.157  1.00  0.00           O
ATOM    262  N   HIS A 177     153.360 134.730  41.537  1.00  0.00           N
ATOM    263  CA  HIS A 177     152.235 134.280  42.359  1.00  0.00           C
ATOM    264  CB  HIS A 177     150.979 134.091  41.488  1.00  0.00           C
ATOM    265  CG  HIS A 177     149.731 134.431  42.255  1.00  0.00           C
ATOM    266  ND1 HIS A 177     149.155 133.650  43.256  1.00  0.00           N
ATOM    267  CE1 HIS A 177     148.179 134.396  43.790  1.00  0.00           C
ATOM    268  NE2 HIS A 177     148.128 135.601  43.195  1.00  0.00           N
ATOM    269  CD2 HIS A 177     149.111 135.646  42.232  1.00  0.00           C
ATOM    270  C   HIS A 177     152.622 132.992  43.100  1.00  0.00           C
ATOM    271  O   HIS A 177     153.610 132.358  42.715  1.00  0.00           O
ATOM    272  N   ARG A 178     151.886 132.622  44.152  1.00  0.00           N
ATOM    273  CA  ARG A 178     152.169 131.476  45.040  1.00  0.00           C
ATOM    274  CB  ARG A 178     151.146 131.416  46.194  1.00  0.00           C
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ATOM    275  CG  ARG A 178     150.945 132.705  47.016  1.00  0.00           C
ATOM    276  CD  ARG A 178     152.115 133.101  47.927  1.00  0.00           C
ATOM    277  NE  ARG A 178     153.314 133.558  47.214  1.00  0.00           N
ATOM    278  CZ  ARG A 178     153.536 134.718  46.630  1.00  0.00           C
ATOM    279  NH1 ARG A 178     152.673 135.675  46.484  1.00  0.00           N
ATOM    280  NH2 ARG A 178     154.690 134.929  46.099  1.00  0.00           N
ATOM    281  C   ARG A 178     152.220 130.145  44.267  1.00  0.00           C
ATOM    282  O   ARG A 178     151.201 129.496  44.032  1.00  0.00           O
ATOM    283  N   LEU A 179     153.423 129.735  43.874  1.00  0.00           N
ATOM    284  CA  LEU A 179     153.735 128.571  43.030  1.00  0.00           C
ATOM    285  CB  LEU A 179     154.247 129.049  41.652  1.00  0.00           C
ATOM    286  CG  LEU A 179     153.190 129.758  40.774  1.00  0.00           C
ATOM    287  CD1 LEU A 179     153.883 130.591  39.696  1.00  0.00           C
ATOM    288  CD2 LEU A 179     152.253 128.778  40.060  1.00  0.00           C
ATOM    289  C   LEU A 179     154.707 127.640  43.779  1.00  0.00           C
ATOM    290  O   LEU A 179     155.731 127.207  43.244  1.00  0.00           O
ATOM    291  N   LYS A 180     154.402 127.424  45.067  1.00  0.00           N
ATOM    292  CA  LYS A 180     155.267 126.871  46.120  1.00  0.00           C
ATOM    293  CB  LYS A 180     154.359 126.465  47.300  1.00  0.00           C
ATOM    294  CG  LYS A 180     155.143 125.843  48.460  1.00  0.00           C
ATOM    295  CD  LYS A 180     154.253 125.513  49.665  1.00  0.00           C
ATOM    296  CE  LYS A 180     155.069 124.951  50.839  1.00  0.00           C
ATOM    297  NZ  LYS A 180     155.693 123.644  50.542  1.00  0.00           N
ATOM    298  C   LYS A 180     156.186 125.740  45.653  1.00  0.00           C
ATOM    299  O   LYS A 180     157.402 125.917  45.624  1.00  0.00           O
ATOM    300  N   ASN A 181     155.610 124.652  45.144  1.00  0.00           N
ATOM    301  CA  ASN A 181     156.347 123.450  44.743  1.00  0.00           C
ATOM    302  CB  ASN A 181     155.341 122.331  44.407  1.00  0.00           C
ATOM    303  CG  ASN A 181     154.413 121.914  45.539  1.00  0.00           C
ATOM    304  OD1 ASN A 181     154.089 122.651  46.456  1.00  0.00           O
ATOM    305  ND2 ASN A 181     153.860 120.727  45.453  1.00  0.00           N
ATOM    306  C   ASN A 181     157.278 123.684  43.538  1.00  0.00           C
ATOM    307  O   ASN A 181     158.266 122.972  43.378  1.00  0.00           O
ATOM    308  N   GLN A 182     156.930 124.614  42.646  1.00  0.00           N
ATOM    309  CA  GLN A 182     157.714 124.928  41.451  1.00  0.00           C
ATOM    310  CB  GLN A 182     156.820 125.543  40.363  1.00  0.00           C
ATOM    311  CG  GLN A 182     155.638 124.646  39.960  1.00  0.00           C
ATOM    312  CD  GLN A 182     154.340 125.038  40.660  1.00  0.00           C
ATOM    313  OE1 GLN A 182     154.116 124.774  41.829  1.00  0.00           O
ATOM    314  NE2 GLN A 182     153.411 125.642  39.955  1.00  0.00           N
ATOM    315  C   GLN A 182     158.893 125.862  41.739  1.00  0.00           C
ATOM    316  O   GLN A 182     159.859 125.836  40.979  1.00  0.00           O
ATOM    317  N   SER A 183     158.849 126.643  42.826  1.00  0.00           N
ATOM    318  CA  SER A 183     159.892 127.624  43.171  1.00  0.00           C
ATOM    319  CB  SER A 183     159.534 128.339  44.481  1.00  0.00           C
ATOM    320  OG  SER A 183     159.544 127.460  45.588  1.00  0.00           O
ATOM    321  C   SER A 183     161.293 126.996  43.244  1.00  0.00           C
ATOM    322  O   SER A 183     162.130 127.315  42.404  1.00  0.00           O
ATOM    323  N   SER A 184     161.427 125.878  43.961  1.00  0.00           N
ATOM    324  CA  SER A 184     162.689 125.136  44.105  1.00  0.00           C
ATOM    325  CB  SER A 184     162.485 123.971  45.081  1.00  0.00           C
