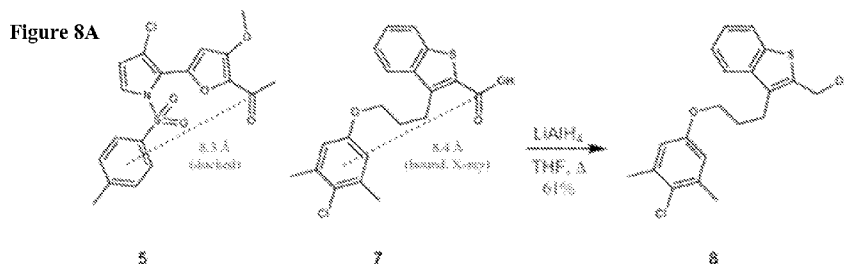




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(54) Title: MCL-1 ANTAGONISTS



(57) Abstract: Provided herein are Mcl-1 antagonist compositions and methods of treating g the compositions described herein.

MCL-1 ANTAGONISTS

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Appl. No. 61/947,211, filed March 3, 2014, the content of which is incorporated herein by reference in its entirety and for all purposes.

REFERENCE TO A "SEQUENCE LISTING," A TABLE, OR A COMPUTER PROGRAM LISTING APPENDIX SUBMITTED AS AN ASCII FILE

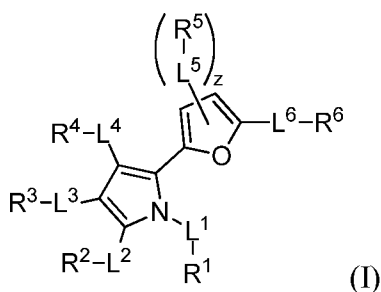
[0002] The Sequence Listing written in file 48539-507001WO_ST25.TXT, created on March 2, 2015, 761 bytes, machine format IBM-PC, MS-Windows operating system, is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0003] Apoptosis is the biochemical program Applicants' bodies utilize to remove unwanted, damaged, or diseased cells. Deregulation of this process is required for cancer development and serves as a major barrier to effective treatment. Recent evidence suggests that one or more components of apoptotic signaling are disrupted in all human cancers, either by genetic mutation of genes encoding core apoptotic machinery or by other mechanisms (e.g. epigenetic mechanisms or upstream oncogenic mutations). These genetic changes provide cancer cells with a survival advantage, ensuring their uncontrolled growth. Despite the important role of apoptosis in the development and maintenance of cancer, few therapeutics targeting apoptotic signaling have reached clinical evaluation. The compositions and methods provided address these and other needs in the art.

BRIEF SUMMARY OF THE INVENTION

[0004] Provided herein are compounds having the formula:



[0005] In the compound of formula (I), L^1 , L^2 , L^3 , L^4 , L^5 , and L^6 are independently a bond, -CO- (i.e. -C(O)-), -COO- (i.e. -C(O)O-), -OCO- (i.e. -OC(O)-), -CONR⁷- (i.e. -C(O)N(R⁷)-), -NR⁷CO- (i.e. -N(R⁷)C(O)-), -O-, -SO_n- (i.e. -S(O)_n-), -SONR⁷- (i.e. -S(O)N(R⁷)-), -NR⁷SO- (i.e. -N(R⁷)S(O)-), -CONR⁷SO₂- (i.e. -C(O)NR⁷S(O)₂-), -SO₂NR⁷CO- (i.e. -S(O)₂N(R⁷)C(O)-), -NR⁷- (i.e. -N(R⁷)-), substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene. R⁷ is independently hydrogen, halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, -NH₂, -COOH, -CONH₂, -NO₂, -SH, -SO₂Cl, -SO₃H, -SO₂Ph, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHCNHNH₂, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. The symbol n is 0, 1, or 2. R¹ is hydrogen, halogen, -N₃, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -CHO, =O, -OR^{1A}, -NR^{1B}R^{1C}, -COR^{1A}, -COOR^{1A}, -CONR^{1B}R^{1C}, -NR^{1B}COR^{1A}, -NO₂, -SR^{1D}, -SO_{n1}R^{1B}, -S(O)_{n1}OR^{1B}, -S(O)_{n1}NR^{1B}R^{1C}, -NR^{1B}S(O)_{n1}R^{1C}, -NHNR^{1B}R^{1C}, -ONR^{1B}R^{1C}, -NHC(O)NHNR^{1B}R^{1C}, -NHC(O)NR^{1B}R^{1C}, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R¹ and R² are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R² is hydrogen, halogen, -N₃, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -CHO, =O, -OR^{2A}, -NR^{2B}R^{2C}, -COR^{2A}, -COOR^{2A}, -CONR^{2B}R^{2C}, -NR^{2B}COR^{2A}, -NO₂, -SR^{2D}, -SO_{n2}R^{2B}, -S(O)_{n2}OR^{2B}, -S(O)_{n2}NR^{2B}R^{2C}, -NR^{2B}S(O)_{n2}R^{2C}, -NHNR^{2B}R^{2C}, -ONR^{2B}R^{2C}, -NHC(O)NHNR^{2B}R^{2C}, -NHC(O)NR^{2B}R^{2C}, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R² and R³ are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R³ is hydrogen, halogen, -N₃, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -CHO, =O, -OR^{3A}, -NR^{3B}R^{3C}, -COR^{3A}, -COOR^{3A}, -CONR^{3B}R^{3C}, -NR^{3B}COR^{3A}, -NO₂, -SR^{3D}, -SO_{n3}R^{3B}, -S(O)_{n3}OR^{3B}, -S(O)_{n3}NR^{3B}R^{3C}, -NR^{3B}S(O)_{n3}R^{3C}, -NHNR^{3B}R^{3C}, -ONR^{3B}R^{3C}, -NHC(O)NHNR^{3B}R^{3C}, -NHC(O)NR^{3B}R^{3C},

$\text{-NHC(O)NR}^{3B}\text{R}^{3C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^3 and R^4 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^4 is hydrogen, halogen, -N_3 , -CF_3 , -CCl_3 , -CBr_3 , -Cl_3 , -CN , -CHO , =O , -OR^{4A} , $\text{-NR}^{4B}\text{R}^{4C}$, -COR^{4A} , -COOR^{4A} , $\text{-CONR}^{4B}\text{R}^{4C}$, $\text{-NR}^{4B}\text{COR}^{4A}$, -NO_2 , -SR^{4D} , $\text{-SO}_{n4}\text{R}^{4B}$, $\text{-S(O)}_{n4}\text{OR}^{4B}$, $\text{-S(O)}_{n4}\text{NR}^{4B}\text{R}^{4C}$, $\text{-NR}^{4B}\text{S(O)}_{n4}\text{R}^{4C}$, $\text{-NHNR}^{4B}\text{R}^{4C}$, $\text{-ONR}^{4B}\text{R}^{4C}$, $\text{-NHC(O)NHNR}^{4B}\text{R}^{4C}$, $\text{-NHC(O)NR}^{4B}\text{R}^{4C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^5 is independently hydrogen, halogen, -N_3 , -CF_3 , -CCl_3 , -CBr_3 , -Cl_3 , -CN , -CHO , =O , -OR^{5A} , $\text{-NR}^{5B}\text{R}^{5C}$, -COR^{5A} , -COOR^{5A} , $\text{-CONR}^{5B}\text{R}^{5C}$, $\text{-NR}^{5B}\text{COR}^{5A}$, -NO_2 , -SR^{5D} , $\text{-SO}_{n5}\text{R}^{5B}$, $\text{-S(O)}_{n5}\text{OR}^{5B}$, $\text{-S(O)}_{n5}\text{NR}^{5B}\text{R}^{5C}$, $\text{-NR}^{5B}\text{S(O)}_{n5}\text{R}^{5C}$, $\text{-NHNR}^{5B}\text{R}^{5C}$, $\text{-ONR}^{5B}\text{R}^{5C}$, $\text{-NHC(O)NHNR}^{5B}\text{R}^{5C}$, $\text{-NHC(O)NR}^{5B}\text{R}^{5C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^5 and R^6 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^6 is hydrogen, halogen, -N_3 , -CF_3 , -CCl_3 , -CBr_3 , -Cl_3 , -CN , -CHO , =O , -OR^{6A} , $\text{-NR}^{6B}\text{R}^{6C}$, -COR^{6A} , -COOR^{6A} , $\text{-CONR}^{6B}\text{R}^{6C}$, $\text{-NR}^{6B}\text{COR}^{6A}$, -NO_2 , -SR^{6D} , $\text{-SO}_{n6}\text{R}^{6B}$, $\text{-S(O)}_{n6}\text{OR}^{6B}$, $\text{-S(O)}_{n6}\text{NR}^{6B}\text{R}^{6C}$, $\text{-NR}^{6B}\text{S(O)}_{n6}\text{R}^{6C}$, $\text{-NHNR}^{6B}\text{R}^{6C}$, $\text{-ONR}^{6B}\text{R}^{6C}$, $\text{-NHC(O)NHNR}^{6B}\text{R}^{6C}$, $\text{-NHC(O)NR}^{6B}\text{R}^{6C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^{1A} , R^{2A} , R^{3A} , R^{4A} , R^{5A} , R^{6A} , R^{1B} , R^{2B} , R^{3B} , R^{4B} , R^{5B} , R^{6B} , R^{1C} , R^{2C} , R^{3C} , R^{4C} , R^{5C} , R^{6C} , R^{1D} , R^{2D} , R^{3D} , R^{4D} , R^{5D} , and R^{6D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^{6B} and R^{6C} , are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. The symbols n_1 , n_2 , n_3 , n_4 , n_5 , and n_6 are independently 0, 1 or 2 (e.g. 1 or 2). The symbol z is 1 or 2.

[0006] Provided herein are pharmaceutical compositions that include a compound described herein (e.g. formula (I), (II), (III), (IV) or (V), including embodiments thereof) and a pharmaceutically acceptable excipient.

[0007] Also provided herein are methods of treating cancer in a subject in need thereof by administering an effective amount of a compound described herein (e.g. formula (I), (II), (III), (IV) or (V), including embodiments thereof) to the subject.

[0008] Provided herein are methods of antagonizing Mcl-1 by contacting an Mcl-1 (e.g. an Mcl-1 mixture) with a compound described herein (e.g. formula (I), (II), (III), (IV) or (V), including embodiments thereof).

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1. Structures of putative Mcl-1 inhibitors reported in the literature.

[0010] Figures 2A-2B. *In vitro* data for **10** and comparison to reported Mcl-1 inhibitors **8** and **9**. Figure 2A (Left panel): Schematic depicting liposome functional assay for recapitulating mitochondrial membrane permeability. Figure 2A (right panel): Time course of liposomal functional assay. Figure 2B (left panel): Legend of compound structures; Figure 2B (right panel): Histogram depicting percentage cell death as a function of concentration for compounds **8**, **9** and **10**.

[0011] Figure 3. Comparison of invention **10** (JHF3056) and reported pan-Bcl-2 inhibitor **9** (obatoclax) with and without doxorubicin in mouse lymphoma model.

[0012] Figure 4. Synthesis of JHF3056 (**10**) from known compound **11**.

[0013] Figures 5A-5B. Data for active substances tested to date and comparison to obatoclax (**9**). Figure 5A (left panel): Data for liposome functional assay. Figure 5A (right panel): Time course of calcium release for recited compounds. Figure 5B (left panel): Data for *in vitro* cytotoxicity assay. Figure 5B (right panel): Histogram depicting percentage cell death as a function of concentration for recited compounds.

[0014] Figure 6. Obatoclax (**2**) and roseophilin segment **5**, in contrast to roseophilin (**3**), counter Mcl-1 activity and promote Bak-mediated permeabilization of liposomal membranes. Data normalized to DMSO control.

[0015] Figure 7. A peptide corresponding to the Mcl-1 BH3 domain (**6**, Ac-KALETLLRRVGDGVQRNHETAF-CONH₂) (SEQ ID NO:1) binds Mcl-1 *in vitro* ($K_D = 1.1$

$\pm 0.06 \mu\text{M}$). See reference 12 of Example 2. Neither compound **5** nor obatoclax (**2**) exhibit similar behavior. Titration microcalorimetry data shown are averaged values from triplicate analyses.

[0016] Figures 8A-8D. Figures 8A-8B: Binding of benzothiophene **7** to purified Mcl-1 was detectable by ITC ($K_D = 1.0 \pm 0.41 \mu\text{M}$). This was not the case for derived primary alcohol **8**. Figure 8C. PyMOL rendering of compound **7** bound to Mcl-1 in the solid state (PDB:4HW3). Figure 8D. Pyrrolofuran **5** could be docked (Autodock Vina) into the same space on Mcl-1 occupied by **7**, wherein its carbonyl group is oriented proximal to R263, analogous to the carboxylate group in **7**. See reference 18 of Example ;2.

[0017] Figures 9A-9C. Compounds **12**, **14** and **15** bind directly to recombinant Mcl-1 in vitro (Figures 9A and 9C) and stimulate Bak-mediated permeabilization of liposomal membranes (Figure 8B). [K_D (ITC) for **12**, **14**, and **15** = $0.7 \pm 0.12 \mu\text{M}$, $3.4 \pm 0.49 \mu\text{M}$, and $2.3 \mu\text{M} \pm 0.16 \mu\text{M}$, respectively].

[0018] Figure 10. Tetrazole **12** did not stimulate MOMP-like pore formations in liposomes that contain Bcl-xL in place of Mcl-1. ABT-737, a known antagonist of Bcl-xL, was used as a positive control. See reference 24 of Example ;2.

DETAILED DESCRIPTION OF THE INVENTION

DEFINITIONS

[0019] The abbreviations used herein have their conventional meaning within the chemical and biological arts. The chemical structures and formulae set forth herein are constructed according to the standard rules of chemical valency known in the chemical arts.

[0020] Where substituent groups are specified by their conventional chemical formulae, written from left to right, they equally encompass the chemically identical substituents that would result from writing the structure from right to left, e.g., $-\text{CH}_2\text{O}-$ is equivalent to $-\text{OCH}_2-$.

[0021] The term "alkyl," by itself or as part of another substituent, means, unless otherwise stated, a straight (i.e., unbranched) or branched carbon chain (or carbon), or combination thereof, which may be fully saturated, mono- or polyunsaturated and can include di- and multivalent radicals, having the number of carbon atoms designated (i.e., $\text{C}_1\text{-C}_{10}$ means one to ten carbons). Alkyl is not cyclized. Examples of saturated hydrocarbon radicals include, but are not limited to, groups such as methyl, ethyl, n-propyl, isopropyl, n-butyl, t-butyl, isobutyl, sec-butyl, (cyclohexyl)methyl, homologs and isomers of, for example, n-pentyl, n-hexyl, n-heptyl, n-octyl,

and the like. An unsaturated alkyl group is one having one or more double bonds or triple bonds (e.g. alkene, alkyne). Examples of unsaturated alkyl groups include, but are not limited to, vinyl, 2-propenyl, crotyl, 2-isopentenyl, 2-(butadienyl), 2,4-pentadienyl, 3-(1,4-pentadienyl), ethynyl, 1- and 3-propynyl, 3-butylnyl, and the higher homologs and isomers. An alkoxy is an alkyl attached to the remainder of the molecule via an oxygen linker (-O-). An alkyl moiety may be an alkenyl moiety. An alkyl moiety may be an alkynyl moiety. An alkyl moiety may be fully saturated.

[0022] The term “alkylene,” by itself or as part of another substituent, means, unless otherwise stated, a divalent radical derived from an alkyl, as exemplified, but not limited by, -

CH₂CH₂CH₂CH₂-. Typically, an alkyl (or alkylene) group will have from 1 to 24 carbon atoms, with those groups having 10 or fewer carbon atoms being preferred in the present invention. A “lower alkyl” or “lower alkylene” is a shorter chain alkyl or alkylene group, generally having eight or fewer carbon atoms. The term “alkenylene,” by itself or as part of another substituent, means, unless otherwise stated, a divalent radical derived from an alkene.

[0023] The term “heteroalkyl,” by itself or in combination with another term, means, unless otherwise stated, a stable straight or branched chain, or combinations thereof, including at least one carbon atom and at least one heteroatom selected from the group consisting of O, N, P, Si, and S, and wherein the nitrogen and sulfur atoms may optionally be oxidized, and the nitrogen heteroatom may optionally be quaternized. Heteroalkyl is not cyclized. The heteroatom(s) O, N, P, S, and Si may be placed at any interior position of the heteroalkyl group or at the position at which the alkyl group is attached to the remainder of the molecule. Examples include, but are not limited to: -CH₂-CH₂-O-CH₃, -CH₂-CH₂-NH-CH₃, -CH₂-CH₂-N(CH₃)-CH₃, -CH₂-S-CH₂-CH₃, -CH₂-CH₂-S(O)-CH₃, -CH₂-CH₂-S(O)₂-CH₃, -CH=CH-O-CH₃, -Si(CH₃)₃, -CH₂-CH=N-OCH₃, -CH=CH-N(CH₃)-CH₃, -O-CH₃, -O-CH₂-CH₃, and -CN. Up to two or three heteroatoms may be consecutive, such as, for example, -CH₂-NH-OCH₃ and -CH₂-O-Si(CH₃)₃. A heteroalkyl moiety may include one heteroatom (e.g., O, N, S, Si, or P). A heteroalkyl moiety may include two optionally different heteroatoms (e.g., O, N, S, Si, or P). A heteroalkyl moiety may include three optionally different heteroatoms (e.g., O, N, S, Si, or P). A heteroalkyl moiety may include four optionally different heteroatoms (e.g., O, N, S, Si, or P). A heteroalkyl moiety may include five optionally different heteroatoms (e.g., O, N, S, Si, or P). A heteroalkyl moiety may include up to 8 optionally different heteroatoms (e.g., O, N, S, Si, or P).

[0024] Similarly, the term “heteroalkylene,” by itself or as part of another substituent, means, unless otherwise stated, a divalent radical derived from heteroalkyl, as exemplified, but not limited by, $-\text{CH}_2-\text{CH}_2-\text{S}-\text{CH}_2-\text{CH}_2-$ and $-\text{CH}_2-\text{S}-\text{CH}_2-\text{CH}_2-\text{NH}-\text{CH}_2-$. For heteroalkylene groups, heteroatoms can also occupy either or both of the chain termini (e.g., alkyleneoxy, alkylenedioxy, alkyleneamino, alkylenediamino, and the like). Still further, for alkylene and heteroalkylene linking groups, no orientation of the linking group is implied by the direction in which the formula of the linking group is written. For example, the formula $-\text{C}(\text{O})_2\text{R}'-$ represents both $-\text{C}(\text{O})_2\text{R}'-$ and $-\text{R}'\text{C}(\text{O})_2-$. As described above, heteroalkyl groups, as used herein, include those groups that are attached to the remainder of the molecule through a heteroatom, such as $-\text{C}(\text{O})\text{R}'$, $-\text{C}(\text{O})\text{NR}'$, $-\text{NR}'\text{R}''$, $-\text{OR}'$, $-\text{SR}'$, and/or $-\text{SO}_2\text{R}'$. Where “heteroalkyl” is recited, followed by recitations of specific heteroalkyl groups, such as $-\text{NR}'\text{R}''$ or the like, it will be understood that the terms heteroalkyl and $-\text{NR}'\text{R}''$ are not redundant or mutually exclusive. Rather, the specific heteroalkyl groups are recited to add clarity. Thus, the term “heteroalkyl” should not be interpreted herein as excluding specific heteroalkyl groups, such as $-\text{NR}'\text{R}''$ or the like.

[0025] The terms “cycloalkyl” and “heterocycloalkyl,” by themselves or in combination with other terms, mean, unless otherwise stated, non-aromatic cyclic versions of “alkyl” and “heteroalkyl,” respectively, wherein the carbons making up the ring or rings do not necessarily need to be bonded to a hydrogen due to all carbon valencies participating in bonds with non-hydrogen atoms. Additionally, for heterocycloalkyl, a heteroatom can occupy the position at which the heterocycle is attached to the remainder of the molecule. Examples of cycloalkyl include, but are not limited to, cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, 1-cyclohexenyl, 3-cyclohexenyl, cycloheptyl, 3-hydroxy-cyclobut-3-enyl-1,2, dione, 1H-1,2,4-triazolyl-5(4H)-one, 4H-1,2,4-triazolyl, and the like. Examples of heterocycloalkyl include, but are not limited to, 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, 2-piperazinyl, and the like. A “cycloalkylene” and a “heterocycloalkylene,” alone or as part of another substituent, means a divalent radical derived from a cycloalkyl and heterocycloalkyl, respectively. A heterocycloalkyl moiety may include one ring heteroatom (e.g., O, N, S, Si, or P). A heterocycloalkyl moiety may include two optionally different ring heteroatoms (e.g., O, N, S, Si, or P). A heterocycloalkyl moiety may include three optionally different ring heteroatoms (e.g., O, N, S, Si, or P). A heterocycloalkyl moiety may include four optionally different ring heteroatoms (e.g., O, N, S, Si, or P). A heterocycloalkyl moiety may

include five optionally different ring heteroatoms (e.g., O, N, S, Si, or P). A heterocycloalkyl moiety may include up to 8 optionally different ring heteroatoms (e.g., O, N, S, Si, or P).

[0026] The terms “halo” or “halogen,” by themselves or as part of another substituent, mean, unless otherwise stated, a fluorine, chlorine, bromine, or iodine atom. Additionally, terms such as “haloalkyl” are meant to include monohaloalkyl and polyhaloalkyl. For example, the term “halo(C₁-C₄)alkyl” includes, but is not limited to, fluoromethyl, difluoromethyl, trifluoromethyl, 2,2,2-trifluoroethyl, 4-chlorobutyl, 3-bromopropyl, and the like.

[0027] The term “acyl” means, unless otherwise stated, -C(O)R where R is a substituted or unsubstituted alkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl.

[0028] The term “aryl” means, unless otherwise stated, a polyunsaturated, aromatic, hydrocarbon substituent, which can be a single ring or multiple rings (preferably from 1 to 3 rings) that are fused together (i.e., a fused ring aryl) or linked covalently. A fused ring aryl refers to multiple rings fused together wherein at least one of the fused rings is an aryl ring. The term “heteroaryl” refers to aryl groups (or rings) that contain at least one heteroatom such as N, O, or S, wherein the nitrogen and sulfur atoms are optionally oxidized, and the nitrogen atom(s) are optionally quaternized. Thus, the term “heteroaryl” includes fused ring heteroaryl groups (i.e., multiple rings fused together wherein at least one of the fused rings is a heteroaromatic ring). A 5,6-fused ring heteroarylene refers to two rings fused together, wherein one ring has 5 members and the other ring has 6 members, and wherein at least one ring is a heteroaryl ring. Likewise, a 6,6-fused ring heteroarylene refers to two rings fused together, wherein one ring has 6 members and the other ring has 6 members, and wherein at least one ring is a heteroaryl ring. And a 6,5-fused ring heteroarylene refers to two rings fused together, wherein one ring has 6 members and the other ring has 5 members, and wherein at least one ring is a heteroaryl ring. A heteroaryl group can be attached to the remainder of the molecule through a carbon or heteroatom. Non-limiting examples of aryl and heteroaryl groups include phenyl, 1-naphthyl, 2-naphthyl, 4-biphenyl, 1-pyrrolyl, 2-pyrrolyl, 3-pyrrolyl, 3-pyrazolyl, 2-imidazolyl, 4-imidazolyl, pyrazinyl, 2-oxazolyl, 4-oxazolyl, 2-phenyl-4-oxazolyl, 5-oxazolyl, 3-isoxazolyl, 4-isoxazolyl, 5-isoxazolyl, 2-thiazolyl, 4-thiazolyl, 5-thiazolyl, 2-furyl, 3-furyl, 2-thienyl, 3-thienyl, 2-pyridyl, 3-pyridyl, 4-pyridyl, 2-pyrimidyl, 4-pyrimidyl, 5-benzothiazolyl, purinyl, 2-benzimidazolyl, 5-indolyl, 1-isoquinolyl, 5-isoquinolyl, 2-quinoxaliny, 5-quinoxaliny, 3-quinolyl, and 6-quinolyl.

Substituents for each of the above noted aryl and heteroaryl ring systems are selected from the group of acceptable substituents described below. An “arylene” and a “heteroarylene,” alone or as part of another substituent, mean a divalent radical derived from an aryl and heteroaryl, respectively. Non-limiting examples of aryl and heteroaryl groups include pyridinyl, pyrimidinyl, thiophenyl, thienyl, furanyl, indolyl, benzoxadiazolyl, benzodioxolyl, benzodioxanyl, thianaphthanyl, pyrrolopyridinyl, indazolyl, quinolinyl, quinoxalinyl, pyridopyrazinyl, quinazolinonyl, benzoisoxazolyl, imidazopyridinyl, benzofuranyl, benzothienyl, benzothiophenyl, phenyl, naphthyl, biphenyl, pyrrolyl, pyrazolyl, imidazolyl, pyrazinyl, oxazolyl, isoxazolyl, thiazolyl, furylthienyl, pyridyl, pyrimidyl, benzothiazolyl, purinyl, benzimidazolyl, isoquinolyl, thiadiazolyl, oxadiazolyl, pyrrolyl, diazolyl, triazolyl, tetrazolyl, benzothiadiazolyl, isothiazolyl, pyrazolopyrimidinyl, pyrrolopyrimidinyl, benzotriazolyl, benzoxazolyl, or quinolyl. The examples above may be substituted or unsubstituted and divalent radicals of each heteroaryl example above are non-limiting examples of heteroarylene. A heteroaryl moiety may include one ring heteroatom (e.g., O, N, or S). A heteroaryl moiety may include two optionally different ring heteroatoms (e.g., O, N, or S). A heteroaryl moiety may include three optionally different ring heteroatoms (e.g., O, N, or S). A heteroaryl moiety may include four optionally different ring heteroatoms (e.g., O, N, or S). A heteroaryl moiety may include five optionally different ring heteroatoms (e.g., O, N, or S). An aryl moiety may have a single ring. An aryl moiety may have two optionally different rings. An aryl moiety may have three optionally different rings. An aryl moiety may have four optionally different rings. A heteroaryl moiety may have one ring. A heteroaryl moiety may have two optionally different rings. A heteroaryl moiety may have three optionally different rings. A heteroaryl moiety may have four optionally different rings. A heteroaryl moiety may have five optionally different rings.

[0029] A fused ring heterocycloalkyl-aryl is an aryl fused to a heterocycloalkyl. A fused ring heterocycloalkyl-heteroaryl is a heteroaryl fused to a heterocycloalkyl. A fused ring heterocycloalkyl-cycloalkyl is a heterocycloalkyl fused to a cycloalkyl. A fused ring heterocycloalkyl-heterocycloalkyl is a heterocycloalkyl fused to another heterocycloalkyl. Fused ring heterocycloalkyl-aryl, fused ring heterocycloalkyl-heteroaryl, fused ring heterocycloalkyl-cycloalkyl, or fused ring heterocycloalkyl-heterocycloalkyl may each independently be unsubstituted or substituted with one or more of the substituents described herein.

[0030] The term “oxo,” as used herein, means an oxygen that is double bonded (“=O”) to a carbon atom.

[0031] The term “alkylsulfonyl,” as used herein, means a moiety having the formula $-S(O_2)-R'$, where R' is a substituted or unsubstituted alkyl group as defined above. R' may have a specified number of carbons (e.g., “ C_1-C_4 alkylsulfonyl”).

[0032] Each of the above terms (e.g., “alkyl,” “heteroalkyl,” “cycloalkyl,” “heterocycloalkyl,” “aryl,” and “heteroaryl”) includes both substituted and unsubstituted forms of the indicated radical. Preferred substituents for each type of radical are provided below.

[0033] Substituents for the alkyl and heteroalkyl radicals (including those groups often referred to as alkylene, alkenyl, heteroalkylene, heteroalkenyl, alkynyl, cycloalkyl, heterocycloalkyl, cycloalkenyl, and heterocycloalkenyl) can be one or more of a variety of groups selected from, but not limited to, $-OR'$, $=O$, $=NR'$, $=N-OR'$, $-NR'R''$, $-SR'$, $-halogen$, $-SiR'R''R'''$, $-OC(O)R'$, $-C(O)R'$, $-CO_2R'$, $-CONR'R''$, $-OC(O)NR'R''$, $-NR''C(O)R'$, $-NR''C(O)NR''R'''$, $-NR''C(O)_2R'$, $-NR-C(NR'R'')=NR'''$, $-S(O)R'$, $-S(O)_2R'$, $-S(O)_2N(R')(R''-NRSO_2R')$, $-CN$, and $-NO_2$ in a number ranging from zero to $(2m'+1)$, where m' is the total number of carbon atoms in such radical. R' , R'' , R''' , and R'''' each preferably independently refer to hydrogen, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl (e.g., aryl substituted with 1-3 halogens), substituted or unsubstituted alkyl, alkoxy, or thioalkoxy groups, or arylalkyl groups. When a compound of the invention includes more than one R group, for example, each of the R groups is independently selected as are each R' , R'' , R''' , and R'''' group when more than one of these groups is present. When R' and R'' are attached to the same nitrogen atom, they can be combined with the nitrogen atom to form a 4-, 5-, 6-, or 7-membered ring. For example, $-NR'R''$ includes, but is not limited to, 1-pyrrolidinyl and 4-morpholinyl. From the above discussion of substituents, one of skill in the art will understand that the term “alkyl” is meant to include groups including carbon atoms bound to groups other than hydrogen groups, such as haloalkyl (e.g., $-CF_3$ and $-CH_2CF_3$) and acyl (e.g., $-C(O)CH_3$, $-C(O)CF_3$, $-C(O)CH_2OCH_3$, and the like).

[0034] Similar to the substituents described for the alkyl radical, substituents for the aryl and heteroaryl groups are varied and are selected from, for example: $-OR'$, $-NR'R''$, $-SR'$, $-halogen$, $-SiR'R''R'''$, $-OC(O)R'$, $-C(O)R'$, $-CO_2R'$, $-CONR'R''$, $-OC(O)NR'R''$, $-NR''C(O)R'$, $-NR''C(O)NR''R'''$, $-NR''C(O)_2R'$, $-NRC(NR'R'')=NR'''$, $S(O)R'$, $-S(O)_2R'$, $-S(O)_2N(R')(R''-NRSO_2R')$, $-CN$, $-NO_2$, $-R'$, $-N_3$, $-CH(Ph)_2$, fluoro(C_1-C_4)alkoxy, and fluoro(C_1-C_4)alkyl, in a number ranging from zero to the total number of open valences on the aromatic ring system; and where R' , R'' , R''' , and R'''' are preferably independently selected from hydrogen, substituted or unsubstituted

alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, and substituted or unsubstituted heteroaryl. When a compound of the invention includes more than one R group, for example, each of the R groups is independently selected as are each R', R'', R''', and R'''' groups when more than one of these groups is present.

[0035] Where a moiety is substituted with an R substituent, the group may be referred to as "R-substituted." Where a moiety is R-substituted, the moiety is substituted with at least one R substituent and each R substituent is optionally different. For example, where a moiety herein is R^{1A}-substituted or unsubstituted alkyl, a plurality of R^{1A} substituents may be attached to the alkyl moiety wherein each R^{1A} substituent is optionally different. Where an R-substituted moiety is substituted with a plurality R substituents, each of the R-substituents may be differentiated herein using a prime symbol (') such as R', R'', etc. For example, where a moiety is R^{1A}-substituted or unsubstituted alkyl, and the moiety is substituted with a plurality of R^{1A} substituents, the plurality of R^{1A} substituents may be differentiated as R^{1A'}, R^{1A''}, R^{1A'''}, etc. In some embodiments, the plurality of R substituents is 3. In some embodiments, the plurality of R substituents is 2.

[0036] In embodiments, a compound as described herein may include multiple instances of R¹, R², R³, R⁴, R⁵, R⁶, R^{6A}, R⁷, and/or other substituents and variables. In such embodiments, each variable may optional be different and be appropriately labeled to distinguish each group for greater clarity. For example, where each R^{6A} is different, they may be referred to, for example, as R^{6A.1}, R^{6A.2}, R^{6A.3}, or R^{6A.4}, respectively, wherein the definition of R^{6A} is assumed by R^{6A.1}, R^{6A.2}, R^{6A.3}, and/or R^{6A.4}. The variables used within a definition of R¹, R², R³, R⁴, R⁵, R⁶, R^{6A}, R⁷, and/or other variables that appear at multiple instances and are different may similarly be appropriately labeled to distinguish each group for greater clarity.

[0037] Two or more substituents may optionally be joined to form aryl, heteroaryl, cycloalkyl, or heterocycloalkyl groups. Such so-called ring-forming substituents are typically, though not necessarily, found attached to a cyclic base structure. In one embodiment, the ring-forming substituents are attached to adjacent members of the base structure. For example, two ring-forming substituents attached to adjacent members of a cyclic base structure create a fused ring structure. In embodiments, the ring-forming substituents are attached to a single member of the base structure. For example, two ring-forming substituents attached to a single member of a

cyclic base structure create a spirocyclic structure. In yet another embodiment, the ring-forming substituents are attached to non-adjacent members of the base structure.

[0038] Two of the substituents on adjacent atoms of the aryl or heteroaryl ring may optionally form a ring of the formula $-T-C(O)-(CRR')_q-U-$, wherein T and U are independently $-NR-$, $-O-$, $-CRR'-$, or a single bond, and q is an integer of from 0 to 3. Alternatively, two of the substituents on adjacent atoms of the aryl or heteroaryl ring may optionally be replaced with a substituent of the formula $-A-(CH_2)_r-B-$, wherein A and B are independently $-CRR'-$, $-O-$, $-NR-$, $-S-$, $-S(O)-$, $-S(O)_2-$, $-S(O)_2NR'-$, or a single bond, and r is an integer of from 1 to 4. One of the single bonds of the new ring so formed may optionally be replaced with a double bond. Alternatively, two of the substituents on adjacent atoms of the aryl or heteroaryl ring may optionally be replaced with a substituent of the formula $-(CRR')_s-X'-(C''R''R''')_d-$, where variables s and d are independently integers of from 0 to 3, and X' is $-O-$, $-NR'-$, $-S-$, $-S(O)-$, $-S(O)_2-$, or $-S(O)_2NR'-$. The substituents R, R', R'', and R''' are preferably independently selected from hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, and substituted or unsubstituted heteroaryl.

[0039] As used herein, the terms “heteroatom” or “ring heteroatom” are meant to include, oxygen (O), nitrogen (N), sulfur (S), phosphorus (P), and silicon (Si).