ATOM    326  OG  SER A 184     161.843 124.421  46.260  1.00  0.00           O
ATOM    327  C   SER A 184     163.257 124.598  42.787  1.00  0.00           C
ATOM    328  O   SER A 184     164.473 124.565  42.612  1.00  0.00           O
ATOM    329  N   LEU A 185     162.404 124.239  41.823  1.00  0.00           N
ATOM    330  CA  LEU A 185     162.853 123.835  40.488  1.00  0.00           C
ATOM    331  CB  LEU A 185     161.766 122.958  39.839  1.00  0.00           C
ATOM    332  CG  LEU A 185     162.078 122.513  38.397  1.00  0.00           C
ATOM    333  CD1 LEU A 185     163.390 121.731  38.286  1.00  0.00           C
ATOM    334  CD2 LEU A 185     160.950 121.609  37.897  1.00  0.00           C
ATOM    335  C   LEU A 185     163.235 125.043  39.620  1.00  0.00           C
ATOM    336  O   LEU A 185     164.313 125.061  39.033  1.00  0.00           O
ATOM    337  N   LEU A 186     162.393 126.078  39.587  1.00  0.00           N
ATOM    338  CA  LEU A 186     162.605 127.270  38.763  1.00  0.00           C
ATOM    339  CB  LEU A 186     161.329 128.134  38.795  1.00  0.00           C
ATOM    340  CG  LEU A 186     160.117 127.507  38.078  1.00  0.00           C
ATOM    341  CD1 LEU A 186     158.846 128.298  38.395  1.00  0.00           C
ATOM    342  CD2 LEU A 186     160.293 127.488  36.557  1.00  0.00           C
ATOM    343  C   LEU A 186     163.832 128.082  39.203  1.00  0.00           C
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ATOM   344  O   LEU A 186     164.551 128.598  38.351  1.00  0.00           O
ATOM   345  N   HIS A 187     164.114 128.146  40.507  1.00  0.00           N
ATOM   346  CA  HIS A 187     165.266 128.874  41.062  1.00  0.00           C
ATOM   347  CB  HIS A 187     165.077 129.127  42.563  1.00  0.00           C
ATOM   348  CG  HIS A 187     163.851 129.897  43.001  1.00  0.00           C
ATOM   349  ND1 HIS A 187     163.633 130.295  44.308  1.00  0.00           N
ATOM   350  CE1 HIS A 187     162.419 130.848  44.346  1.00  0.00           C
ATOM   351  NE2 HIS A 187     161.858 130.814  43.133  1.00  0.00           N
ATOM   352  CD2 HIS A 187     162.746 130.241  42.257  1.00  0.00           C
ATOM   353  C   HIS A 187     166.574 128.115  40.817  1.00  0.00           C
ATOM   354  O   HIS A 187     167.526 128.699  40.298  1.00  0.00           O
ATOM   355  N   LYS A 188     166.540 126.779  40.938  1.00  0.00           N
ATOM   356  CA  LYS A 188     167.638 125.896  40.530  1.00  0.00           C
ATOM   357  CB  LYS A 188     167.288 124.451  40.911  1.00  0.00           C
ATOM   358  CG  LYS A 188     168.458 123.504  40.618  1.00  0.00           C
ATOM   359  CD  LYS A 188     168.122 122.067  41.018  1.00  0.00           C
ATOM   360  CE  LYS A 188     169.359 121.205  40.755  1.00  0.00           C
ATOM   361  NZ  LYS A 188     169.158 119.814  41.223  1.00  0.00           N
ATOM   362  C   LYS A 188     167.952 126.035  39.040  1.00  0.00           C
ATOM   363  O   LYS A 188     169.097 126.309  38.701  1.00  0.00           O
ATOM   364  N   THR A 189     166.934 126.010  38.177  1.00  0.00           N
ATOM   365  CA  THR A 189     167.105 126.194  36.728  1.00  0.00           C
ATOM   366  CB  THR A 189     165.796 125.878  35.987  1.00  0.00           C
ATOM   367  CG2 THR A 189     165.836 126.153  34.484  1.00  0.00           C
ATOM   368  OG1 THR A 189     165.514 124.502  36.110  1.00  0.00           O
ATOM   369  C   THR A 189     167.623 127.587  36.363  1.00  0.00           C
ATOM   370  O   THR A 189     168.496 127.686  35.510  1.00  0.00           O
ATOM   371  N   LEU A 190     167.182 128.664  37.022  1.00  0.00           N
ATOM   372  CA  LEU A 190     167.706 130.010  36.737  1.00  0.00           C
ATOM   373  CB  LEU A 190     166.717 131.085  37.213  1.00  0.00           C
ATOM   374  CG  LEU A 190     165.834 131.603  36.069  1.00  0.00           C
ATOM   375  CD1 LEU A 190     165.112 130.496  35.297  1.00  0.00           C
ATOM   376  CD2 LEU A 190     164.799 132.572  36.638  1.00  0.00           C
ATOM   377  C   LEU A 190     169.118 130.246  37.277  1.00  0.00           C
ATOM   378  O   LEU A 190     169.890 130.911  36.597  1.00  0.00           O
ATOM   379  N   SER A 191     169.507 129.598  38.374  1.00  0.00           N
ATOM   380  CA  SER A 191     170.900 129.571  38.835  1.00  0.00           C
ATOM   381  CB  SER A 191     170.925 128.979  40.243  1.00  0.00           C
ATOM   382  OG  SER A 191     172.243 128.931  40.737  1.00  0.00           O
ATOM   383  C   SER A 191     171.812 128.781  37.882  1.00  0.00           C
ATOM   384  O   SER A 191     172.781 129.323  37.358  1.00  0.00           O
ATOM   385  N   GLU A 192     171.337 127.620  37.421  1.00  0.00           N
ATOM   386  CA  GLU A 192     171.975 126.776  36.398  1.00  0.00           C
ATOM   387  CB  GLU A 192     171.180 125.452  36.381  1.00  0.00           C
ATOM   388  CG  GLU A 192     171.648 124.337  35.437  1.00  0.00           C
ATOM   389  CD  GLU A 192     170.725 123.104  35.561  1.00  0.00           C