[0040] A “substituent group,” as used herein, means a group selected from the following moieties:

(A) oxo, halogen, $-CF_3$, $-CN$, $-OH$, $-NH_2$, $-COOH$, $-CONH_2$, $-NO_2$, $-SH$, $-SO_2Cl$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-NHC(=O)NHNH_2$, $-NHC(=O)NH_2$, $-NHSO_2H$, $-NHC(=O)H$, $-NHC(O)-OH$, $-NHOH$, $-OCF_3$, $-OCHF_2$, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, unsubstituted heteroaryl, and

(B) alkyl, heteroalkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, substituted with at least one substituent selected from:

(i) oxo, halogen, $-CF_3$, $-CN$, $-OH$, $-NH_2$, $-COOH$, $-CONH_2$, $-NO_2$, $-SH$, $-SO_2Cl$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-NHC(=O)NHNH_2$, $-NHC(=O)NH_2$, $-NHSO_2H$, $-NHC(=O)H$, $-NHC(O)-OH$, $-NHOH$, $-OCF_3$, $-OCHF_2$, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, unsubstituted heteroaryl, and

(ii) alkyl, heteroalkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, substituted with at least one substituent selected from:

(a) oxo, halogen, -CF₃, -CN, -OH, -NH₂, -COOH, -CONH₂, -NO₂, -SH, -SO₂Cl, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -NHC=(O)NHNH₂, -NHC=(O)NH₂, -NHSO₂H, -NHC=(O)H, -NHC(O)-OH, -NHOH, -OCF₃, -OCHF₂, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, unsubstituted heteroaryl, and

(b) alkyl, heteroalkyl, cycloalkyl, heterocycloalkyl, aryl, heteroaryl, substituted with at least one substituent selected from: oxo,

halogen, -CF₃, -CN, -OH, -NH₂, -COOH, -CONH₂, -NO₂, -SH, -SO₂Cl, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -NHC=(O)NHNH₂, -NHC=(O)NH₂, -NHSO₂H, -NHC=(O)H, -NHC(O)-OH, -NHOH, -OCF₃, -OCHF₂, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, unsubstituted heteroaryl.

[0041] A “size-limited substituent” or “size-limited substituent group,” as used herein, means a group selected from all of the substituents described above for a “substituent group,” wherein each substituted or unsubstituted alkyl is a substituted or unsubstituted C₁-C₂₀ alkyl, each substituted or unsubstituted heteroalkyl is a substituted or unsubstituted 2 to 20 membered heteroalkyl, each substituted or unsubstituted cycloalkyl is a substituted or unsubstituted C₃-C₈ cycloalkyl, each substituted or unsubstituted heterocycloalkyl is a substituted or unsubstituted 3 to 8 membered heterocycloalkyl, each substituted or unsubstituted aryl is a substituted or unsubstituted C₆-C₁₀ aryl, and each substituted or unsubstituted heteroaryl is a substituted or unsubstituted 5 to 10 membered heteroaryl.

[0042] A “lower substituent” or “lower substituent group,” as used herein, means a group selected from all of the substituents described above for a “substituent group,” wherein each substituted or unsubstituted alkyl is a substituted or unsubstituted C₁-C₈ alkyl, each substituted or unsubstituted heteroalkyl is a substituted or unsubstituted 2 to 8 membered heteroalkyl, each substituted or unsubstituted cycloalkyl is a substituted or unsubstituted C₃-C₇ cycloalkyl, each substituted or unsubstituted heterocycloalkyl is a substituted or unsubstituted 3 to 7 membered heterocycloalkyl, each substituted or unsubstituted aryl is a substituted or unsubstituted C₆-C₁₀ aryl, and each substituted or unsubstituted heteroaryl is a substituted or unsubstituted 5 to 9 membered heteroaryl.

[0043] In embodiments, each substituted group described in the compounds herein is substituted with at least one substituent group. More specifically, In embodiments, each substituted alkyl, substituted heteroalkyl, substituted cycloalkyl, substituted heterocycloalkyl, substituted aryl, substituted heteroaryl, substituted alkylene, substituted heteroalkylene, substituted cycloalkylene, substituted heterocycloalkylene, substituted arylene, and/or substituted heteroarylene described in the compounds herein are substituted with at least one substituent group. In other embodiments, at least one or all of these groups are substituted with at least one size-limited substituent group. In other embodiments, at least one or all of these groups are substituted with at least one lower substituent group.

[0044] In embodiments of the compounds herein, each substituted or unsubstituted alkyl may be a substituted or unsubstituted C₁-C₂₀ alkyl, each substituted or unsubstituted heteroalkyl is a substituted or unsubstituted 2 to 20 membered heteroalkyl, each substituted or unsubstituted cycloalkyl is a substituted or unsubstituted C₃-C₈ cycloalkyl, each substituted or unsubstituted heterocycloalkyl is a substituted or unsubstituted 3 to 8 membered heterocycloalkyl, each substituted or unsubstituted aryl is a substituted or unsubstituted C₆-C₁₀ aryl, and/or each substituted or unsubstituted heteroaryl is a substituted or unsubstituted 5 to 10 membered heteroaryl. In embodiments herein, each substituted or unsubstituted alkylene is a substituted or unsubstituted C₁-C₂₀ alkylene, each substituted or unsubstituted heteroalkylene is a substituted or unsubstituted 2 to 20 membered heteroalkylene, each substituted or unsubstituted cycloalkylene is a substituted or unsubstituted C₃-C₈ cycloalkylene, each substituted or unsubstituted heterocycloalkylene is a substituted or unsubstituted 3 to 8 membered heterocycloalkylene, each substituted or unsubstituted arylene is a substituted or unsubstituted C₆-C₁₀ arylene, and/or each substituted or unsubstituted heteroarylene is a substituted or unsubstituted 5 to 10 membered heteroarylene.

[0045] In embodiments, each substituted or unsubstituted alkyl is a substituted or unsubstituted C₁-C₈ alkyl, each substituted or unsubstituted heteroalkyl is a substituted or unsubstituted 2 to 8 membered heteroalkyl, each substituted or unsubstituted cycloalkyl is a substituted or unsubstituted C₃-C₇ cycloalkyl, each substituted or unsubstituted heterocycloalkyl is a substituted or unsubstituted 3 to 7 membered heterocycloalkyl, each substituted or unsubstituted aryl is a substituted or unsubstituted C₆-C₁₀ aryl, and/or each substituted or unsubstituted heteroaryl is a substituted or unsubstituted 5 to 9 membered heteroaryl. In embodiments, each substituted or unsubstituted alkylene is a substituted or unsubstituted C₁-C₈ alkylene, each substituted or unsubstituted heteroalkylene is a substituted or unsubstituted 2 to 8 membered

heteroalkylene, each substituted or unsubstituted cycloalkylene is a substituted or unsubstituted C₃-C₇ cycloalkylene, each substituted or unsubstituted heterocycloalkylene is a substituted or unsubstituted 3 to 7 membered heterocycloalkylene, each substituted or unsubstituted arylene is a substituted or unsubstituted C₆-C₁₀ arylene, and/or each substituted or unsubstituted

heteroarylene is a substituted or unsubstituted 5 to 9 membered heteroarylene. In embodiments, the compound is a chemical species set forth in the Examples section below.

[0046] The term “pharmaceutically acceptable salts” is meant to include salts of the active compounds that are prepared with relatively nontoxic acids or bases, depending on the particular substituents found on the compounds described herein. When compounds of the present invention contain relatively acidic functionalities, base addition salts can be obtained by contacting the neutral form of such compounds with a sufficient amount of the desired base, either neat or in a suitable inert solvent. Examples of pharmaceutically acceptable base addition salts include sodium, potassium, calcium, ammonium, organic amino, or magnesium salt, or a similar salt. When compounds of the present invention contain relatively basic functionalities, acid addition salts can be obtained by contacting the neutral form of such compounds with a sufficient amount of the desired acid, either neat or in a suitable inert solvent. Examples of pharmaceutically acceptable acid addition salts include those derived from inorganic acids like hydrochloric, hydrobromic, nitric, carbonic, monohydrogencarbonic, phosphoric, monohydrogenphosphoric, dihydrogenphosphoric, sulfuric, monohydrogensulfuric, hydriodic, or phosphorous acids and the like, as well as the salts derived from relatively nontoxic organic acids like acetic, propionic, isobutyric, maleic, malonic, benzoic, succinic, suberic, fumaric, lactic, mandelic, phthalic, benzenesulfonic, p-tolylsulfonic, citric, tartaric, methanesulfonic, and the like. Also included are salts of amino acids such as arginate and the like, and salts of organic acids like glucuronic or galactunoric acids and the like (*see, e.g., Berge et al., Journal of Pharmaceutical Science* 66:1-19 (1977)). 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. Other pharmaceutically acceptable carriers known to those of skill in the art are suitable for the present invention. Salts tend to be more soluble in aqueous or other protonic solvents than are the corresponding free base forms. In other cases, the preparation may be a lyophilized powder in 1 mM-50 mM histidine, 0.1%-2% sucrose, 2%-7% mannitol at a pH range of 4.5 to 5.5, that is combined with buffer prior to use.

[0047] Thus, the compounds of the present invention may exist as salts, such as with pharmaceutically acceptable acids. The present invention includes such salts. Examples of such

salts include hydrochlorides, hydrobromides, sulfates, methanesulfonates, nitrates, maleates, acetates, citrates, fumarates, tartrates (e.g., (+)-tartrates, (-)-tartrates, or mixtures thereof including racemic mixtures), succinates, benzoates, and salts with amino acids such as glutamic acid. These salts may be prepared by methods known to those skilled in the art.

5 [0048] The neutral forms of the compounds are preferably 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.

[0049] Provided herein are agents (e.g. compounds, drugs, therapeutic agents) that may be in a
10 prodrug form. Prodrugs of the compounds described herein are those compounds that readily undergo chemical changes under select physiological conditions to provide the final agents (e.g. compounds, drugs, therapeutic agents). Additionally, prodrugs can be converted to agents (e.g. compounds, drugs, therapeutic agents) by chemical or biochemical methods in an *ex vivo* environment. Prodrugs described herein include compounds that readily undergo chemical
15 changes under select physiological conditions to provide agents (e.g. compounds, drugs, therapeutic agents) to a biological system (e.g. in a subject, in a cancer cell, in the extracellular space near a cancer cell).

[0050] Certain compounds of the present invention can exist in unsolvated forms as well as solvated forms, including hydrated forms. In general, the solvated forms are equivalent to
20 unsolvated forms and are encompassed within the scope of the present invention. Certain compounds of the present invention may exist in multiple crystalline or amorphous forms. In general, all physical forms are equivalent for the uses contemplated by the present invention and are intended to be within the scope of the present invention.

[0051] As used herein, the term "salt" refers to acid or base salts of the compounds used in the
25 methods of the present invention. Illustrative examples of acceptable salts are mineral acid (hydrochloric acid, hydrobromic acid, phosphoric acid, and the like) salts, organic acid (acetic acid, propionic acid, glutamic acid, citric acid and the like) salts, quaternary ammonium (methyl iodide, ethyl iodide, and the like) salts.

[0052] Certain compounds of the present invention possess asymmetric carbon atoms (optical
30 or chiral centers) or double bonds; the enantiomers, racemates, diastereomers, tautomers, geometric isomers, stereoisomeric forms that may be defined, in terms of absolute stereochemistry, as (R)- or (S)- or, as (D)- or (L)- for amino acids, and individual isomers are

encompassed within the scope of the present invention. The compounds of the present invention do not include those which are known in art to be too unstable to synthesize and/or isolate. The present invention is meant to include compounds in racemic and optically pure forms. Optically active (R)- and (S)-, or (D)- and (L)-isomers may be prepared using chiral synthons or chiral reagents, or resolved using conventional techniques. When the compounds described herein contain olefinic bonds or other centers of geometric asymmetry, and unless specified otherwise, it is intended that the compounds include both E and Z geometric isomers.

[0053] As used herein, the term “isomers” refers to compounds having the same number and kind of atoms, and hence the same molecular weight, but differing in respect to the structural arrangement or configuration of the atoms.

[0054] The term “tautomer,” as used herein, refers to one of two or more structural isomers which exist in equilibrium and which are readily converted from one isomeric form to another.

[0055] It will be apparent to one skilled in the art that certain compounds of this invention may exist in tautomeric forms, all such tautomeric forms of the compounds being within the scope of the invention.

[0056] Unless otherwise stated, structures depicted herein are also meant to include all stereochemical forms of the structure; i.e., the R and S configurations for each asymmetric center. Therefore, single stereochemical isomers as well as enantiomeric and diastereomeric mixtures of the present compounds are within the scope of the invention.

[0057] Unless otherwise stated, structures depicted herein are also meant to include compounds which differ only in the presence of one or more isotopically enriched atoms. For example, compounds having the present structures except for the replacement of a hydrogen by a deuterium or tritium, or the replacement of a carbon by ^{13}C - or ^{14}C -enriched carbon are within the scope of this invention.

[0058] 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 (^3H), iodine-125 (^{125}I), or carbon-14 (^{14}C). All isotopic variations of the compounds of the present invention, whether radioactive or not, are encompassed within the scope of the present invention.

[0059] The symbol “~” denotes the point of attachment of a chemical moiety to the remainder of a molecule or chemical formula.

[0060] The terms "a" or "an," as used in herein means one or more. In addition, the phrase "substituted with a[n]," as used herein, means the specified group may be substituted with one or more of any or all of the named substituents. For example, where a group, such as an alkyl or heteroaryl group, is "substituted with an unsubstituted C₁-C₂₀ alkyl, or unsubstituted 2 to 20 membered heteroalkyl," the group may contain one or more unsubstituted C₁-C₂₀ alkyls, and/or one or more unsubstituted 2 to 20 membered heteroalkyls. Moreover, where a moiety is substituted with an R substituent, the group may be referred to as "R-substituted." Where a moiety is R-substituted, the moiety is substituted with at least one R substituent and each R substituent is optionally different.

[0061] Descriptions of compounds of the present invention are limited by principles of chemical bonding known to those skilled in the art. Accordingly, where a group may be substituted by one or more of a number of substituents, such substitutions are selected so as to comply with principles of chemical bonding and to give compounds which are not inherently unstable and/or would be known to one of ordinary skill in the art as likely to be unstable under ambient conditions, such as aqueous, neutral, and several known physiological conditions. For example, a heterocycloalkyl or heteroaryl is attached to the remainder of the molecule via a ring heteroatom in compliance with principles of chemical bonding known to those skilled in the art thereby avoiding inherently unstable compounds.

[0062] The terms "polypeptide," "peptide" and "protein" are used interchangeably herein to refer to a polymer of amino acid residues, wherein the polymer may be conjugated to a moiety that does not consist of amino acids. The terms apply to amino acid polymers in which one or more amino acid residue is an artificial chemical mimetic of a corresponding naturally occurring amino acid, as well as to naturally occurring amino acid polymers and non-naturally occurring amino acid polymers. The terms apply to macrocyclic peptides, peptides that have been modified with non-peptide functionality, peptidomimetics, polyamides, and macrolactams. A "fusion protein" refers to a chimeric protein encoding two or more separate protein sequences that are recombinantly expressed as a single moiety.

[0063] The term "peptidyl" and "peptidyl moiety" means a monovalent peptide.

[0064] The term "amino acid" refers to naturally occurring and synthetic amino acids, as well as amino acid analogs and amino acid mimetics that function in a manner similar to the naturally occurring amino acids. Naturally occurring amino acids are those encoded by the genetic code, as well as those amino acids that are later modified, *e.g.*, hydroxyproline, γ -carboxyglutamate,

and O-phosphoserine. Amino acid analogs refers to compounds that have the same basic chemical structure as a naturally occurring amino acid, *i.e.*, an α carbon that is bound to a hydrogen, a carboxyl group, an amino group, and an R group, *e.g.*, homoserine, norleucine, methionine sulfoxide, methionine methyl sulfonium. Such analogs have modified R groups (e.g., norleucine) or modified peptide backbones, but retain the same basic chemical structure as a naturally occurring amino acid. Amino acid mimetics refers to chemical compounds that have a structure that is different from the general chemical structure of an amino acid, but that functions in a manner similar to a naturally occurring amino acid. The terms "non-naturally occurring amino acid" and "unnatural amino acid" refer to amino acid analogs, synthetic amino acids, and amino acid mimetics which are not found in nature.

[0065] Amino acids may be referred to herein by either their commonly known three letter symbols or by the one-letter symbols recommended by the IUPAC-IUB Biochemical Nomenclature Commission. Nucleotides, likewise, may be referred to by their commonly accepted single-letter codes.

[0066] An amino acid or nucleotide base "position" is denoted by a number that sequentially identifies each amino acid (or nucleotide base) in the reference sequence based on its position relative to the N-terminus (or 5'-end). Due to deletions, insertions, truncations, fusions, and the like that must be taken into account when determining an optimal alignment, in general the amino acid residue number in a test sequence determined by simply counting from the N-terminus will not necessarily be the same as the number of its corresponding position in the reference sequence. For example, in a case where a variant has a deletion relative to an aligned reference sequence, there will be no amino acid in the variant that corresponds to a position in the reference sequence at the site of deletion. Where there is an insertion in an aligned reference sequence, that insertion will not correspond to a numbered amino acid position in the reference sequence. In the case of truncations or fusions there can be stretches of amino acids in either the reference or aligned sequence that do not correspond to any amino acid in the corresponding sequence.

[0067] The terms "numbered with reference to" or "corresponding to," when used in the context of the numbering of a given amino acid or polynucleotide sequence, refers to the numbering of the residues of a specified reference sequence when the given amino acid or polynucleotide sequence is compared to the reference sequence.