ATOM   390  OE1 GLU A 192     170.701 122.476  36.649  1.00  0.00           O
ATOM   391  OE2 GLU A 192     169.950 122.851  34.606  1.00  0.00           O
ATOM   392  C   GLU A 192     172.067 127.456  35.012  1.00  0.00           C
ATOM   393  O   GLU A 192     172.923 127.101  34.202  1.00  0.00           O
ATOM   394  N   PHE A 193     171.222 128.461  34.737  1.00  0.00           N
ATOM   395  CA  PHE A 193     171.185 129.202  33.467  1.00  0.00           C
ATOM   396  CB  PHE A 193     169.719 129.427  33.048  1.00  0.00           C
ATOM   397  CG  PHE A 193     168.996 128.247  32.411  1.00  0.00           C
ATOM   398  CD1 PHE A 193     167.824 128.510  31.672  1.00  0.00           C
ATOM   399  CE1 PHE A 193     167.115 127.441  31.091  1.00  0.00           C
ATOM   400  CZ  PHE A 193     167.566 126.126  31.240  1.00  0.00           C
ATOM   401  CE2 PHE A 193     168.722 125.855  31.981  1.00  0.00           C
ATOM   402  CD2 PHE A 193     169.445 126.913  32.547  1.00  0.00           C
ATOM   403  C   PHE A 193     171.934 130.548  33.488  1.00  0.00           C
ATOM   404  O   PHE A 193     172.361 130.997  32.422  1.00  0.00           O
ATOM   405  N   SER A 194     171.913 131.284  34.603  1.00  0.00           N
ATOM   406  CA  SER A 194     172.258 132.714  34.650  1.00  0.00           C
ATOM   407  CB  SER A 194     171.282 133.444  35.571  1.00  0.00           C
ATOM   408  OG  SER A 194     171.459 134.840  35.457  1.00  0.00           O
ATOM   409  C   SER A 194     173.703 132.947  35.096  1.00  0.00           C
ATOM   410  O   SER A 194     174.030 132.781  36.269  1.00  0.00           O
ATOM   411  N   VAL A 195     174.600 133.278  34.160  1.00  0.00           N
ATOM   412  CA  VAL A 195     176.057 133.190  34.405  1.00  0.00           C
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ATOM    413  CB  VAL A 195     176.829 133.057  33.074  1.00  0.00           C
ATOM    414  CG1 VAL A 195     178.357 133.047  33.240  1.00  0.00           C
ATOM    415  CG2 VAL A 195     176.453 131.748  32.364  1.00  0.00           C
ATOM    416  C   VAL A 195     176.633 134.322  35.271  1.00  0.00           C
ATOM    417  O   VAL A 195     177.561 134.065  36.035  1.00  0.00           O
ATOM    418  N   VAL A 196     176.202 135.578  35.083  1.00  0.00           N
ATOM    419  CA  VAL A 196     176.874 136.755  35.684  1.00  0.00           C
ATOM    420  CB  VAL A 196     177.300 137.776  34.601  1.00  0.00           C
ATOM    421  CG1 VAL A 196     177.916 139.057  35.181  1.00  0.00           C
ATOM    422  CG2 VAL A 196     178.336 137.162  33.649  1.00  0.00           C
ATOM    423  C   VAL A 196     176.043 137.416  36.783  1.00  0.00           C
ATOM    424  O   VAL A 196     176.601 137.817  37.804  1.00  0.00           O
ATOM    425  N   PHE A 197     174.742 137.612  36.562  1.00  0.00           N
ATOM    426  CA  PHE A 197     173.912 138.446  37.432  1.00  0.00           C
ATOM    427  CB  PHE A 197     174.122 139.911  37.031  1.00  0.00           C
ATOM    428  CG  PHE A 197     173.263 140.911  37.775  1.00  0.00           C
ATOM    429  CD1 PHE A 197     172.145 141.492  37.148  1.00  0.00           C
ATOM    430  CE1 PHE A 197     171.396 142.473  37.818  1.00  0.00           C
ATOM    431  CZ  PHE A 197     171.759 142.870  39.117  1.00  0.00           C
ATOM    432  CE2 PHE A 197     172.850 142.260  39.760  1.00  0.00           C
ATOM    433  CD2 PHE A 197     173.598 141.275  39.091  1.00  0.00           C
ATOM    434  C   PHE A 197     172.432 138.062  37.376  1.00  0.00           C
ATOM    435  O   PHE A 197     171.867 137.937  36.291  1.00  0.00           O
ATOM    436  N   SER A 198     171.778 138.066  38.539  1.00  0.00           N
ATOM    437  CA  SER A 198     170.371 137.708  38.726  1.00  0.00           C
ATOM    438  CB  SER A 198     170.253 136.222  39.105  1.00  0.00           C
ATOM    439  OG  SER A 198     170.935 135.397  38.178  1.00  0.00           O
ATOM    440  C   SER A 198     169.744 138.593  39.811  1.00  0.00           C
ATOM    441  O   SER A 198     169.952 138.376  41.005  1.00  0.00           O
ATOM    442  N   LEU A 199     169.020 139.640  39.409  1.00  0.00           N
ATOM    443  CA  LEU A 199     168.344 140.566  40.328  1.00  0.00           C
ATOM    444  CB  LEU A 199     168.187 141.922  39.617  1.00  0.00           C
ATOM    445  CG  LEU A 199     167.589 143.056  40.466  1.00  0.00           C
ATOM    446  CD1 LEU A 199     168.500 143.472  41.620  1.00  0.00           C
ATOM    447  CD2 LEU A 199     167.387 144.289  39.583  1.00  0.00           C
ATOM    448  C   LEU A 199     167.000 139.985  40.804  1.00  0.00           C
ATOM    449  O   LEU A 199     166.014 140.044  40.071  1.00  0.00           O
ATOM    450  N   LEU A 200     166.969 139.407  42.009  1.00  0.00           N
ATOM    451  CA  LEU A 200     165.793 138.746  42.600  1.00  0.00           C
ATOM    452  CB  LEU A 200     166.260 137.569  43.494  1.00  0.00           C
ATOM    453  CG  LEU A 200     166.485 136.202  42.819  1.00  0.00           C
ATOM    454  CD1 LEU A 200     165.180 135.607  42.301  1.00  0.00           C
ATOM    455  CD2 LEU A 200     167.500 136.229  41.680  1.00  0.00           C
ATOM    456  C   LEU A 200     164.919 139.757  43.371  1.00  0.00           C
ATOM    457  O   LEU A 200     165.130 140.011  44.562  1.00  0.00           O
ATOM    458  N   LEU A 201     163.921 140.332  42.697  1.00  0.00           N
ATOM    459  CA  LEU A 201     163.032 141.394  43.193  1.00  0.00           C
ATOM    460  CB  LEU A 201     162.482 142.182  41.983  1.00  0.00           C
ATOM    461  CG  LEU A 201     163.534 142.877  41.102  1.00  0.00           C
ATOM    462  CD1 LEU A 201     162.853 143.547  39.910  1.00  0.00           C
ATOM    463  CD2 LEU A 201     164.291 143.956  41.879  1.00  0.00           C
ATOM    464  C   LEU A 201     161.907 140.865  44.113  1.00  0.00           C
ATOM    465  O   LEU A 201     160.721 141.029  43.833  1.00  0.00           O
ATOM    466  N   THR A 202     162.280 140.254  45.242  1.00  0.00           N
ATOM    467  CA  THR A 202     161.363 139.579  46.189  1.00  0.00           C
ATOM    468  CB  THR A 202     162.118 139.156  47.459  1.00  0.00           C
ATOM    469  CG2 THR A 202     161.232 138.519  48.532  1.00  0.00           C
ATOM    470  OG1 THR A 202     163.086 138.191  47.122  1.00  0.00           O
ATOM    471  C   THR A 202     160.146 140.443  46.559  1.00  0.00           C
ATOM    472  O   THR A 202     160.300 141.584  46.998  1.00  0.00           O
ATOM    473  N   GLY A 203     158.936 139.890  46.412  1.00  0.00           N
ATOM    474  CA  GLY A 203     157.651 140.602  46.478  1.00  0.00           C
ATOM    475  C   GLY A 203     157.389 141.323  47.804  1.00  0.00           C
ATOM    476  O   GLY A 203     157.474 142.548  47.861  1.00  0.00           O
ATOM    477  N   THR A 204     157.047 140.562  48.841  1.00  0.00           N
ATOM    478  CA  THR A 204     157.019 140.951  50.260  1.00  0.00           C
ATOM    479  CB  THR A 204     155.823 141.864  50.594  1.00  0.00           C
ATOM    480  CG2 THR A 204     154.438 141.288  50.288  1.00  0.00           C
ATOM    481  OG1 THR A 204     155.827 142.144  51.969  1.00  0.00           O
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ATOM    482  C   THR A 204     156.993 139.667  51.110  1.00  0.00           C
ATOM    483  O   THR A 204     156.233 138.748  50.785  1.00  0.00           O
ATOM    484  N   PRO A 205     157.800 139.535  52.182  1.00  0.00           N
ATOM    485  CD  PRO A 205     158.711 140.534  52.726  1.00  0.00           C
ATOM    486  CG  PRO A 205     159.208 139.964  54.055  1.00  0.00           C
ATOM    487  CB  PRO A 205     159.154 138.455  53.823  1.00  0.00           C
ATOM    488  CA  PRO A 205     157.921 138.278  52.933  1.00  0.00           C
ATOM    489  C   PRO A 205     156.664 137.882  53.732  1.00  0.00           C
ATOM    490  O   PRO A 205     156.601 136.766  54.231  1.00  0.00           O
ATOM    491  N   ILE A 206     155.617 138.716  53.742  1.00  0.00           N
ATOM    492  CA  ILE A 206     154.264 138.371  54.221  1.00  0.00           C
ATOM    493  CB  ILE A 206     153.506 139.693  54.539  1.00  0.00           C
ATOM    494  CG2 ILE A 206     151.983 139.509  54.688  1.00  0.00           C
ATOM    495  CG1 ILE A 206     154.002 140.371  55.842  1.00  0.00           C
ATOM    496  CD1 ILE A 206     155.381 141.042  55.768  1.00  0.00           C
ATOM    497  C   ILE A 206     153.510 137.474  53.204  1.00  0.00           C
ATOM    498  O   ILE A 206     152.522 136.826  53.547  1.00  0.00           O
ATOM    499  N   GLN A 207     153.908 137.503  51.926  1.00  0.00           N
ATOM    500  CA  GLN A 207     153.336 136.698  50.837  1.00  0.00           C
ATOM    501  CB  GLN A 207     153.028 137.610  49.634  1.00  0.00           C
ATOM    502  CG  GLN A 207     151.600 138.176  49.660  1.00  0.00           C
ATOM    503  CD  GLN A 207     150.528 137.178  49.208  1.00  0.00           C
ATOM    504  OE1 GLN A 207     150.720 136.321  48.359  1.00  0.00           O
ATOM    505  NE2 GLN A 207     149.297 137.337  49.637  1.00  0.00           N
ATOM    506  C   GLN A 207     154.259 135.556  50.397  1.00  0.00           C
ATOM    507  O   GLN A 207     153.770 134.456  50.147  1.00  0.00           O
ATOM    508  N   ASN A 208     155.536 135.853  50.136  1.00  0.00           N
ATOM    509  CA  ASN A 208     156.504 134.882  49.619  1.00  0.00           C
ATOM    510  CB  ASN A 208     157.777 135.639  49.182  1.00  0.00           C
ATOM    511  CG  ASN A 208     157.535 136.670  48.088  1.00  0.00           C
ATOM    512  OD1 ASN A 208     157.540 137.867  48.303  1.00  0.00           O
ATOM    513  ND2 ASN A 208     157.359 136.248  46.863  1.00  0.00           N
ATOM    514  C   ASN A 208     156.788 133.801  50.683  1.00  0.00           C
ATOM    515  O   ASN A 208     157.390 134.099  51.711  1.00  0.00           O
ATOM    516  N   SER A 209     156.296 132.575  50.465  1.00  0.00           N
ATOM    517  CA  SER A 209     156.232 131.534  51.507  1.00  0.00           C