[0068] "Conservatively modified variants" applies to both amino acid and nucleic acid sequences. With respect to particular nucleic acid sequences, conservatively modified variants refers to those nucleic acids which encode identical or essentially identical amino acid sequences, or where the nucleic acid does not encode an amino acid sequence, to essentially identical sequences. Because of the degeneracy of the genetic code, a large number of functionally identical nucleic acids encode any given protein. For instance, the codons GCA, GCC, GCG and GCU all encode the amino acid alanine. Thus, at every position where an alanine is specified by a codon, the codon can be altered to any of the corresponding codons described without altering the encoded polypeptide. Such nucleic acid variations are "silent variations," which are one species of conservatively modified variations. Every nucleic acid sequence herein which encodes a polypeptide also describes every possible silent variation of the nucleic acid. One of skill will recognize that each codon in a nucleic acid (except AUG, which is ordinarily the only codon for methionine, and TGG, which is ordinarily the only codon for tryptophan) can be modified to yield a functionally identical molecule. Accordingly, each silent variation of a nucleic acid which encodes a polypeptide is implicit in each described sequence with respect to the expression product, but not with respect to actual probe sequences.

[0069] As to amino acid sequences, one of skill will recognize that individual substitutions, deletions or additions to a nucleic acid, peptide, polypeptide, or protein sequence which alters, adds or deletes a single amino acid or a small percentage of amino acids in the encoded sequence is a "conservatively modified variant" where the alteration results in the substitution of an amino acid with a chemically similar amino acid. Conservative substitution tables providing functionally similar amino acids are well known in the art. Such conservatively modified variants are in addition to and do not exclude polymorphic variants, interspecies homologs, and alleles of the invention.

[0070] The following eight groups each contain amino acids that are conservative substitutions for one another: 1) Alanine (A), Glycine (G); 2) Aspartic acid (D), Glutamic acid (E); 3) Asparagine (N), Glutamine (Q); 4) Arginine (R), Lysine (K); 5) Isoleucine (I), Leucine (L), Methionine (M), Valine (V); 6) Phenylalanine (F), Tyrosine (Y), Tryptophan (W); 7) Serine (S), Threonine (T); and 8) Cysteine (C), Methionine (M) (see, e.g., Creighton, Proteins (1984)).

[0071] The terms "treating", or "treatment" refers to any indicia of success in the treatment or amelioration of an injury, disease, pathology or condition, including any objective or subjective parameter such as abatement; remission; diminishing of symptoms or making the injury,

pathology or condition more tolerable to the patient; slowing in the rate of degeneration or decline; making the final point of degeneration less debilitating; improving a patient's physical or mental well-being. The treatment or amelioration of symptoms can be based on objective or subjective parameters; including the results of a physical examination, neuropsychiatric exams, and/or a psychiatric evaluation. The term "treating" and conjugations thereof, include prevention of an injury, pathology, condition, or disease. In embodiments, "treating" refers to treatment of cancer.

[0072] An "effective amount" is an amount sufficient for a compound to accomplish a stated purpose relative to the absence of the compound (e.g. achieve the effect for which it is administered, treat a disease, reduce enzyme activity, increase enzyme activity, reduce a signaling pathway, or reduce one or more symptoms of a disease or condition). An example of an "therapeutically effective amount" is an amount sufficient to contribute to the treatment, prevention, or reduction of a symptom or symptoms of a disease, which could also be referred to as a "therapeutically effective amount." A "reduction" of a symptom or symptoms (and grammatical equivalents of this phrase) means decreasing of the severity or frequency of the symptom(s), or elimination of the symptom(s). The exact amounts will depend on the purpose of the treatment, and will be ascertainable by one skilled in the art using known techniques (*see, e.g., Lieberman, Pharmaceutical Dosage Forms* (vols. 1-3, 1992); Lloyd, *The Art, Science and Technology of Pharmaceutical Compounding* (1999); Pickar, *Dosage Calculations* (1999); and *Remington: The Science and Practice of Pharmacy*, 20th Edition, 2003, Gennaro, Ed., Lippincott, Williams & Wilkins).

[0073] The term "associated" or "associated with" in the context of a substance or substance activity or function associated with a disease (e.g. infectious disease, hyperproliferative disease, cancer) means that the disease is caused by (in whole or in part), or a symptom of the disease is caused by (in whole or in part) the substance or substance activity or function. As used herein, what is described as being associated with a disease, if a causative agent, could be a target for treatment of the disease. For example, a disease associated with infection may be treated with an agent (e.g. compound as described herein) effective as an antibiotic.

[0074] "Control" or "control experiment" is used in accordance with its plain ordinary meaning and refers to an experiment in which the subjects or reagents of the experiment are treated as in a parallel experiment except for omission of a procedure, reagent, or variable of the experiment. In some instances, the control is used as a standard of comparison in evaluating

experimental effects. In some embodiments, a control is the measurement of the activity of a protein in the absence of a compound as described herein (including embodiments and examples).

[0075] As defined herein, the term “inhibition”, “inhibit”, “inhibiting” and the like in reference to a protein-inhibitor interaction means negatively affecting (e.g. decreasing) the activity or function of the protein relative to the activity or function of the protein in the absence of the inhibitor. In some embodiments inhibition refers to reduction of a disease or symptoms of disease. In some embodiments, inhibition refers to a reduction in the activity of a particular protein or nucleic acid target. Thus, inhibition includes, at least in part, partially or totally blocking stimulation, decreasing, preventing, or delaying activation, or inactivating, desensitizing, or down-regulating signal transduction or enzymatic activity or the amount of a protein.

[0076] “Contacting” is used in accordance with its plain ordinary meaning and refers to the process of allowing at least two distinct species (e.g. chemical compounds including biomolecules or cells) to become sufficiently proximal to react, interact or physically touch. It should be appreciated; however, the resulting reaction product can be produced directly from a reaction between the added reagents or from an intermediate from one or more of the added reagents which can be produced in the reaction mixture.

[0077] The term “contacting” may include allowing two species to react, interact, or physically touch, wherein the two species may be a compound as described herein and a protein or enzyme. In some embodiments contacting includes allowing a compound described herein to interact with a protein or enzyme that is involved in a signaling pathway.

[0078] “Patient,” “subject,” “patient in need thereof,” and “subject in need thereof” are herein used interchangeably and refer to a living organism suffering from or prone to a disease or condition that can be treated by administration of a pharmaceutical composition as provided herein. Non-limiting examples include humans, other mammals, bovines, rats, mice, dogs, monkeys, goat, sheep, cows, deer, and other non-mammalian animals. In some embodiments, a patient is human.

[0079] “Disease” or “condition” refer to a state of being or health status of a patient or subject capable of being treated with the compounds or methods provided herein.

[0080] In some embodiments, the disease is a disease having the symptom of cell hyperproliferation. In some embodiments, the disease is a disease having the symptom of an aberrant level of androgen receptor activity. In some embodiments, the disease is a cancer. In some further instances, "cancer" refers to human cancers and carcinomas, sarcomas, adenocarcinomas, lymphomas, leukemias, etc., including solid and lymphoid cancers, kidney, breast, lung, bladder, colon, ovarian, prostate, pancreas, stomach, brain, head and neck, skin, uterine, testicular, glioma, esophagus, and liver cancer, including hepatocarcinoma, lymphoma, including B-acute lymphoblastic lymphoma, non-Hodgkin's lymphomas (*e.g.*, Burkitt's, Small Cell, and Large Cell lymphomas), Hodgkin's lymphoma, leukemia (including AML, ALL, and CML), or multiple myeloma. In embodiments, the disease is prostate cancer. In embodiments, the disease is hormone sensitive prostate cancer. In embodiments, the disease is hormone refractory (insensitive) prostate cancer.

[0081] As used herein, the term "cancer" refers to all types of cancer, neoplasm or malignant tumors found in mammals (*e.g.* humans), including leukemia, carcinomas and sarcomas.

Exemplary cancers that may be treated with a compound or method provided herein include cancer of the prostate, thyroid, endocrine system, brain, breast, cervix, colon, head & neck, liver, kidney, lung, non-small cell lung, melanoma, mesothelioma, ovary, sarcoma, stomach, uterus, Medulloblastoma, colorectal cancer, pancreatic cancer. Additional examples may include, Hodgkin's Disease, Non-Hodgkin's Lymphoma, multiple myeloma, neuroblastoma, glioma, glioblastoma multiforme, ovarian cancer, rhabdomyosarcoma, primary thrombocytosis, primary macroglobulinemia, primary brain tumors, cancer, malignant pancreatic insulanoma, malignant carcinoid, urinary bladder cancer, premalignant skin lesions, testicular cancer, lymphomas, thyroid cancer, neuroblastoma, esophageal cancer, genitourinary tract cancer, malignant hypercalcemia, endometrial cancer, adrenal cortical cancer, neoplasms of the endocrine or exocrine pancreas, medullary thyroid cancer, medullary thyroid carcinoma, melanoma, colorectal cancer, papillary thyroid cancer, hepatocellular carcinoma, or prostate cancer.

[0082] The term "leukemia" refers broadly to progressive, malignant diseases of the blood-forming organs and is generally characterized by a distorted proliferation and development of leukocytes and their precursors in the blood and bone marrow. Leukemia is generally clinically classified on the basis of (1) the duration and character of the disease-acute or chronic; (2) the type of cell involved; myeloid (myelogenous), lymphoid (lymphogenous), or monocytic; and (3) the increase or non-increase in the number abnormal cells in the blood-leukemic or aleukemic (subleukemic). Exemplary leukemias that may be treated with a compound or method provided

herein include, for example, acute nonlymphocytic leukemia, chronic lymphocytic leukemia, acute granulocytic leukemia, chronic granulocytic leukemia, acute promyelocytic leukemia, adult T-cell leukemia, aleukemic leukemia, a leukocythemic leukemia, basophylic leukemia, blast cell leukemia, bovine leukemia, chronic myelocytic leukemia, leukemia cutis, embryonal leukemia, eosinophilic leukemia, Gross' leukemia, hairy-cell leukemia, hemoblastic leukemia, hemocytoblastic leukemia, histiocytic leukemia, stem cell leukemia, acute monocytic leukemia, leukopenic leukemia, lymphatic leukemia, lymphoblastic leukemia, lymphocytic leukemia, lymphogenous leukemia, lymphoid leukemia, lymphosarcoma cell leukemia, mast cell leukemia, megakaryocytic leukemia, micromyeloblastic leukemia, monocytic leukemia, myeloblastic leukemia, myelocytic leukemia, myeloid granulocytic leukemia, myelomonocytic leukemia, Naegeli leukemia, plasma cell leukemia, multiple myeloma, plasmacytic leukemia, promyelocytic leukemia, Rieder cell leukemia, Schilling's leukemia, stem cell leukemia, subleukemic leukemia, or undifferentiated cell leukemia.

[0083] The term "sarcoma" generally refers to a tumor which is made up of a substance like the embryonic connective tissue and is generally composed of closely packed cells embedded in a fibrillar or homogeneous substance. Sarcomas that may be treated with a compound or method provided herein include a chondrosarcoma, fibrosarcoma, lymphosarcoma, melanosarcoma, myxosarcoma, osteosarcoma, Abemethy's sarcoma, adipose sarcoma, liposarcoma, alveolar soft part sarcoma, ameloblastic sarcoma, botryoid sarcoma, chloroma sarcoma, chorio carcinoma, embryonal sarcoma, Wilms' tumor sarcoma, endometrial sarcoma, stromal sarcoma, Ewing's sarcoma, fascial sarcoma, fibroblastic sarcoma, giant cell sarcoma, granulocytic sarcoma, Hodgkin's sarcoma, idiopathic multiple pigmented hemorrhagic sarcoma, immunoblastic sarcoma of B cells, lymphoma, immunoblastic sarcoma of T-cells, Jensen's sarcoma, Kaposi's sarcoma, Kupffer cell sarcoma, angiosarcoma, leukosarcoma, malignant mesenchymoma sarcoma, parosteal sarcoma, reticulocytic sarcoma, Rous sarcoma, serocystic sarcoma, synovial sarcoma, or telangiectaltic sarcoma.

[0084] The term "melanoma" is taken to mean a tumor arising from the melanocytic system of the skin and other organs. Melanomas that may be treated with a compound or method provided herein include, for example, acral-lentiginous melanoma, amelanotic melanoma, benign juvenile melanoma, Cloudman's melanoma, S91 melanoma, Harding-Passey melanoma, juvenile melanoma, lentigo maligna melanoma, malignant melanoma, nodular melanoma, subungal melanoma, or superficial spreading melanoma.

[0085] The term "carcinoma" refers to a malignant new growth made up of epithelial cells tending to infiltrate the surrounding tissues and give rise to metastases. Exemplary carcinomas that may be treated with a compound or method provided herein include, for example, medullary thyroid carcinoma, familial medullary thyroid carcinoma, acinar carcinoma, acinous carcinoma, adenocystic carcinoma, adenoid cystic carcinoma, carcinoma adenomatosum, carcinoma of adrenal cortex, alveolar carcinoma, alveolar cell carcinoma, basal cell carcinoma, carcinoma basocellulare, basaloid carcinoma, basosquamous cell carcinoma, bronchioalveolar carcinoma, bronchiolar carcinoma, bronchogenic carcinoma, cerebriform carcinoma, cholangiocellular carcinoma, chorionic carcinoma, colloid carcinoma, comedo carcinoma, corpus carcinoma, cribriform carcinoma, carcinoma en cuirasse, carcinoma cutaneum, cylindrical carcinoma, cylindrical cell carcinoma, duct carcinoma, carcinoma durum, embryonal carcinoma, encephaloid carcinoma, epiermoid carcinoma, carcinoma epitheliale adenoides, exophytic carcinoma, carcinoma ex ulcere, carcinoma fibrosum, gelatiniformi carcinoma, gelatinous carcinoma, giant cell carcinoma, carcinoma gigantocellulare, glandular carcinoma, granulosa cell carcinoma, hair-matrix carcinoma, hematoid carcinoma, hepatocellular carcinoma, Hurthle cell carcinoma, hyaline carcinoma, hypernephroid carcinoma, infantile embryonal carcinoma, carcinoma in situ, intraepidermal carcinoma, intraepithelial carcinoma, Krompecher's carcinoma, Kulchitzky-cell carcinoma, large-cell carcinoma, lenticular carcinoma, carcinoma lenticulare, lipomatous carcinoma, lymphoepithelial carcinoma, carcinoma medullare, medullary carcinoma, melanotic carcinoma, carcinoma molle, mucinous carcinoma, carcinoma muciparum, carcinoma mucocellulare, mucoepidermoid carcinoma, carcinoma mucosum, mucous carcinoma, carcinoma myxomatodes, nasopharyngeal carcinoma, oat cell carcinoma, carcinoma ossificans, osteoid carcinoma, papillary carcinoma, periportal carcinoma, preinvasive carcinoma, prickle cell carcinoma, pultaceous carcinoma, renal cell carcinoma of kidney, reserve cell carcinoma, carcinoma sarcomatodes, schneiderian carcinoma, scirrhou carcinoma, carcinoma scroti, signet-ring cell carcinoma, carcinoma simplex, small-cell carcinoma, solanoid carcinoma, spheroidal cell carcinoma, spindle cell carcinoma, carcinoma spongiosum, squamous carcinoma, squamous cell carcinoma, string carcinoma, carcinoma telangiectaticum, carcinoma telangiectodes, transitional cell carcinoma, carcinoma tuberosum, tuberous carcinoma, verrucous carcinoma, or carcinoma villosum.

[0086] The term "aberrant" as used herein refers to different from normal. When used to describe enzymatic activity, aberrant refers to activity that is greater or less than a normal control or the average of normal non-diseased control samples. Aberrant activity may refer to an amount

of activity that results in a disease, wherein returning the aberrant activity to a normal or non-disease-associated amount (e.g. by administering a compound or using a method as described herein), results in reduction of the disease or one or more disease symptoms.

[0087] “Pharmaceutically acceptable excipient” and “pharmaceutically acceptable carrier”

5 refer to a substance that aids the administration of an active agent to and absorption by a subject and can be included in the compositions of the present invention without causing a significant adverse toxicological effect on the patient. Non-limiting examples of pharmaceutically acceptable excipients include water, NaCl, normal saline solutions, lactated Ringer's, normal sucrose, normal glucose, binders, fillers, disintegrants, lubricants, coatings, sweeteners, flavors,
10 salt solutions (such as Ringer's solution), alcohols, oils, gelatins, carbohydrates such as lactose, amylose or starch, fatty acid esters, hydroxymethylcellulose, polyvinyl pyrrolidone, and colors, and the like. Such preparations can be sterilized and, if desired, mixed with auxiliary agents such as lubricants, preservatives, stabilizers, wetting agents, emulsifiers, salts for influencing osmotic pressure, buffers, coloring, and/or aromatic substances and the like that do not deleteriously react
15 with the compounds of the invention. One of skill in the art will recognize that other pharmaceutical excipients are useful in the present invention.

[0088] The term "preparation" is intended to include the formulation of the active compound with encapsulating material as a carrier providing a capsule in which the active component with or without other carriers, is surrounded by a carrier, which is thus in association with it.

20 Similarly, cachets and lozenges are included. Tablets, powders, capsules, pills, cachets, and lozenges can be used as solid dosage forms suitable for oral administration.

[0089] As used herein, the term "administering" means oral administration, administration as a suppository, topical contact, intravenous, parenteral, intraperitoneal, intramuscular, intralesional, intrathecal, intranasal or subcutaneous administration, or the implantation of a slow-release

25 device, *e.g.*, a mini-osmotic pump, to a subject. Administration is by any route, including parenteral and transmucosal (*e.g.*, buccal, sublingual, palatal, gingival, nasal, vaginal, rectal, or transdermal). Parenteral administration includes, *e.g.*, intravenous, intramuscular, intra-arteriole, intradermal, subcutaneous, intraperitoneal, intraventricular, and intracranial. Other modes of delivery include, but are not limited to, the use of liposomal formulations, intravenous infusion,
30 transdermal patches, *etc.*

[0090] By "co-administer" it is meant that a composition described herein is administered at the same time, just prior to, or just after the administration of one or more additional therapies.