ATOM    518  CB  SER A 209     155.236 130.440  51.086  1.00  0.00           C
ATOM    519  OG  SER A 209     155.825 129.427  50.288  1.00  0.00           O
ATOM    520  C   SER A 209     157.611 130.962  51.890  1.00  0.00           C
ATOM    521  O   SER A 209     158.581 131.128  51.152  1.00  0.00           O
ATOM    522  N   LEU A 210     157.681 130.103  52.918  1.00  0.00           N
ATOM    523  CA  LEU A 210     158.946 129.538  53.427  1.00  0.00           C
ATOM    524  CB  LEU A 210     158.676 128.595  54.612  1.00  0.00           C
ATOM    525  CG  LEU A 210     158.030 129.253  55.843  1.00  0.00           C
ATOM    526  CD1 LEU A 210     157.639 128.148  56.817  1.00  0.00           C
ATOM    527  CD2 LEU A 210     158.961 130.237  56.551  1.00  0.00           C
ATOM    528  C   LEU A 210     159.768 128.801  52.356  1.00  0.00           C
ATOM    529  O   LEU A 210     160.897 129.204  52.091  1.00  0.00           O
ATOM    530  N   GLN A 211     159.156 127.869  51.613  1.00  0.00           N
ATOM    531  CA  GLN A 211     159.824 127.189  50.491  1.00  0.00           C
ATOM    532  CB  GLN A 211     158.912 126.082  49.924  1.00  0.00           C
ATOM    533  CG  GLN A 211     159.555 125.360  48.722  1.00  0.00           C
ATOM    534  CD  GLN A 211     158.842 124.083  48.288  1.00  0.00           C
ATOM    535  OE1 GLN A 211     157.705 123.799  48.638  1.00  0.00           O
ATOM    536  NE2 GLN A 211     159.450 123.298  47.431  1.00  0.00           N
ATOM    537  C   GLN A 211     160.231 128.163  49.372  1.00  0.00           C
ATOM    538  O   GLN A 211     161.294 128.000  48.772  1.00  0.00           O
ATOM    539  N   GLU A 212     159.385 129.153  49.076  1.00  0.00           N
ATOM    540  CA  GLU A 212     159.617 130.131  48.012  1.00  0.00           C
ATOM    541  CB  GLU A 212     158.332 130.941  47.745  1.00  0.00           C
ATOM    542  CG  GLU A 212     157.157 130.104  47.199  1.00  0.00           C
ATOM    543  CD  GLU A 212     155.810 130.851  47.064  1.00  0.00           C
ATOM    544  OE1 GLU A 212     155.669 132.011  47.531  1.00  0.00           O
ATOM    545  OE2 GLU A 212     154.925 130.291  46.372  1.00  0.00           O
ATOM    546  C   GLU A 212     160.797 131.063  48.335  1.00  0.00           C
ATOM    547  O   GLU A 212     161.623 131.303  47.462  1.00  0.00           O
ATOM    548  N   LEU A 213     160.991 131.439  49.602  1.00  0.00           N
ATOM    549  CA  LEU A 213     162.168 132.188  50.056  1.00  0.00           C
ATOM    550  CB  LEU A 213     161.819 132.925  51.358  1.00  0.00           C
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ATOM    551  CG  LEU A 213     160.800 134.069  51.214  1.00  0.00           C
ATOM    552  CD1 LEU A 213     160.492 134.626  52.605  1.00  0.00           C
ATOM    553  CD2 LEU A 213     161.328 135.220  50.353  1.00  0.00           C
ATOM    554  C   LEU A 213     163.411 131.303  50.254  1.00  0.00           C
ATOM    555  O   LEU A 213     164.506 131.702  49.867  1.00  0.00           O
ATOM    556  N   TYR A 214     163.265 130.090  50.795  1.00  0.00           N
ATOM    557  CA  TYR A 214     164.374 129.147  51.012  1.00  0.00           C
ATOM    558  CB  TYR A 214     163.836 127.926  51.777  1.00  0.00           C
ATOM    559  CG  TYR A 214     164.816 126.780  51.975  1.00  0.00           C
ATOM    560  CD1 TYR A 214     164.433 125.464  51.643  1.00  0.00           C
ATOM    561  CE1 TYR A 214     165.331 124.396  51.833  1.00  0.00           C
ATOM    562  CZ  TYR A 214     166.617 124.640  52.351  1.00  0.00           C
ATOM    563  OH  TYR A 214     167.474 123.604  52.528  1.00  0.00           O
ATOM    564  CE2 TYR A 214     167.003 125.954  52.690  1.00  0.00           C
ATOM    565  CD2 TYR A 214     166.102 127.021  52.504  1.00  0.00           C
ATOM    566  C   TYR A 214     165.048 128.714  49.703  1.00  0.00           C
ATOM    567  O   TYR A 214     166.275 128.684  49.610  1.00  0.00           O
ATOM    568  N   SER A 215     164.256 128.579  48.639  1.00  0.00           N
ATOM    569  CA  SER A 215     164.742 128.242  47.299  1.00  0.00           C
ATOM    570  CB  SER A 215     163.552 127.949  46.386  1.00  0.00           C
ATOM    571  OG  SER A 215     162.790 126.868  46.899  1.00  0.00           O
ATOM    572  C   SER A 215     165.643 129.317  46.670  1.00  0.00           C
ATOM    573  O   SER A 215     166.533 128.958  45.902  1.00  0.00           O
ATOM    574  N   LEU A 216     165.606 130.570  47.154  1.00  0.00           N
ATOM    575  CA  LEU A 216     166.518 131.639  46.714  1.00  0.00           C
ATOM    576  CB  LEU A 216     166.117 132.987  47.345  1.00  0.00           C
ATOM    577  CG  LEU A 216     164.683 133.468  47.059  1.00  0.00           C
ATOM    578  CD1 LEU A 216     164.397 134.737  47.866  1.00  0.00           C
ATOM    579  CD2 LEU A 216     164.478 133.798  45.581  1.00  0.00           C
ATOM    580  C   LEU A 216     167.995 131.353  47.041  1.00  0.00           C
ATOM    581  O   LEU A 216     168.882 131.874  46.363  1.00  0.00           O