The compound of the invention can be administered alone or can be co-administered to the patient. Co-administration is meant to include simultaneous or sequential administration of the compound individually or in combination (more than one compound or agent). Thus, the preparations can also be combined, when desired, with other active substances (e.g. to reduce metabolic degradation).

[0091] The compositions disclosed herein can be delivered by transdermally, by a topical route, formulated as applicator sticks, solutions, suspensions, emulsions, gels, creams, ointments, pastes, jellies, paints, powders, and aerosols. Oral preparations include tablets, pills, powder, dragees, capsules, liquids, lozenges, cachets, gels, syrups, slurries, suspensions, etc., suitable for ingestion by the patient. Solid form preparations include powders, tablets, pills, capsules, cachets, suppositories, and dispersible granules. Liquid form preparations include solutions, suspensions, and emulsions, for example, water or water/propylene glycol solutions. The compositions of the present invention may additionally include components to provide sustained release and/or comfort. Such components include high molecular weight, anionic mucomimetic polymers, gelling polysaccharides and finely-divided drug carrier substrates. These components are discussed in greater detail in U.S. Pat. Nos. 4,911,920; 5,403,841; 5,212,162; and 4,861,760. The entire contents of these patents are incorporated herein by reference in their entirety for all purposes. The compositions disclosed herein can also be delivered as microspheres for slow release in the body. For example, microspheres can be administered via intradermal injection of drug-containing microspheres, which slowly release subcutaneously (see Rao, *J. Biomater Sci. Polym. Ed.* 7:623-645, 1995; as biodegradable and injectable gel formulations (see, e.g., Gao *Pharm. Res.* 12:857-863, 1995); or, as microspheres for oral administration (see, e.g., Eyles, *J. Pharm. Pharmacol.* 49:669-674, 1997). In another embodiment, the formulations of the compositions of the present invention can be delivered by the use of liposomes which fuse with the cellular membrane or are endocytosed, *i.e.*, by employing receptor ligands attached to the liposome, that bind to surface membrane protein receptors of the cell resulting in endocytosis. By using liposomes, particularly where the liposome surface carries receptor ligands specific for target cells, or are otherwise preferentially directed to a specific organ, one can focus the delivery of the compositions of the present invention into the target cells *in vivo*. (See, *e.g.*, Al-Muhammed, *J. Microencapsul.* 13:293-306, 1996; Chonn, *Curr. Opin. Biotechnol.* 6:698-708, 1995; Ostro, *Am. J. Hosp. Pharm.* 46:1576-1587, 1989). The compositions can also be delivered as nanoparticles.

[0092] Pharmaceutical compositions may include compositions wherein the active ingredient (e.g. compounds described herein, including embodiments or examples) is contained in a therapeutically effective amount, *i.e.*, in an amount effective to achieve its intended purpose. The actual amount effective for a particular application will depend, *inter alia*, on the condition being treated. When administered in methods to treat a disease, such compositions will contain an amount of active ingredient effective to achieve the desired result, e.g., modulating the activity of a target molecule, and/or reducing, eliminating, or slowing the progression of disease symptoms.

[0093] The dosage and frequency (single or multiple doses) administered to a mammal can vary depending upon a variety of factors, for example, whether the mammal suffers from another disease, and its route of administration; size, age, sex, health, body weight, body mass index, and diet of the recipient; nature and extent of symptoms of the disease being treated, kind of concurrent treatment, complications from the disease being treated or other health-related problems. Other therapeutic regimens or agents can be used in conjunction with the methods and compounds of Applicants' invention. Adjustment and manipulation of established dosages (e.g., frequency and duration) are well within the ability of those skilled in the art.

[0094] For any compound described herein, the therapeutically effective amount can be initially determined from cell culture assays. Target concentrations will be those concentrations of active compound(s) that are capable of achieving the methods described herein, as measured using the methods described herein or known in the art.

[0095] As is well known in the art, therapeutically effective amounts for use in humans can also be determined from animal models. For example, a dose for humans can be formulated to achieve a concentration that has been found to be effective in animals. The dosage in humans can be adjusted by monitoring compounds effectiveness and adjusting the dosage upwards or downwards, as described above. Adjusting the dose to achieve maximal efficacy in humans based on the methods described above and other methods is well within the capabilities of the ordinarily skilled artisan.

[0096] Dosages may be varied depending upon the requirements of the patient and the compound being employed. The dose administered to a patient, in the context of the present invention should be sufficient to effect a beneficial therapeutic response in the patient over time. The size of the dose also will be determined by the existence, nature, and extent of any adverse side-effects. Determination of the proper dosage for a particular situation is within the skill of

the practitioner. Generally, treatment is initiated with smaller dosages which are less than the optimum dose of the compound. Thereafter, the dosage is increased by small increments until the optimum effect under circumstances is reached. Dosage amounts and intervals can be adjusted individually to provide levels of the administered compound effective for the particular clinical indication being treated. This will provide a therapeutic regimen that is commensurate with the severity of the individual's disease state.

[0097] “Mcl-1” is used according to its common, ordinary meaning and refers to proteins of the same or similar names and functional fragments and homologs thereof. The term includes recombinant or naturally occurring forms of Mcl-1 (e.g. Myeloid Leukemia sequence protein 1 (BCL2-related); GI No: 7582271, or variants thereof that maintain Mcl-1 activity (e.g. within at least 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, or 100% activity compared to Mcl-1). A “Mcl-1 mixture” is a mixture that includes at least Mcl-1. Thus, in embodiments, a Mcl-1 mixture may be a region (e.g. cytoplasm, nucleus) within a cell. A Mcl-1 mixture may be a solution (e.g. a buffer or assay) which includes at least Mcl-1 and one other protein or receptor.

[0098] “Bcl-2” is used according to its common, ordinary meaning and refers to proteins of the same or similar names and functional fragments and homologs thereof. The term includes recombinant or naturally occurring forms of Bcl-2 (e.g. B cell lymphoma 2 protein); GI:72198189, or variants thereof that maintain Bcl-2 activity (e.g. within at least 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, or 100% activity compared to Bcl-2). A “Bcl-2 mixture” is a mixture that includes at least Bcl-2. Thus, in embodiments, a Bcl-2 mixture may be a region (e.g. cytoplasm, nucleus) within a cell. A Bcl-2 mixture may be a solution (e.g. a buffer or assay) which includes at least Bcl-2 and one other protein or receptor.

[0099] “Bcl-xl” is used according to its common, ordinary meaning and refers to proteins of the same or similar names and functional fragments and homologs thereof. The term includes recombinant or naturally occurring forms of Bcl-xl (e.g. BCL2-like 1 isoform 1) or variants thereof that maintain Bcl-xl activity (e.g. within at least 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, or 100% activity compared to Bcl-xl). A “Bcl-xl mixture” is a mixture that includes at least Bcl-xl. Thus, in embodiments, a Bcl-xl mixture may be a region (e.g. cytoplasm, nucleus) within a cell. A Bcl-xl mixture may be a solution (e.g. a buffer or assay) which includes at least Bcl-xl and one other protein or receptor.

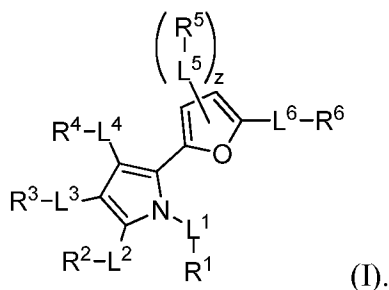
[0100] The term “associated” or “associated with” in the context of a substance or substance activity or function associated with a disease means that the disease is caused by or otherwise

characterized by (in whole or in part), a symptom of the disease is caused by (in whole or in part) the substance or substance activity or function, or a side-effect of the compound (e.g. toxicity) is caused by or characterized by (in whole or in part) the substance or substance activity or function.

- 5 **[0101]** The term “signaling pathway” as used herein refers to a series of interactions between cellular and optionally extra-cellular components (e.g. proteins, nucleic acids, small molecules, ions, lipids) that conveys a change in one component to one or more other components, which in turn may convey a change to additional components, which is optionally propagated to other signaling pathway components.
- 10 **[0102]** An “agonist,” as used herein, refers to a compound capable of detectably increasing the expression or activity of a given protein or receptor. The agonist can increase expression or activity 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% or more in comparison to a control in the absence of the agonist. In embodiments, expression or activity is 1.5-fold, 2-fold, 3-fold, 4-fold, 5-fold, 10-fold or more higher than the expression or activity in the absence of the
- 15 agonist. An “Mcl-1 agonist” is a compound which increases Mcl-1 activity. A Mcl-1 agonist may directly interact with Mcl-1 to increase its activity. Alternatively, a Mcl-1 agonist may increase and/or decrease the activity of a protein or receptor in a signaling pathway that is involved in the activation of Mcl-1 which increases Mcl-1 activity.
- 20 **[0103]** The term “antagonist” refers to a substance capable of detectably lowering expression or activity of a given protein relative to the absence of the antagonist. The antagonist can inhibit expression or activity 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100% or less in comparison to a control in the absence of the antagonist. In embodiments, the inhibition is 1.5-fold, 2-fold, 3-fold, 4-fold, 5-fold, 10-fold, or more than the expression or activity in the absence of the antagonist. An “Mcl-1 antagonist” is a compound which decreases Mcl-1 activity. A
- 25 Mcl-1 antagonist may directly interact with Mcl-1 to decrease its activity. Alternatively, a Mcl-1 antagonist may increase and/or decrease the activity of a protein or receptor in a signaling pathway that is involved in the activation of Mcl-1 which decreases Mcl-1 activity.

COMPOSITIONS

[0104] Provided herein are compounds having the formula:



[0105] In embodiments, in the compound of formula (I), L^1 , L^2 , L^3 , L^4 , L^5 , and L^6 are independently a bond, $-C(O)-$, $-C(O)O-$, $-C(O)NR^7-$, $-O-$, $-S(O)_n-$, $-S(O)NR^7-$, $-C(O)NR^7S(O)_2-$, $-NR^7-$, substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene,

5 substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene. R^7 is independently hydrogen, halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $-NH_2$, $-COOH$, $-CONH_2$, $-NO_2$, $-SH$, $-SO_2Cl$, $-SO_3H$, $-SO_2Ph$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHCNHNH_2$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl,

10 substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. The symbol n is 0, 1, or 2. R^1 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{1A}$, $-NR^{1B}R^{1C}$, $-COOR^{1A}$, $-CONR^{1B}R^{1C}$, $-NO_2$, $-SR^{1D}$, $-SO_{n1}R^{1B}$, $-S(O)_{n1}OR^{1B}$, $-S(O)_{n1}NR^{1B}R^{1C}$, $-NHNR^{1B}R^{1C}$, $-ONR^{1B}R^{1C}$, $-NHC(O)NHNR^{1B}R^{1C}$, substituted or unsubstituted alkyl, substituted or

15 unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^1 and R^2 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^2 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$,

20 $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{2A}$, $-NR^{2B}R^{2C}$, $-COOR^{2A}$, $-CONR^{2B}R^{2C}$, NO_2 , SR^{2D} , $-SO_{n2}R^{2B}$, $-SO_{n2}OR^{2B}$, $-SO_{n2}NR^{2B}R^{2C}$, $-NHNR^{2B}R^{2C}$, $-ONR^{2B}R^{2C}$, $-NHC(O)NHNR^{2B}R^{2C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^2 and R^3 are optionally joined together to form

25 a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^3 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{3A}$, $-NR^{3B}R^{3C}$, $-COOR^{3A}$, $-CONR^{3B}R^{3C}$, NO_2 , SR^{3D} , $-SO_{n3}R^{3B}$, $-SO_{n3}OR^{3B}$, $-SO_{n3}NR^{3B}R^{3C}$, $-NHNR^{3B}R^{3C}$, $-ONR^{3B}R^{3C}$, $-NHC(O)NHNR^{3B}R^{3C}$, substituted or unsubstituted alkyl, substituted or unsubstituted

heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^3 and R^4 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^4 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{4A}$, $-NR^{4B}R^{4C}$, $-COOR^{4A}$, $-CONR^{4B}R^{4C}$, NO_2 , SR^{4D} , $-SO_{n4}R^{4B}$, $-SO_{n4}OR^{4B}$, $-SO_{n4}NR^{4B}R^{4C}$, $-NHN R^{4B}R^{4C}$, $-ONR^{4B}R^{4C}$, $-NHC(O)NHN R^{4B}R^{4C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^5 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{5A}$, $-NR^{5B}R^{5C}$, $-COOR^{5A}$, $-CONR^{5B}R^{5C}$, NO_2 , SR^{5D} , $-SO_{n5}R^{5B}$, $-SO_{n5}OR^{5B}$, $-SO_{n5}NR^{5B}R^{5C}$, $-NHN R^{5B}R^{5C}$, $-ONR^{5B}R^{5C}$, $-NHC(O)NHN R^{5B}R^{5C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^5 and R^6 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^6 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{6A}$, $-NR^{6B}R^{6C}$, $-COOR^{6A}$, $-CONR^{6B}R^{6C}$, NO_2 , SR^{6D} , $-SO_{n6}R^{6B}$, $-SO_{n6}OR^{6B}$, $-SO_{n6}NR^{6B}R^{6C}$, $-NHN R^{6B}R^{6C}$, $-ONR^{6B}R^{6C}$, $-NHC(O)NHN R^{6B}R^{6C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^{1A} , R^{2A} , R^{3A} , R^{4A} , R^{5A} , R^{6A} , R^{1B} , R^{2B} , R^{3B} , R^{4B} , R^{5B} , R^{6B} , R^{1C} , R^{2C} , R^{3C} , R^{4C} , R^{5C} , R^{6C} , R^{1D} , R^{2D} , R^{3D} , R^{4D} , R^{5D} , and R^{6D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^{6B} and R^{6C} are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. The symbols $n1$, $n2$, $n3$, $n4$, $n5$, and $n6$ are independently 1 or 2. The symbol z is 1 or 2. The symbol z may be 1. The symbol z may be 2. The symbols $n1$, $n2$, $n3$, $n4$, $n5$, and $n6$ may independently be 1. The symbols $n1$, $n2$, $n3$, $n4$, $n5$, and $n6$ may independently be 2.

[0106] In embodiments L^1 is a bond, $-S(O)_2-$, or substituted or unsubstituted alkylene. In embodiments, L^1 is a bond, $-S(O)_2-$. In embodiments, L^1 is substituted or unsubstituted C_1-C_3 alkylene. In embodiments, L^1 is unsubstituted C_1-C_3 alkylene.

[0107] In embodiments, L^2 and L^3 are independently a bond or substituted or unsubstituted alkylene. In embodiments, L^2 and L^3 are a bond. In embodiments, L^2 and L^3 are independently substituted or unsubstituted C_1-C_3 alkylene. In embodiments, L^2 and L^3 are independently unsubstituted C_1-C_3 alkylene.

[0108] In embodiments, L^4 is a bond, $S(O)_2-$, or substituted or unsubstituted alkylene. In embodiments, L^4 is a bond or $S(O)_2-$. In embodiments, L^4 is substituted or unsubstituted C_1-C_3 alkylene. In embodiments, L^4 is unsubstituted C_1-C_3 alkylene.

[0109] In embodiments, L^5 is a bond, $-O-$, or substituted or unsubstituted alkylene. In embodiments, L^5 is substituted or unsubstituted C_1-C_3 alkylene. In embodiments, L^5 is a bond. In embodiments, L^5 is $-O-$.

[0110] In embodiments, L^6 includes a salt bridge forming moiety. A salt bridge forming moiety as provided herein refers to a moiety capable of forming noncovalent interactions (e.g., hydrogen bonding, electrostatic interactions or a combination thereof) with other molecules. In embodiments, the salt bridge forming moiety is or includes $-NH_3^+$ or $-C(O)O^-$. In embodiments, the salt bridge moiety interacts with Arg 263 of Mcl-1 or a corresponding residue thereof. In embodiments, the salt bridge moiety does not bind to Bcl-2. In embodiments, the salt bridge moiety does not bind to Bcl-xl. In embodiments, the salt bridge moiety binds more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 5 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 10 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 20 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 30 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 40 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 50 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 60 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 70 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 80 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 90 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In

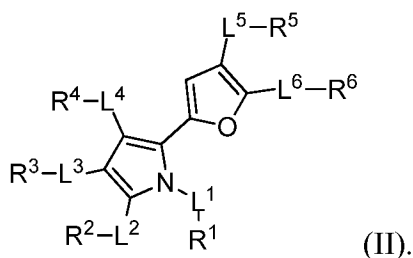
embodiments, the salt bridge moiety binds about 100 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 200 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 300 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 400 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 500 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds about 1000 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl.

[0111] In embodiments, the salt bridge moiety binds more specifically to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 2 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 5 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 10 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 20 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 30 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 40 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 50 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 60 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 70 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 80 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 90 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 100 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 200 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 300 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 400 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 500 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 1000 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. In embodiments, the salt bridge moiety binds at least 5, 10, 50, 100, 500 or 1000 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. Thus, in embodiments the compounds provided herein including embodiments thereof (e.g., compounds of formula (I), (II), (III), (IV), (IVA), (V) and (VA)) bind at least 5, 10, 50, 100, 500 or 1000 times more specific to Mcl-1 than to Bcl-2 or Bcl-xl. Where a compound provided herein binds “at least” 5 times more specific to Mcl-1 than to

Bcl-2 or Bcl-xl, the dissociation constant (K_d) of the compound bound to Mcl-1 is 5 times less than the K_d of the same compound bound to Bcl-2 or Bcl-xl.

[0112] In embodiments, L^6 is a bond, $-C(O)-$, $-C(O)NR^7$, $-S(O)_2-$, $-C(O)NR^7S(O)_2-$, or substituted or unsubstituted alkylene. In embodiments, L^6 is a bond or $-C(O)-$. In embodiments, L^6 is $-C(O)NR^7S(O)_2-$ and R^7 is hydrogen.

[0113] In embodiments, the compound of formula (I) has the formula:



[0114] In embodiments, R^1 is a lipophilic substituent. A lipophilic substituent as provided herein is a substituent which increases the ability of a compound to dissolve in fats, oils, lipids, and non-polar solvents. In embodiments, the lipophilic substituent is a non-polar substituent. In embodiments, the lipophilic substituent is a large hydrocarbon moiety having the structure $-(CH_2)_{y1}CH_3$, wherein $y1$ is at least 1 (e.g. 1 to 100, 1- 50, 1 to 20, 1 to 10). In embodiments, $y1$ is 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10. In embodiments, R^1 is an aromatic lipophilic substituent. In embodiments, R^1 is substituted or unsubstituted alkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl, or wherein R^1 and R^2 are joined together to form a substituted or unsubstituted heterocycloalkyl. In embodiments, R^1 is substituted or unsubstituted alkyl. In embodiments, R^1 is substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl. In embodiments, R^1 and R^2 are joined together to form an R-substituted or unsubstituted heterocycloalkyl, wherein R is substituted or unsubstituted alkyl.

[0115] In embodiments, R^1 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{1A}$, $-NR^{1B}R^{1C}$, $-COOR^{1A}$, $-CONR^{1B}R^{1C}$, $-NO_2$, $-SR^{1D}$, $-SO_{n1}R^{1B}$, $-S(O)_{n1}OR^{1B}$, $-S(O)_{n1}NR^{1B}R^{1C}$, $-NHNr^{1B}R^{1C}$, $-ONR^{1B}R^{1C}$, $-NHC(O)NHNr^{1B}R^{1C}$, R^9 -substituted or unsubstituted alkyl, R^9 -substituted or unsubstituted heteroalkyl, R^9 -substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, R^9 -substituted or unsubstituted aryl, or R^9 -substituted or unsubstituted heteroaryl, wherein R^1 and R^2 are optionally joined together to form a R^9 -substituted or unsubstituted cycloalkyl, R^9 -substituted or unsubstituted

heterocycloalkyl, R⁹-substituted or unsubstituted aryl, or R⁹-substituted or unsubstituted heteroaryl.

[0116] R⁹ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂,
 5 R¹⁰-substituted or unsubstituted alkyl, R¹⁰-substituted or unsubstituted heteroalkyl, R¹⁰-substituted or unsubstituted cycloalkyl, R¹⁰-substituted or unsubstituted heterocycloalkyl, R¹⁰-substituted or unsubstituted aryl, or R¹⁰-substituted or unsubstituted heteroaryl.

[0117] R¹⁰ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃,
 10 -NHC(O)NHNH₂, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, or unsubstituted heteroaryl.

[0118] In embodiments, R² is independently hydrogen, halogen, -N₃, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -CHO, =O, -OR^{2A}, -NR^{2B}R^{2C}, -COOR^{2A}, -CONR^{2B}R^{2C}, NO₂, SR^{2D}, -SO_{n2}R^{2B}, -SO_{n2}OR^{2B}, -SO_{n2}NR^{2B}R^{2C}, -NHNR^{2B}R^{2C}, -ONR^{2B}R^{2C}, -NHC(O)NHNR^{2B}R^{2C}, R¹⁹-substituted or
 15 unsubstituted alkyl, R¹⁹-substituted or unsubstituted heteroalkyl, R¹⁹-substituted or unsubstituted cycloalkyl, R¹⁹-substituted or unsubstituted heterocycloalkyl, R¹⁹-substituted or unsubstituted aryl, or R¹⁹-substituted or unsubstituted heteroaryl, wherein R² and R³ are optionally joined together to form a R¹⁹-substituted or unsubstituted cycloalkyl, R¹⁹-substituted or unsubstituted heterocycloalkyl, R¹⁹-substituted or unsubstituted aryl, or R¹⁹-substituted or unsubstituted
 20 heteroaryl.

[0119] R¹⁹ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R²⁰-substituted or unsubstituted alkyl, R²⁰-substituted or unsubstituted heteroalkyl, R²⁰-substituted or unsubstituted cycloalkyl, R²⁰-substituted or unsubstituted
 25 heterocycloalkyl, R²⁰-substituted or unsubstituted aryl, or R²⁰-substituted or unsubstituted heteroaryl.

[0120] R²⁰ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl,
 30 unsubstituted heterocycloalkyl, unsubstituted aryl, or unsubstituted heteroaryl.

[0121] In embodiments, R^3 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{3A}$, $-NR^{3B}R^{3C}$, $-COOR^{3A}$, $-CONR^{3B}R^{3C}$, NO_2 , SR^{3D} , $-SO_{n3}R^{3B}$, $-SO_{n3}OR^{3B}$, $-SO_{n3}NR^{3B}R^{3C}$, $-NHNr^{3B}R^{3C}$, $-ONR^{3B}R^{3C}$, $-NHC(O)NHNr^{3B}R^{3C}$, R^{21} -substituted or unsubstituted alkyl, R^{21} -substituted or unsubstituted heteroalkyl, R^{21} -substituted or unsubstituted cycloalkyl, R^{21} -substituted or unsubstituted heterocycloalkyl, R^{21} -substituted or unsubstituted aryl, or R^{21} -substituted or unsubstituted heteroaryl, wherein R^2 and R^3 are optionally joined together to form a R^{21} -substituted or unsubstituted cycloalkyl, R^{21} -substituted or unsubstituted heterocycloalkyl, R^{21} -substituted or unsubstituted aryl, or R^{21} -substituted or unsubstituted heteroaryl.

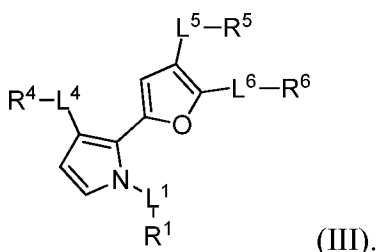
[0122] R^{21} is independently halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, R^{22} -substituted or unsubstituted alkyl, R^{22} -substituted or unsubstituted heteroalkyl, R^{22} -substituted or unsubstituted cycloalkyl, R^{22} -substituted or unsubstituted heterocycloalkyl, R^{22} -substituted or unsubstituted aryl, or R^{22} -substituted or unsubstituted heteroaryl.

[0123] R^{22} is independently halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, or unsubstituted heteroaryl.

[0124] In embodiments, R^2 is hydrogen, joined together with R^1 to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. In embodiments, R^2 is hydrogen, joined together with R^3 to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. In embodiments, R^2 is hydrogen, joined together with R^1 to form a substituted or unsubstituted cycloalkyl or substituted or unsubstituted heterocycloalkyl, or joined together with R^3 to form substituted or unsubstituted heterocycloalkyl or substituted or unsubstituted aryl. In embodiments, R^2 is hydrogen. In embodiments, R^2 is not hydrogen. In embodiments, R^2 is joined together with R^3 to form a substituted or unsubstituted aryl. In embodiments, R^2 is joined together with R^1 to form a substituted or unsubstituted heterocycloalkyl.

[0125] In embodiments, R^3 is hydrogen. In embodiments, R^2 and R^3 are hydrogen.

[0126] In embodiments, the compound of formula (I) has the formula:



[0127] In embodiments, R^4 is halogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted aryl or joined together with R^3 to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl. In embodiments, R^4 is halogen. In embodiments, R^4 is R^{11} -substituted or unsubstituted alkyl. In embodiments, R^4 is R^{11} -substituted or unsubstituted aryl. In embodiments, R^4 and R^3 to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, or substituted or unsubstituted aryl.

[0128] In embodiments, R^4 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{4A}$, $-NR^{4B}R^{4C}$, $-COOR^{4A}$, $-CONR^{4B}R^{4C}$, $-NO_2$, $-SR^{4D}$, $-SO_nR^{4B}$, $-SO_nOR^{4B}$, $-SO_nNR^{4B}R^{4C}$, $-NHN R^{4B}R^{4C}$, $-ONR^{4B}R^{4C}$, $-NHC(O)NHN R^{4B}R^{4C}$, R^{11} -substituted or unsubstituted alkyl, R^{11} -substituted or unsubstituted heteroalkyl, R^{11} -substituted or unsubstituted cycloalkyl, R^{11} -substituted or unsubstituted heterocycloalkyl, R^{11} -substituted or unsubstituted aryl, or R^{11} -substituted or unsubstituted heteroaryl.

[0129] R^{11} is independently halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, R^{12} -substituted or unsubstituted alkyl, R^{12} -substituted or unsubstituted heteroalkyl, R^{12} -substituted or unsubstituted cycloalkyl, R^{12} -substituted or unsubstituted heterocycloalkyl, R^{12} -substituted or unsubstituted aryl, or R^{12} -substituted or unsubstituted heteroaryl.

[0130] R^{12} is independently halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, or unsubstituted heteroaryl.

[0131] In embodiments, R^{11} is independently halogen, oxo, $-OH$, substituted or unsubstituted alkyl or substituted or unsubstituted aryl.

[0132] In embodiments, R^5 is independently $-OR^{5A}$, CF_3 , substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl.

[0133] In embodiments, R^5 is independently $-OR^{5A}$, wherein R^{5A} is R^{13} -substituted or unsubstituted alkyl, R^{13} -substituted or unsubstituted heteroalkyl, R^{13} is halogen $-OH$, $=O$, CF_3 , $-NR^{13A}R^{13B}$, substituted or unsubstituted alkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, R^{13A} and R^{13B} are independently hydrogen or substituted or unsubstituted alkyl. In embodiments, R^5 is joined together with R^6 to form a substituted or unsubstituted heterocycloalkyl or substituted or unsubstituted heteroaryl.

[0134] In embodiments, R^5 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $-OR^{5A}$, $=O$, $-NR^{5B}R^{5C}$, $-COOR^{5A}$, $-CONR^{5B}R^{5C}$, $-NO_2$, $-SR^{5D}$, $-SO_nR^{5B}$, $-SO_nOR^{5B}$, $-SO_nNR^{5B}R^{5C}$, $-NHNr^{5B}R^{5C}$, $-ONR^{5B}R^{5C}$, $-NHC(O)NHNr^{5B}R^{5C}$, R^{13} -substituted or unsubstituted alkyl, R^{13} -substituted or unsubstituted heteroalkyl, R^{13} -substituted or unsubstituted cycloalkyl, R^{13} -substituted or unsubstituted heterocycloalkyl, R^{13} -substituted or unsubstituted aryl, or R^{13} -substituted or unsubstituted heteroaryl, wherein R^5 and R^6 are optionally joined together to form a R^{13} -substituted or unsubstituted cycloalkyl, R^{13} -substituted or unsubstituted heterocycloalkyl, R^{13} -substituted or unsubstituted aryl, or R^{13} -substituted or unsubstituted heteroaryl.

[0135] R^{13} is independently halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, R^{14} -substituted or unsubstituted alkyl, R^{14} -substituted or unsubstituted heteroalkyl, R^{14} -substituted or unsubstituted cycloalkyl, R^{14} -substituted or unsubstituted heterocycloalkyl, R^{14} -substituted or unsubstituted aryl, or R^{14} -substituted or unsubstituted heteroaryl.

[0136] R^{13A} is independently halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, R^{14A} -substituted or unsubstituted alkyl, R^{14A} -substituted or unsubstituted heteroalkyl, R^{14A} -substituted or unsubstituted cycloalkyl, R^{14A} -substituted or unsubstituted heterocycloalkyl, R^{14A} -substituted or unsubstituted aryl, or R^{14A} -substituted or unsubstituted heteroaryl.

[0137] R^{13B} is independently halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, R^{14B} -substituted or unsubstituted alkyl, R^{14B} -substituted or unsubstituted

heteroalkyl, R^{14B}-substituted or unsubstituted cycloalkyl, R^{14B}-substituted or unsubstituted heterocycloalkyl, R^{14B}-substituted or unsubstituted aryl, or R^{14B}-substituted or unsubstituted heteroaryl.

[0138] R¹⁴ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R¹⁵-substituted or unsubstituted alkyl, R¹⁵-substituted or unsubstituted heteroalkyl, R¹⁵-substituted or unsubstituted cycloalkyl, R¹⁵-substituted or unsubstituted heterocycloalkyl, R¹⁵-substituted or unsubstituted aryl, or R¹⁵-substituted or unsubstituted heteroaryl.

[0139] R^{14A} is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R¹⁵-substituted or unsubstituted alkyl, R¹⁵-substituted or unsubstituted heteroalkyl, R¹⁵-substituted or unsubstituted cycloalkyl, R¹⁵-substituted or unsubstituted heterocycloalkyl, R¹⁵-substituted or unsubstituted aryl, or R¹⁵-substituted or unsubstituted heteroaryl.

[0140] R^{14B} is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R¹⁵-substituted or unsubstituted alkyl, R¹⁵-substituted or unsubstituted heteroalkyl, R¹⁵-substituted or unsubstituted cycloalkyl, R¹⁵-substituted or unsubstituted heterocycloalkyl, R¹⁵-substituted or unsubstituted aryl, or R¹⁵-substituted or unsubstituted heteroaryl.

[0141] R¹⁵ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, or unsubstituted heteroaryl.

[0142] In embodiments, R⁶ includes a salt bridge forming moiety. A salt bridge forming moiety as provided herein refers to a moiety capable of forming noncovalent interactions (e.g., hydrogen bonding, electrostatic interactions or a combination thereof) with other molecules. In embodiments, the salt bridge forming moiety is NH₃⁺ or C(O)O⁻. In embodiments, the salt bridge moiety interacts with Arg 263 of Mcl-1 or a corresponding residue thereof. In embodiments, the salt bridge moiety does not interact with Bcl-2.

[0143] In embodiments, R^6 is independently halogen, -CN, substituted or unsubstituted alkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl.

[0144] In embodiments, R^6 is independently hydrogen, halogen, -N₃, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -CHO, =O, -OR^{6A}, -NR^{6B}R^{6C}, -COOR^{6A}, -CONR^{6B}R^{6C}, -NO₂, -SR^{6D}, -SO_{n6}R^{6B}, -SO_{n6}OR^{6B}, -SO_{n6}NR^{6B}R^{6C}, -NHN^{6B}R^{6C}, -ONR^{6B}R^{6C}, -NHC(O)NHN^{6B}R^{6C}, R¹⁶-substituted or unsubstituted alkyl, R¹⁶-substituted or unsubstituted heteroalkyl, R¹⁶-substituted or unsubstituted cycloalkyl, R¹⁶-substituted or unsubstituted heterocycloalkyl, R¹⁶-substituted or unsubstituted aryl, or R¹⁶-substituted or unsubstituted heteroaryl.

[0145] R^{16} is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, NR^{16A}R^{16B}, R¹⁷-substituted or unsubstituted alkyl, R¹⁷-substituted or unsubstituted heteroalkyl, R¹⁷-substituted or unsubstituted cycloalkyl, R¹⁷-substituted or unsubstituted heterocycloalkyl, R¹⁷-substituted or unsubstituted aryl, or R¹⁷-substituted or unsubstituted heteroaryl.

[0146] R^{16A} is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R^{17A}-substituted or unsubstituted alkyl, R^{17A}-substituted or unsubstituted heteroalkyl, R^{17A}-substituted or unsubstituted cycloalkyl, R^{17A}-substituted or unsubstituted heterocycloalkyl, R^{17A}-substituted or unsubstituted aryl, or R^{17A}-substituted or unsubstituted heteroaryl.

[0147] R^{16B} is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R^{17B}-substituted or unsubstituted alkyl, R^{17B}-substituted or unsubstituted heteroalkyl, R^{17B}-substituted or unsubstituted cycloalkyl, R^{17B}-substituted or unsubstituted heterocycloalkyl, R^{17B}-substituted or unsubstituted aryl, or R^{17B}-substituted or unsubstituted heteroaryl.

[0148] R^{17} is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH,

-CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R¹⁸-substituted or unsubstituted alkyl, R¹⁸-substituted or unsubstituted heteroalkyl, R¹⁸-substituted or

unsubstituted cycloalkyl, R¹⁸-substituted or unsubstituted heterocycloalkyl, R¹⁸-substituted or unsubstituted aryl, or R¹⁸-substituted or unsubstituted heteroaryl.

[0149] In embodiments, R¹⁷ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl.

[0150] R^{17A} is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R¹⁸-substituted or unsubstituted alkyl, R¹⁸-substituted or unsubstituted heteroalkyl, R¹⁸-substituted or unsubstituted cycloalkyl, R¹⁸-substituted or unsubstituted heterocycloalkyl, R¹⁸-substituted or unsubstituted aryl, or R¹⁸-substituted or unsubstituted heteroaryl.

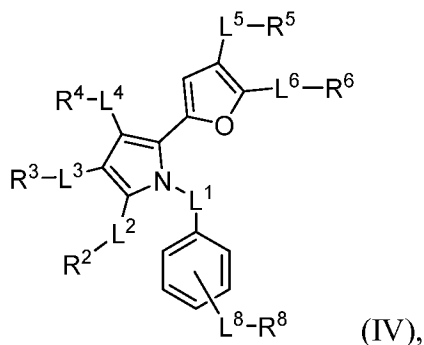
[0151] R^{17B} is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, R¹⁸-substituted or unsubstituted alkyl, R¹⁸-substituted or unsubstituted heteroalkyl, R¹⁸-substituted or unsubstituted cycloalkyl, R¹⁸-substituted or unsubstituted heterocycloalkyl, R¹⁸-substituted or unsubstituted aryl, or R¹⁸-substituted or unsubstituted heteroaryl.