ATOM    582  N   LEU A 217     168.281 130.467  48.003  1.00  0.00           N
ATOM    583  CA  LEU A 217     169.650 130.035  48.296  1.00  0.00           C
ATOM    584  CB  LEU A 217     169.685 129.225  49.605  1.00  0.00           C
ATOM    585  CG  LEU A 217     169.211 129.983  50.862  1.00  0.00           C
ATOM    586  CD1 LEU A 217     169.323 129.063  52.078  1.00  0.00           C
ATOM    587  CD2 LEU A 217     170.037 131.241  51.150  1.00  0.00           C
ATOM    588  C   LEU A 217     170.297 129.252  47.139  1.00  0.00           C
ATOM    589  O   LEU A 217     171.520 129.279  47.022  1.00  0.00           O
ATOM    590  N   SER A 218     169.529 128.739  46.165  1.00  0.00           N
ATOM    591  CA  SER A 218     170.099 128.077  44.980  1.00  0.00           C
ATOM    592  CB  SER A 218     169.000 127.432  44.125  1.00  0.00           C
ATOM    593  OG  SER A 218     168.259 128.383  43.383  1.00  0.00           O
ATOM    594  C   SER A 218     170.948 129.004  44.102  1.00  0.00           C
ATOM    595  O   SER A 218     171.737 128.505  43.303  1.00  0.00           O
ATOM    596  N   PHE A 219     170.767 130.328  44.189  1.00  0.00           N
ATOM    597  CA  PHE A 219     171.553 131.325  43.448  1.00  0.00           C
ATOM    598  CB  PHE A 219     170.726 132.612  43.302  1.00  0.00           C
ATOM    599  CG  PHE A 219     169.491 132.480  42.434  1.00  0.00           C
ATOM    600  CD1 PHE A 219     169.626 132.536  41.036  1.00  0.00           C
ATOM    601  CE1 PHE A 219     168.491 132.457  40.215  1.00  0.00           C
ATOM    602  CZ  PHE A 219     167.213 132.308  40.785  1.00  0.00           C
ATOM    603  CE2 PHE A 219     167.074 132.251  42.184  1.00  0.00           C
ATOM    604  CD2 PHE A 219     168.212 132.344  43.005  1.00  0.00           C
ATOM    605  C   PHE A 219     172.927 131.644  44.070  1.00  0.00           C
ATOM    606  O   PHE A 219     173.669 132.432  43.487  1.00  0.00           O
END
```

Figure 21

Compound Code	Supplier	Compound Code	Supplier
ALCi-1	Enamine	ALCi-53	Vitas M
ALCi-2	Enamine	ALCi-54	timtec
ALCi-3	Enamine	ALCi-55	timtec
ALCi-4	Enamine	ALCi-56	timtec
ALCi-5	Enamine	ALCi-57	TimTec
ALCi-6	Chemdiv	ALCi-58	TimTec
ALCi-7	ChemBridge	ALCi-60	TimTec
ALCi-8	ChemBridge	ALCi-61	TimTec
ALCi-9	ChemBridge	ALCi-62	TimTec
ALCi-10	ChemBridge	ALCi-63	TimTec
ALCi-11	ChemBridge	ALCi-64	TimTec
ALCi-14	ChemBridge	ALCi-65	Mcule
ALCi-15	ChemBridge	ALCi-70	Mcule
ALCi-17	Key Organics	ALCi-72	Intonation Research Laboratories
ALCi-18	Key Organics	ALCi-74	Intonation Research Laboratories
ALCi-19	Vitas M	ALCi-75	Intonation Research Laboratories
ALCi-22	Vitas M	ALCi-77	Mcule
ALCi-23	Vitas M	ALCi-79	Mcule
ALCi-24	Alinda	ALCi-81	Mcule
ALCi-29	ChemBridge	ALCi-82	Mcule
ALCi-30	Enamine	ALCi-87	Mcule
ALCi-36	ChemDiv	ALCi-90	Mcule
ALCi-37	ChemDiv	ALCi-93	Mcule
ALCi-39	ChemDiv	ALCi-94	Mcule
ALCi-40	ChemDiv	ALCi-97	Mcule
ALCi-43	Bicoll	ALCi-101	Mcule
ALCi-44	Bicoll	ALCi-120	Otava
ALCi-46	Key Organics	ALCi-123	Enamine
ALCi-47	Vitas M	ALCi-124	Enamine
ALCi-48	Vitas M	ALCi-125	Enamine
ALCi-50	Vitas M	ALCi-127	Ukrorgsyntez
ALCi-51	Vitas M	ALCi-128	Chemdiv
ALCi-52	Vitas M	ALCi-129	Chemdiv

Figure 21 (continued)

Compound Code	Supplier	Compound Code	Supplier
ALCi-130	Chemdiv	ALCi-180	Intonation Research Laboratories
ALCi-131	Chemdiv	ALCi-183	Intonation Research Laboratories
ALCi-132	Chemdiv	ALCi-184	Intonation Research Laboratories
ALCi-133	Enamine	ALCi-185	Intonation Research Laboratories
ALCi-134	Enamine	ALCi-186	Intonation Research Laboratories
ALCi-135	Enamine	ALCi-187	Intonation Research Laboratories
ALCi-136	Enamine	ALCi-188	Intonation Research Laboratories
ALCi-137	Enamine	ALCi-189	Intonation Research Laboratories
ALCi-146	Mcule	ALCi-190	Intonation Research Laboratories
ALCi-147	Mcule	ALCi-191	Intonation Research Laboratories
ALCi-149	Mcule	ALCi-192	Intonation Research Laboratories
ALCi-150	Mcule	ALCi-193	Intonation Research Laboratories
ALCi-151	Mcule	ALCi-194	Intonation Research Laboratories
ALCi-152	Intonation Research Laboratories	ALCi-195	Intonation Research Laboratories
ALCi-157	Bicoll	ALCi-196	Intonation Research Laboratories
ALCi-158	Bicoll	ALCi-197	Intonation Research Laboratories
ALCi-160	Bicoll	ALCi-198	Intonation Research Laboratories
ALCi-162	Intonation Research Laboratories	ALCi-199	Intonation Research Laboratories
ALCi-163	Intonation Research Laboratories	ALCi-200	Intonation Research Laboratories
ALCi-164	Intonation Research Laboratories	ALCi-201	ChemSpace
ALCi-166	Intonation Research Laboratories	ALCi-202	ChemSpace
ALCi-167	Bicoll	ALCi-203	ChemSpace
ALCi-171	Bicoll	ALCi-204	ChemSpace
ALCi-172	Bicoll	ALCi-205	ChemSpace
ALCi-177	Bicoll	ALCi-206	ChemSpace
ALCi-178	Bicoll	ALCi-207	ChemSpace

Figure 21 (continued)

Compound Code	Supplier	Compound Code	Supplier
ALCi-208	ChemSpace	ALCi-241	ChemSpace
ALCi-209	ChemSpace	ALCi-242	ChemSpace
ALCi-210	ChemSpace	ALCi-245	ChemSpace
ALCi-211	ChemSpace	ALCi-246	ChemSpace
ALCi-212	ChemSpace	ALCi-247	ChemSpace
ALCi-213	ChemSpace	ALCi-248	ChemSpace
ALCi-214	ChemSpace	ALCi-250	ChemSpace
ALCi-215	ChemSpace	ALCi-251	ChemSpace