[0152] R¹⁸ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, or unsubstituted heteroaryl.

[0153] Further to any compound with structure of Formulae (I), (II) or (III), in embodiments R⁶ is R¹⁶-substituted or unsubstituted alkyl, wherein R¹⁶ is NR^{16A}R^{16B}, R¹⁷-substituted or unsubstituted heterocycloalkyl, R¹⁷-substituted or unsubstituted aryl, R^{16A} and R^{16B} are independently substituted or unsubstituted alkyl, joined together to form a heterocycloalkyl. R¹⁷ is halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHC(O)NHNH₂, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl.

[0154] Further to any compound with structure of Formulae (I), (II) or (III), in embodiments R^1 is substituted or unsubstituted C_1 - C_{10} alkyl. In embodiments, R^1 is substituted or unsubstituted C_1 - C_5 alkyl. In embodiments, R^1 is R^9 -substituted C_2 alkyl and R^9 is methyl.

[0155] In embodiments, the compound of formula (I) has the formula:

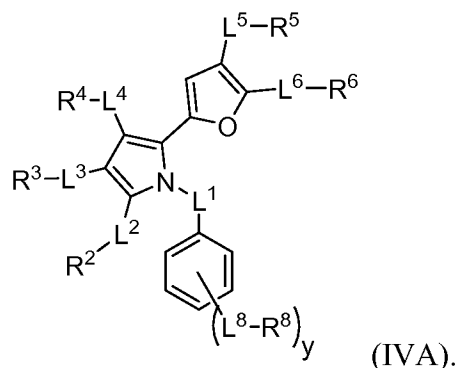


[0156] Regarding Formula (IV), L^8 is independently a bond, $-C(O)-$, $-C(O)O-$, $-OC(O)-$, $-C(O)NR^7-$, $-NR^7C(O)-$, $-O-$, $-S(O)_{n9}-$, $-S(O)NR^7-$, $-NR^7-$, $OR^7OP(O)-$, $NR^7S(O)_2-$, $-(NR^7)NP(O)-$, substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene. The integer $n9$ is 0, 1 or 2 (e.g. 1 or 2). R^8 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-CI_3$, $-CN$, $-CHO$, $=O$, $-OR^{8A}$, $-NR^{8B}R^{8C}$, $-COOR^{8A}$, $-CONR^{8B}R^{8C}$, NO_2 , SR^{8D} , $-SO_{n8}R^{8B}$, $-SO_{n8}OR^{8B}$, $-SO_{n8}NR^{8B}R^{8C}$, $-NHNr^{8B}R^{8C}$, $-ONR^{8B}R^{8C}$, $-NHC(O)NHNr^{8B}R^{8C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^{8A} , R^{8B} , R^{8C} , and R^{8D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. $n8$ is 1, 2, 3, 4, or 5.

[0157] In embodiments, L^1 is a bond, $-S(O)_2-$, or substituted or unsubstituted C_1 - C_5 alkylene.

[0158] In embodiments, L^8 is a bond or substituted or unsubstituted alkylene. In embodiments, L^8 is a bond or substituted or unsubstituted C_1 - C_5 alkylene. In embodiments, R^8 is hydrogen, halogen or substituted or unsubstituted C_1 - C_5 alkyl. In embodiments, R^8 is methyl.

[0159] In embodiments, the compound of formula (I) has the formula:



[0160] In formula (IVA) y is 1-5 and L^1 , L^2 , L^3 , L^4 , L^5 , L^6 , L^8 , R^2 , R^3 , R^4 , R^5 , R^6 and R^8 are defined as described herein. In formula (IVA) $-L^8-R^8$ may occur more than once and be independently different. In embodiments, y is 1, 2, 3, 4 or 5.

5 **[0161]** In embodiments, L^2 and L^3 are independently a bond, or substituted or unsubstituted C_1 - C_5 alkylene.

[0162] Further to any compound with structure of Formula (IV) or (IVA), in embodiments R^2 and R^3 are independently hydrogen or are joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl or
 10 substituted or unsubstituted heteroaryl. In embodiments, wherein R^2 and R^3 are joined together to form an unsubstituted aryl. In embodiments, R^2 and R^3 are joined together to form an unsubstituted phenyl.

[0163] In embodiments, L^4 is a bond or substituted or unsubstituted C_1 - C_5 alkylene.

[0164] In embodiments, R^4 is hydrogen, halogen or substituted or unsubstituted C_1 - C_5 alkyl.

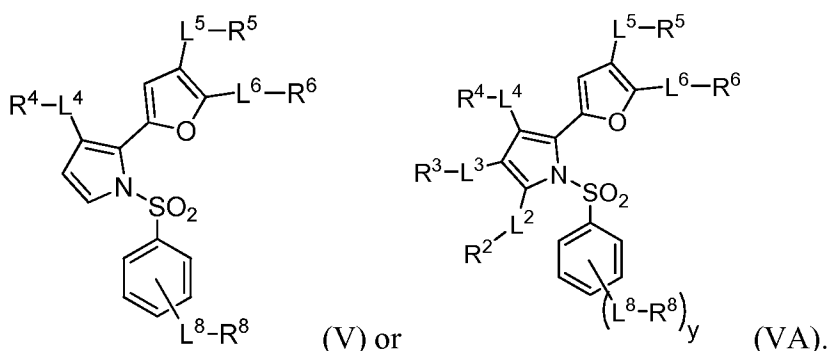
15 In embodiments, R^4 is $-Cl$ or $-Br$.

[0165] In embodiments, L^5 is a bond, $-O-$, substituted or unsubstituted C_1 - C_5 alkylene or substituted or unsubstituted 1-5 membered heteroalkylene.

[0166] In embodiments, R^5 is hydrogen or substituted or unsubstituted C_1 - C_5 alkyl. In embodiments, R^5 is unsubstituted C_1 - C_5 alkyl. In embodiments, R^5 is methyl. In embodiments,
 20 R^5 is substituted C_1 - C_5 alkyl. In embodiments, R^5 is R^{13} -substituted C_1 - C_3 alkyl and R^{13} is substituted or unsubstituted 6 membered heterocycloalkyl or substituted or unsubstituted 6 membered heteroaryl. In embodiments, R^5 is R^{13} -substituted C_1 - C_3 alkyl and R^{13} is unsubstituted morpholinyl or unsubstituted pyridinyl.

[0167] Further to any compound with structure of Formula (IV) or (IVA), in embodiments L⁶ is a bond, -C(O)-, -C(O)O-, -C(O)NR⁷S(O)₂-, or substituted or unsubstituted C₁-C₅ alkylene. In embodiments, R⁶ is -C(O)OR^{6A}, substituted or unsubstituted C₁-C₅ alkyl, substituted or unsubstituted C₁-C₅ heteroalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. In embodiments, R⁶ is -C(O)OR^{6A} and R^{6A} is hydrogen. In embodiments, R⁶ is unsubstituted C₁-C₃ alkyl. In embodiments, R⁶ is methyl. In embodiments, R⁶ is substituted or unsubstituted C₁-C₃ alkyl. In embodiments, R⁶ is R¹⁶-substituted or unsubstituted C₃ alkyl and R¹⁶ is substituted or unsubstituted 6 membered heterocycloalkyl. In embodiments, R⁶ is R¹⁶-substituted or unsubstituted C₁ alkyl and R¹⁶ is substituted or unsubstituted aryl. In
embodiments, R⁶ is R¹⁶-substituted C₁ alkyl, R¹⁶ is R¹⁷-substituted or unsubstituted phenyl and R¹⁷ is -NH₂. In embodiments, R⁶ is R¹⁶-substituted or unsubstituted C₁ alkyl and R¹⁶ is substituted or unsubstituted 6 membered heteroaryl. In embodiments, R⁶ is R¹⁶-substituted C₁ alkyl and R¹⁶ is unsubstituted pyridinyl. In embodiments, R⁶ is R¹⁶-substituted C₁-C₃ heteroalkyl and R¹⁶ is -O or -OH. In embodiments, R⁶ is substituted or unsubstituted 5-8 membered aryl. In
embodiments, R⁶ is R¹⁶-substituted or unsubstituted 5-6 membered aryl and R¹⁶ is hydrogen, halogen, =O, -OH, or substituted or unsubstituted C₁-C₅ alkyl. In embodiments, R⁶ is R¹⁶-substituted or unsubstituted phenyl and R¹⁶ is hydrogen, -OH, halogen or unsubstituted C₁-C₃ alkyl. In embodiments, R⁶ is R¹⁶-substituted or unsubstituted cyclopentadienyl and R¹⁶ is -O or -OH. In embodiments, R⁶ is substituted or unsubstituted 5-8 membered heteroaryl. In
embodiments, R⁶ is unsubstituted triazolyl, tetrazolyl, pyrrolyl, pyridinyl or oxodiazolyl. In embodiments, R⁶ is R¹⁶-substituted 5-8 membered heteroaryl, R¹⁶ is R¹⁷-substituted or unsubstituted 5 membered heteroalkyl and R¹⁷ is =O or methyl. In embodiments, R⁶ is R¹⁶-substituted 5-8 membered heteroaryl, R¹⁶ is R¹⁷-substituted or unsubstituted C₁-C₃ alkyl and R¹⁷ is unsubstituted morpholinyl. In embodiments, R⁶ is R¹⁶-substituted 5-8 membered heteroaryl and R¹⁶ is unsubstituted C₁-C₃ alkyl. In embodiments, R⁶ is R¹⁶-substituted triazolyl, tetrazolyl, pyrrolyl, pyridinyl or oxodiazolyl.

[0168] In embodiments, the compound of formula (I) has the formula:



[0169] Regarding Formula (V) and (VA), L^8 is independently a bond, $-C(O)-$, $-C(O)O-$, $-OC(O)-$, $-C(O)NR^7-$, $-NR^7C(O)-$, $-O-$, $-S(O)_{n9}-$, $-S(O)NR^7-$, $-NR^7-$, $OR^7OP(O)-$, $NR^7S(O)_2-$, $-(NR^7)NP(O)-$, substituted or unsubstituted alkylene, or substituted or unsubstituted

heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene. The variable $n9$ is 0, 1 or 2 (e.g., 1 or 2). R^8 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{8A}$, $-NR^{8B}R^{8C}$, $-COOR^{8A}$, $-CONR^{8B}R^{8C}$, NO_2 , SR^{8D} , $-SO_{n8}R^{8B}$, $-SO_{n8}OR^{8B}$, $-SO_{n8}NR^{8B}R^{8C}$, $-NHNr^{8B}R^{8C}$, $-ONR^{8B}R^{8C}$, $-NHC(O)NHNr^{8B}R^{8C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. R^{8A} , R^{8B} , R^{8C} , and R^{8D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl. $n8$ is 1, 2, 3, 4, or 5. y is 1, 2, 3, 4, or 5.

[0170] In embodiments, R^{1A} , R^{2A} , R^{3A} , R^{4A} , R^{5A} , R^{6A} , R^{1B} , R^{2B} , R^{3B} , R^{4B} , R^{5B} , R^{6B} , R^{1C} , R^{2C} , R^{3C} , R^{4C} , R^{5C} , R^{6C} , R^{1D} , R^{2D} , R^{3D} , R^{4D} , R^{5D} , R^{6D} , R^7 , R^8 , R^{8A} , R^{8B} , R^{8C} , and R^{8D} are independently hydrogen, R^{23} -substituted or unsubstituted alkyl, R^{23} -substituted or unsubstituted heteroalkyl, R^{23} -substituted or unsubstituted cycloalkyl, R^{23} -substituted or unsubstituted heterocycloalkyl, R^{23} -substituted or unsubstituted aryl, or R^{23} -substituted or unsubstituted heteroaryl.

[0171] R^{23} is independently halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, R^{24} -substituted or unsubstituted alkyl, R^{24} -substituted or unsubstituted heteroalkyl, R^{24} -substituted or unsubstituted cycloalkyl, R^{24} -substituted or unsubstituted

heterocycloalkyl, R²⁴-substituted or unsubstituted aryl, or R²⁴-substituted or unsubstituted heteroaryl.

[0172] R²⁴ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃,

5 -NHC(O)NHNH₂, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, or unsubstituted heteroaryl.

[0173] In embodiments, L¹, L², L³, L⁴, L⁵, L⁶, L⁷ and L⁸ are independently a bond, -C(O)-, -C(O)O-, -C(O)NH-, -O-, -S(O)_n-, -S(O)NH-, -C(O)NHS(O)₂-, -NH-, R²⁵-substituted or unsubstituted alkyl, R²⁵-substituted or unsubstituted heteroalkyl, R²⁵-substituted or unsubstituted cycloalkyl, R²⁵-substituted or unsubstituted heterocycloalkyl, R²⁵-substituted or unsubstituted aryl, or R²⁵-substituted or unsubstituted heteroaryl.

[0174] R²⁵ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃,

15 -NHC(O)NHNH₂, R²⁶-substituted or unsubstituted alkyl, R²⁶-substituted or unsubstituted heteroalkyl, R²⁶-substituted or unsubstituted cycloalkyl, R²⁶-substituted or unsubstituted heterocycloalkyl, R²⁶-substituted or unsubstituted aryl, or R²⁶-substituted or unsubstituted heteroaryl.

[0175] R²⁶ is independently halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, =O, -NH₂, -COOH, -CONH₂, -SH, -SO₃H, -SO₄H, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃,

20 -NHC(O)NHNH₂, unsubstituted alkyl, unsubstituted heteroalkyl, unsubstituted cycloalkyl, unsubstituted heterocycloalkyl, unsubstituted aryl, or unsubstituted heteroaryl.

[0176] Further regarding compounds with structure of Formulae (IV), (IVA), (V) or (VA), in embodiments R⁸ is hydrogen, halogen, or substituted or unsubstituted alkyl.

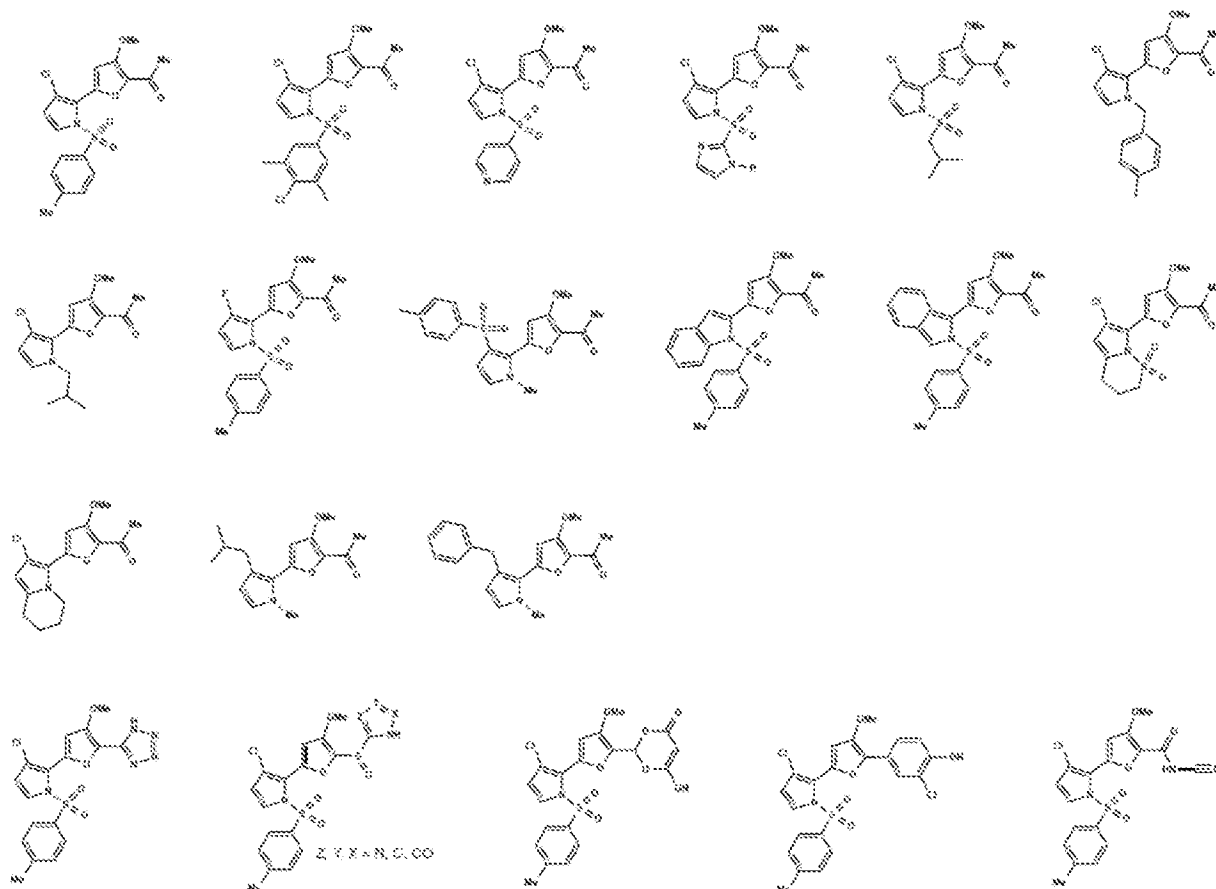
[0177] In another aspect, there is provided a pharmaceutical composition including a

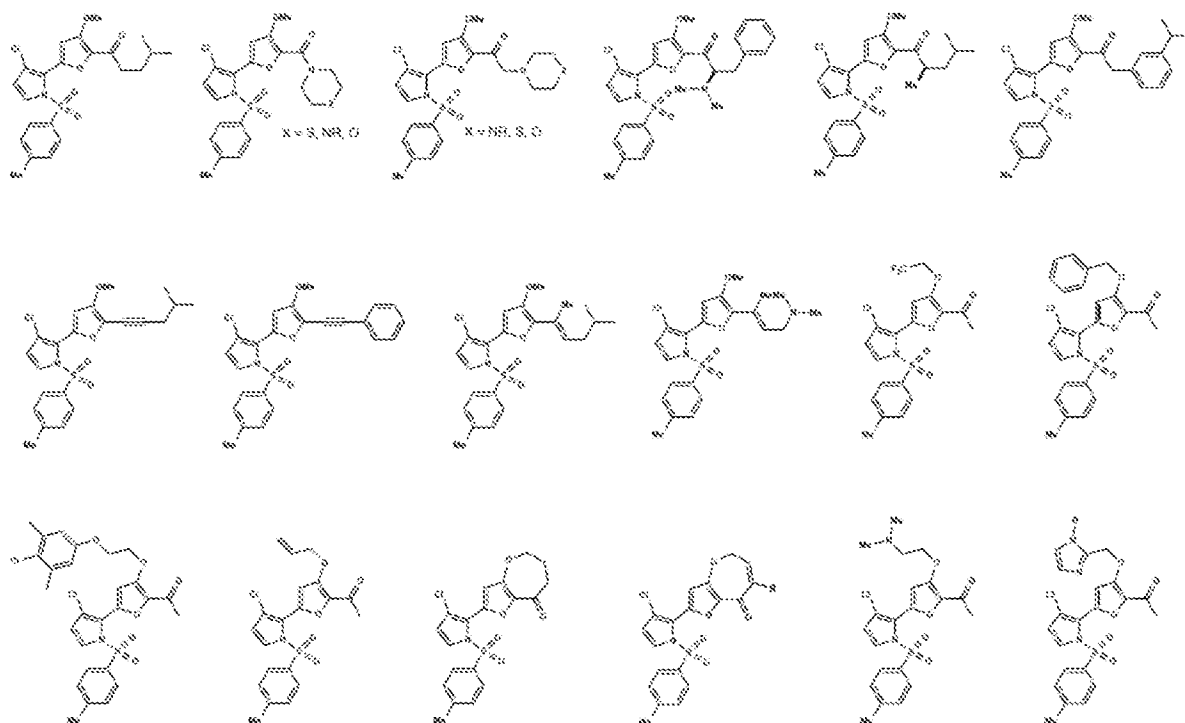
25 compound with structure of any one of Formulae (I), (II), (III), (IV), (IVA), (V) and (VA), or embodiment thereof, and a pharmaceutically acceptable excipient.