ALCi-216	ChemSpace	ALCi-252	ChemSpace
ALCi-217	ChemSpace	ALCi-253	ChemSpace
ALCi-218	ChemSpace	ALCi-254	ChemSpace
ALCi-219	ChemSpace	ALCi-255	ChemSpace
ALCi-220	ChemSpace	ALCi-256	ChemSpace
ALCi-221	ChemSpace	ALCi-257	ChemSpace
ALCi-222	ChemSpace	ALCi-258	ChemSpace
ALCi-223	ChemSpace	ALCi-259	ChemSpace
ALCi-224	ChemSpace	ALCi-260	ChemSpace
ALCi-225	ChemSpace	ALCi-261	ChemSpace
ALCi-226	ChemSpace	ALCi-262	ChemSpace
ALCi-227	ChemSpace	ALCi-263	ChemSpace
ALCi-228	ChemSpace	ALCi-264	Intonation Research Laboratories
ALCi-229	ChemSpace	ALCi-265	Intonation Research Laboratories
ALCi-230	ChemSpace	ALCi-266	ChemSpace
ALCi-231	ChemSpace	ALCi-267	ChemSpace
ALCi-232	ChemSpace	ALCi-268	ChemSpace
ALCi-233	ChemSpace	ALCi-269	ChemSpace
ALCi-234	ChemSpace	ALCi-270	ChemSpace
ALCi-235	ChemSpace	ALCi-271	ChemSpace
ALCi-236	ChemSpace	ALCi-272	ChemSpace
ALCi-237	ChemSpace	ALCi-273	ChemSpace
ALCi-238	ChemSpace	ALCi-274	ChemSpace
ALCi-239	ChemSpace	ALCi-275	ChemSpace
ALCi-240	ChemSpace	ALCi-278	Chemspace

Figure 22

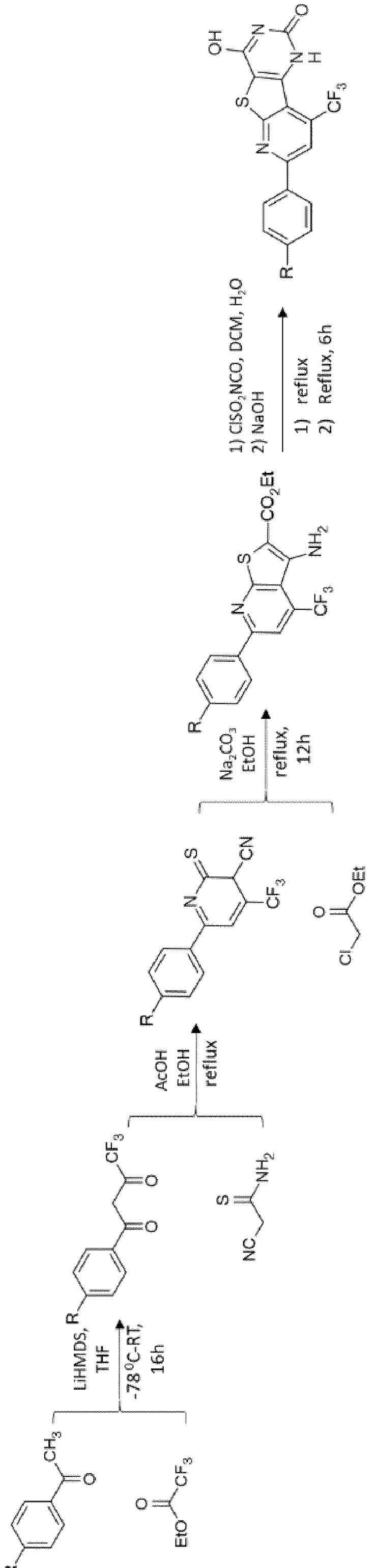

R
CF3
CF3
O
O
NC
NH2
AcOH
EtOH
reflux
S
CN
CF3
N
R
Cl
OEt
O
LiHMDS,
THF
-78 0C-RT,
16h
CH3
O
R
O
CF3
EtO
Na2CO3
EtOH
reflux,
12h
CO2Et
NH2
S
N
CF3
R
1) ClSO2NCO, DCM,
2) NaOH
1) reflux
2) Reflux, 6h
H2O
OH
N
O
N
H
S
CF3

Figure 23

Compound Code	% Inhibition at 250µM	Compound Code	% Inhibition at 250µM
ALCi-1	**100**	ALCi-70	82.52
ALCi-2	**100**	ALCi-72	96.29
ALCi-3	87.27	ALCi-74	93.22
ALCi-4	**100**	ALCi-75	**100**
ALCi-5	81.37[a]	ALCi-77	**100**
ALCi-6	82.58	ALCi-79	**100**
ALCi-7	90.7	ALCi-81	**100**
ALCi-8	**100**	ALCi-82	**100**
ALCi-9	**100**	ALCi-87	94.15
ALCi-10	77.72	ALCi-90	83.33
ALCi-11	73.16	ALCi-93	79.8
ALCi-14	50.31[a]	ALCi-94	**100**
ALCi-15	92.25	ALCi-97	71.88
ALCi-17	88.69	ALCi-101	**100**
ALCi-18	**100**	ALCi-120	98.88[a]
ALCi-19	79.35	ALCi-123	**100**
ALCi-22	**100**	ALCi-124	89.81
ALCi-23	99.48	ALCi-125	99.34
ALCi-24	82.65	ALCi-127	**100**
ALCi-29	**100**	ALCi-128	94.04
ALCi-30	**100**	ALCi-129	58.38
ALCi-36	81.44	ALCi-130	**100**
ALCi-37	90	ALCi-131	**100**
ALCi-39	72.29	ALCi-132	86.96
ALCi-40	92.45	ALCi-133	90.06
ALCi-43	73.6	ALCi-134	**100**
ALCi-44	**100**	ALCi-135	**100**
ALCi-46	**100**	ALCi-136	56.65
ALCi-47	81.38	ALCi-137	56.77
ALCi-48	61.03	ALCi-146	**100**
ALCi-50	**100**	ALCi-147	**100**
ALCi-51	106.17[h]	ALCi-149	96.52
ALCi-52	64.52	ALCi-150	**100**
ALCi-53	84.87[h]	ALCi-151	56.26
ALCi-54	**100**	ALCi-152	**100**
ALCi-55	71.75	ALCi-157	**100**
ALCi-56	**100**	ALCi-158	96.18
ALCi-57	**100**	ALCi-160	**100**
ALCi-58	**100**	ALCi-162	**100**
ALCi-60	**100**	ALCi-163	**100**
ALCi-61	62.92	ALCi-164	95.26
ALCi-62	**100**	ALCi-166	**100**
ALCi-63	51.455	ALCi-167	91.75
ALCi-64	**100**	ALCi-171	**100**
ALCi-65	63.98	ALCi-172	**100**

Figure 23 (continued)

Compound Code	% Inhibition at 250µM	Compound Code	% Inhibition at 250µM
ALCi-177	**100**	ALCi-224	72.38
ALCi-178	67.55	ALCi-225	**100**
ALCi-179	70.15	ALCi-226	**100**
ALCi-180	**100**	ALCi-227	78.88
ALCi-183	95.40	ALCi-228	79.26
ALCi-184	92.95	ALCi-229	**100**
ALCi-185	98.49	ALCi-230	**100**
ALCi-186	86.49	ALCi-231	**100**
ALCi-187	**100**	ALCi-232	83.69
ALCi-188	**100**	ALCi-233	**100**
ALCi-189	63.27	ALCi-234	**100**
ALCi-190	**100**	ALCi-235	**100**
ALCi-191	95.11	ALCi-236	**100**
ALCi-192	**100**	ALCi-237	**100**
ALCi-193	**100**	ALCi-238	98.50
ALCi-194	85.20	ALCi-239	**100**
ALCi-195	81.41	ALCi-240	**100**
ALCi-196	**100**	ALCi-241	94.60
ALCi-197	**100**[e]	ALCi-242	**100**
ALCi-198	**100**	ALCi-245	**100**
ALCi-199	77.49	ALCi-246	**100**
ALCi-200	**100**	ALCi-247	74.79
ALCi-201	**100**	ALCi-248	**100**
ALCi-202	**100**	ALCi-250	99.18
ALCi-203	**100**	ALCi-251	**100**
ALCi-204	93.12	ALCi-252	**100**
ALCi-205	**100**	ALCi-253	**100**
ALCi-206	**100**[a]	ALCi-254	75.07[a]
ALCi-207	**100**[e]	ALCi-255	97.7 [a]
ALCi-208	98.86[h]	ALCi-256	**100**[a]
ALCi-209	**100**	ALCi-257	**100**[d]
ALCi-210	**100**	ALCi-258	96.04 [a]
ALCi-211	**100**	ALCi-259	89.74 [a]
ALCi-212	**100**	ALCi-260	**100**[b]
ALCi-213	78.01[a]	ALCi-261	**100**[c]
ALCi-214	**100**	ALCi-262	83.21[f]
ALCi-215	77.13	ALCi-263	88.73[g]
ALCi-216	**100**	ALCi-264	**100**[a]
ALCi-217	**100**	ALCi-265	**100**
ALCi-218	81.16	ALCi-266	**100**
ALCi-219	76.69	ALCi-267	**100**
ALCi-220	**100**	ALCi-268	**100**
ALCi-221	**100**	ALCi-269	**100**
ALCi-222	**100**	ALCi-270	**100**
ALCi-223	**100**	ALCi-271	**100**

Figure 23 (continued)

Compound Code	% Inhibition at 250µM
ALCi-272	**100**
ALCi-273	**100**
ALCi-274	**100**
ALCi-275	**100**
ALCi-278	**100**

a) solubility problems at 250µM, measurement made at 125 µM.
b) solubility problems at 250µM, measurement made at 135.4µM.
c) solubility problems at 250µM, measurement made at 84.65µM.
d) solubility problems at 250µM, measurement made at 76.25µM.
e) solubility problems at 250µM, measurement made at 62.5µM.
f) solubility problems at 250µM, measurement made at 37.66µM.
g) solubility problems at 250µM, measurement made at 25µM.
h) solubility problems at 250µM, measurement made at 3.91µM.
The assay produced inhibition percentages above 100% in some experiments. Percentages >100% have been set to exactly 100% (in bold type).

SEQUENCE LISTING

<110> Eisbach Bio GmbH

<120> ALC1 INHIBITORS AND SYNERGY WITH PARPI

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<210> 1
<211> 897
<212> PRT
<213> Homo sapiens

<400> 1

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Met Glu Arg Ala Gly Ala Thr Ser Arg Gly Gly Gln Ala Pro Gly Phe
1               5                   10                  15


Leu Leu Arg Leu His Thr Glu Gly Arg Ala Glu Ala Ala Arg Val Gln
            20                  25                  30


Glu Gln Asp Leu Arg Gln Trp Gly Leu Thr Gly Ile His Leu Arg Ser
        35                  40                  45


Tyr Gln Leu Glu Gly Val Asn Trp Leu Ala Gln Arg Phe His Cys Gln
    50                  55                  60


Asn Gly Cys Ile Leu Gly Asp Glu Met Gly Leu Gly Lys Thr Cys Gln
65                  70                  75                  80


Thr Ile Ala Leu Phe Ile Tyr Leu Ala Gly Arg Leu Asn Asp Glu Gly
                85                  90                  95


Pro Phe Leu Ile Leu Cys Pro Leu Ser Val Leu Ser Asn Trp Lys Glu
            100                 105                 110


Glu Met Gln Arg Phe Ala Pro Gly Leu Ser Cys Val Thr Tyr Ala Gly
        115                 120                 125
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Asp Lys Glu Glu Arg Ala Cys Leu Gln Gln Asp Leu Lys Gln Glu Ser
    130                 135                 140

Arg Phe His Val Leu Leu Thr Thr Tyr Glu Ile Cys Leu Lys Asp Ala
145                 150                 155                 160

Ser Phe Leu Lys Ser Phe Pro Trp Ser Val Leu Val Val Asp Glu Ala
                165                 170                 175

His Arg Leu Lys Asn Gln Ser Ser Leu Leu His Lys Thr Leu Ser Glu
            180                 185                 190

Phe Ser Val Val Phe Ser Leu Leu Leu Thr Gly Thr Pro Ile Gln Asn
        195                 200                 205

Ser Leu Gln Glu Leu Tyr Ser Leu Leu Ser Phe Val Glu Pro Asp Leu
    210                 215                 220

Phe Ser Lys Glu Glu Val Gly Asp Phe Ile Gln Arg Tyr Gln Asp Ile
225                 230                 235                 240

Glu Lys Glu Ser Glu Ser Ala Ser Glu Leu His Lys Leu Leu Gln Pro
                245                 250                 255

Phe Leu Leu Arg Arg Val Lys Ala Glu Val Ala Thr Glu Leu Pro Lys
            260                 265                 270

Lys Thr Glu Val Val Ile Tyr His Gly Met Ser Ala Leu Gln Lys Lys
        275                 280                 285

Tyr Tyr Lys Ala Ile Leu Met Lys Asp Leu Asp Ala Phe Glu Asn Glu
    290                 295                 300

Thr Ala Lys Lys Val Lys Leu Gln Asn Ile Leu Ser Gln Leu Arg Lys
305                 310                 315                 320

Cys Val Asp His Pro Tyr Leu Phe Asp Gly Val Glu Pro Glu Pro Phe
                325                 330                 335

Glu Val Gly Asp His Leu Thr Glu Ala Ser Gly Lys Leu His Leu Leu
            340                 345                 350
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Asp Lys Leu Leu Ala Phe Leu Tyr Ser Gly Gly His Arg Val Leu Leu
        355                 360                 365

Phe Ser Gln Met Thr Gln Met Leu Asp Ile Leu Gln Asp Tyr Met Asp
    370                 375                 380

Tyr Arg Gly Tyr Ser Tyr Glu Arg Val Asp Gly Ser Val Arg Gly Glu
385                 390                 395                 400

Glu Arg His Leu Ala Ile Lys Asn Phe Gly Gln Gln Pro Ile Phe Val
                405                 410                 415

Phe Leu Leu Ser Thr Arg Ala Gly Gly Val Gly Met Asn Leu Thr Ala
            420                 425                 430

Ala Asp Thr Val Ile Phe Val Asp Ser Asp Phe Asn Pro Gln Asn Asp
        435                 440                 445

Leu Gln Ala Ala Ala Arg Ala His Arg Ile Gly Gln Asn Lys Ser Val
    450                 455                 460

Lys Val Ile Arg Leu Ile Gly Arg Asp Thr Val Glu Glu Ile Val Tyr
465                 470                 475                 480

Arg Lys Ala Ala Ser Lys Leu Gln Leu Thr Asn Met Ile Ile Glu Gly
                485                 490                 495

Gly His Phe Thr Leu Gly Ala Gln Lys Pro Ala Ala Asp Ala Asp Leu
            500                 505                 510

Gln Leu Ser Glu Ile Leu Lys Phe Gly Leu Asp Lys Leu Leu Ala Ser
        515                 520                 525

Glu Gly Ser Thr Met Asp Glu Ile Asp Leu Glu Ser Ile Leu Gly Glu
    530                 535                 540

Thr Lys Asp Gly Gln Trp Val Ser Asp Ala Leu Pro Ala Ala Glu Gly
545                 550                 555                 560
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Gly Ser Arg Asp Gln Glu Glu Gly Lys Asn His Met Tyr Leu Phe Glu
                565                 570                 575

Gly Lys Asp Tyr Ser Lys Glu Pro Ser Lys Glu Asp Arg Lys Ser Phe
            580                 585                 590

Glu Gln Leu Val Asn Leu Gln Lys Thr Leu Leu Glu Lys Ala Ser Gln
        595                 600                 605

Glu Gly Arg Ser Leu Arg Asn Lys Gly Ser Val Leu Ile Pro Gly Leu
    610                 615                 620

Val Glu Gly Ser Thr Lys Arg Lys Arg Val Leu Ser Pro Glu Glu Leu
625                 630                 635                 640

Glu Asp Arg Gln Lys Lys Arg Gln Glu Ala Ala Ala Lys Arg Arg Arg
                645                 650                 655

Leu Ile Glu Glu Lys Lys Arg Gln Lys Glu Glu Ala Glu His Lys Lys
            660                 665                 670

Lys Met Ala Trp Trp Glu Ser Asn Asn Tyr Gln Ser Phe Cys Leu Pro
        675                 680                 685

Ser Glu Glu Ser Glu Pro Glu Asp Leu Glu Asn Gly Glu Glu Ser Ser
    690                 695                 700

Ala Glu Leu Asp Tyr Gln Asp Pro Asp Ala Thr Ser Leu Lys Tyr Val
705                 710                 715                 720

Ser Gly Asp Val Thr His Pro Gln Ala Gly Ala Glu Asp Ala Leu Ile
                725                 730                 735

Val His Cys Val Asp Asp Ser Gly His Trp Gly Arg Gly Gly Leu Phe
            740                 745                 750

Thr Ala Leu Glu Lys Arg Ser Ala Glu Pro Arg Lys Ile Tyr Glu Leu
        755                 760                 765

Ala Gly Lys Met Lys Asp Leu Ser Leu Gly Gly Val Leu Leu Phe Pro
    770                 775                 780
```

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Val Asp Asp Lys Glu Ser Arg Asn Lys Gly Gln Asp Leu Leu Ala Leu
785                 790                 795                 800


Ile Val Ala Gln His Arg Asp Arg Ser Asn Val Leu Ser Gly Ile Lys
                805                 810                 815


Met Ala Ala Leu Glu Glu Gly Leu Lys Lys Ile Phe Leu Ala Ala Lys
            820                 825                 830


Lys Lys Lys Ala Ser Val His Leu Pro Arg Ile Gly His Ala Thr Lys
        835                 840                 845


Gly Phe Asn Trp Tyr Gly Thr Glu Arg Leu Ile Arg Lys His Leu Ala
    850                 855                 860


Ala Arg Gly Ile Pro Thr Tyr Ile Tyr Tyr Phe Pro Arg Ser Lys Ser
865                 870                 875                 880


Ala Val Leu His Ser Gln Ser Ser Ser Ser Ser Ser Arg Gln Leu Val
                885                 890                 895


Pro
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