[0178] In another aspect, there is provided a method of treating cancer in a subject in need thereof. The method includes administering an effective amount of a compound with structure of any one of Formulae (I), (II), (III), (IV), (IVA), (V) and (VA), or embodiment thereof, to the
30 subject. In embodiments, the cancer is leukemia.

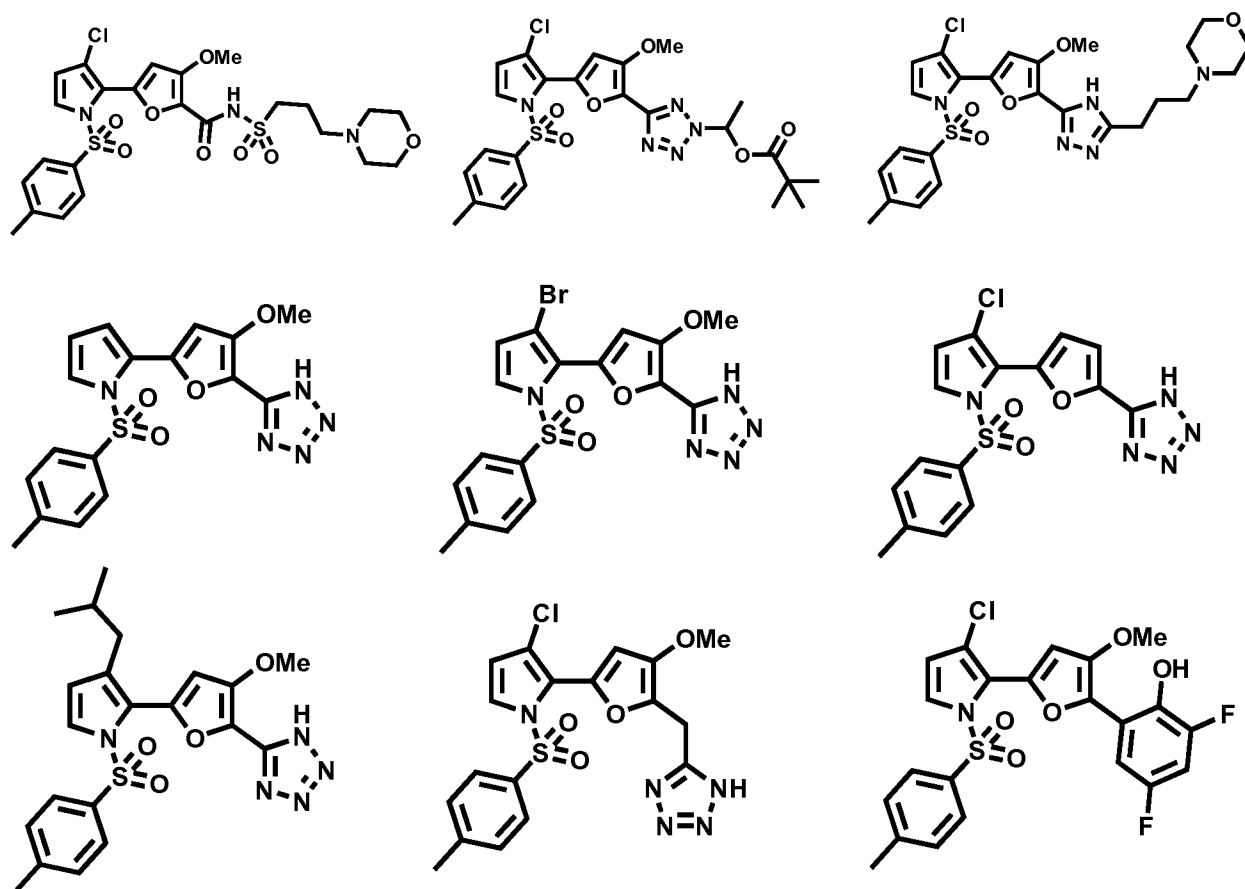
[0179] In another aspect, there is provided a method of antagonizing Mcl-1. The method includes contacting a Mcl-1 mixture with a compound with structure of any one of Formulae (I), (II), (III), (IV), (IVA), (V) and (VA), or embodiment thereof.

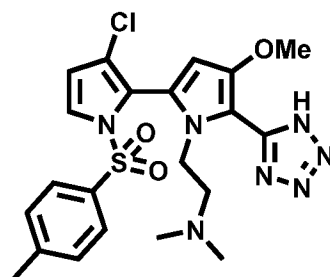
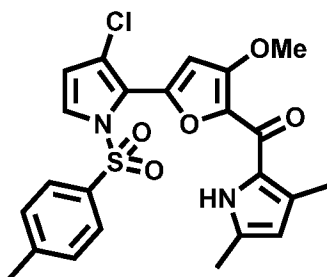
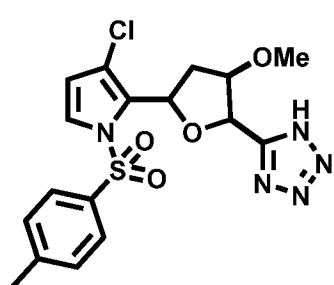
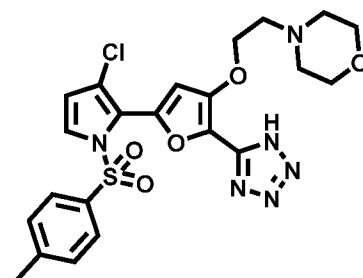
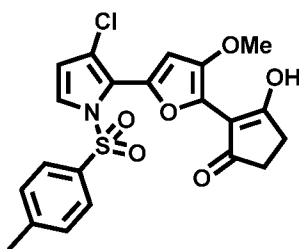
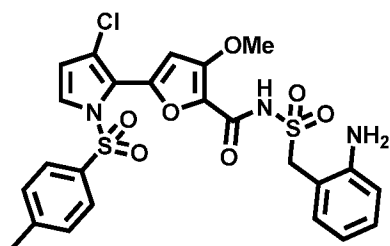
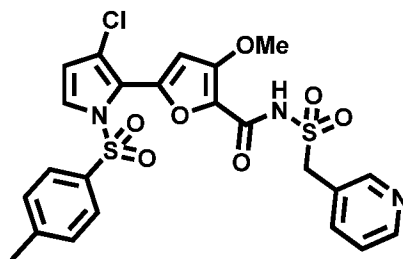
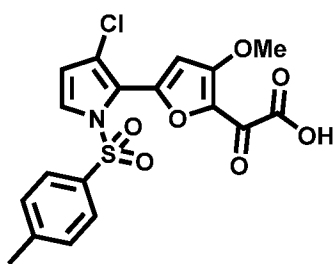
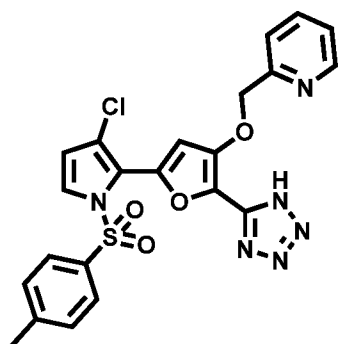
[0180] In embodiments, the compound of formula (I) has the formula:



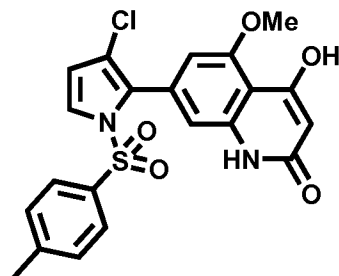
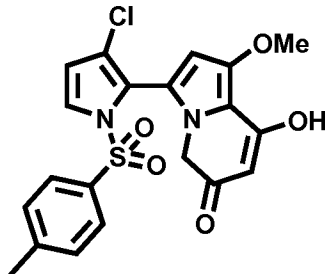
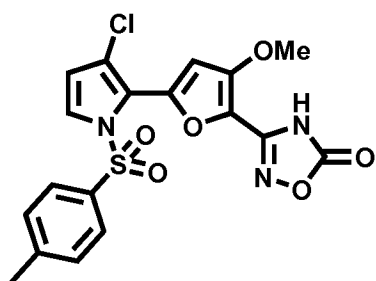
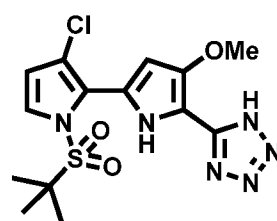
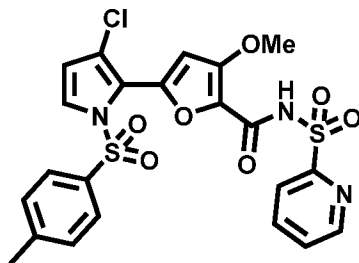
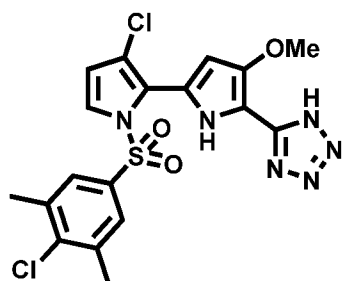


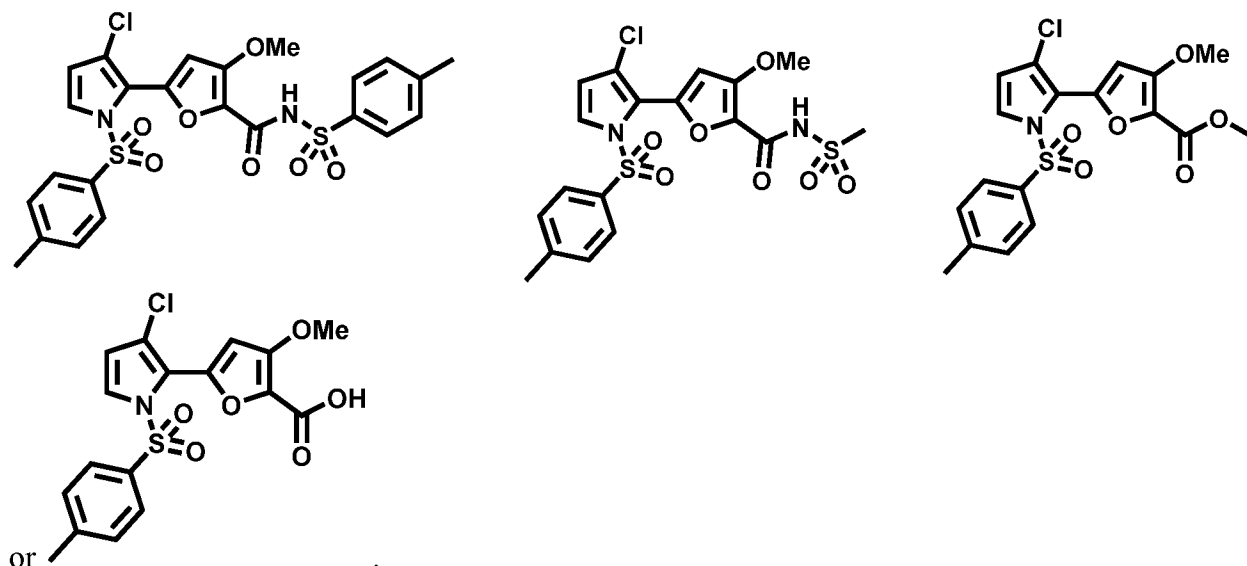
[0181] In embodiments, the compound of Formula (I) has the formula:





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[0182] Also provided herein is a method of treating cancer in a subject in need thereof by administering an effective amount of a compound as described herein (e.g. formula (I), (II), (III), (IV), (IVA), (V) and (VA), including embodiments thereof, to the subject. The cancer is as described herein, including embodiments thereof listed above. In embodiments, the cancer is leukemia.

[0183] Also provided herein are methods of antagonizing Mcl-1, by contacting an Mcl-1 with a compound as described herein (e.g. formula (I), (II), (III), (IV), (IVA), (V) and (VA), including embodiments thereof. In embodiments, the Mcl-1 is within a mixture within a reaction vessel. In other embodiments, the Mcl-1 is within a cell. In other embodiments, the Mcl-1 is within a cell extract.

EXAMPLES:

[0184] Example 1.

[0185] The vast majority of existing cancer chemotherapeutics ultimately kill tumor cells by triggering the intrinsic pathway of apoptosis.⁴ At the cellular level, this proteolytic cascade is controlled by the Bcl-2 family of proteins, which are responsible for perturbing the integrity of the mitochondrial membrane in response to cellular stress.⁵ Bcl-2 proteins are classified as either pro-death or pro-survival, and the balance between these opposing groups regulates intracellular death decisions.⁶ The pro-survival Bcl-2 members (Bcl-2, Bcl-X_L, Bcl-w, Mcl-1, and A1) inhibit the function of multi-domain pro-death Bcl-2 proteins Bak and Bax, which reside on or near the mitochondria. This cytoprotective blockade is regulated through well-characterized protein-protein interactions (PPI's) between four regions of high sequence similarity known Bcl-2

homology (BH1–4) domains.⁷ In response to cellular stress (e.g. DNA damage), transcription of a second group of pro-death Bcl-2 members is activated. These proteins (Bim, Bad, tBid, Puma, and Noxa) share a helical BH3 peptide that functions as exogenous death ligand. Docking of the BH3 helix to a hydrophobic groove on the surface of pro-survival members neutralizes their cytoprotective action. This releases Bax and Bak, which form pores in the mitochondria and initiate apoptosis by releasing apoptogenic factors (e.g. cytochrome *c* and SMAC) into the cytosol that trigger downstream caspase activation.

[0186] Cancer cells have evolved mechanisms to evade intrinsic apoptosis, allowing these damaged cells to gain additional tumorigenic features. The overexpression of pro-survival Bcl-2 members is a critical factor for disease maintenance in many human cancer types.⁸ Elevated levels are correlated with resistance to chemotherapeutic agents and an aggressive malignant phenotype.^{9, 10} These proteins have therefore emerged as highly relevant targets for new cancer therapies; however, effective small-molecule inhibitors have been difficult to develop. The design of pan-Bcl-2 inhibitors is complicated because pro-survival Bcl-2 proteins are divided into two structurally distinct subgroups, one comprising Bcl-2, Bcl-X_L, and Bcl-w, and the other comprising Mcl-1 and A1. Full induction of apoptosis requires the neutralization both subgroups.¹¹ NMR-based structural biology efforts have resulted in the development of the small-molecule Bcl-2/Bcl-X_L inhibitor ABT-737 and its analog ABT-263, which have advanced to human clinical trials.^{12,13} While these compounds have in vivo activity in tumors dependent on Bcl-2 and Bcl-X_L, the overexpression of Mcl-1 serves as a major resistance mechanism.

[0187] Mcl-1 is highly expressed in a variety of tumors and amplification of the *Mcl-1* locus is one of the most frequent somatic genetic events in human cancer.¹⁴ As such, the development of small-molecule Mcl-1 inhibitors has emerged as a vibrant area of cancer research. However, there are no reports of selective Mcl-1 inhibitors that have advanced to clinical trials. Agents with tailored specificity for Mcl-1 would provide finely tuned therapies to treat distinct cancer types while potentially avoiding unwanted side effects, especially when used in combination therapy. In addition, such compounds would serve as invaluable research tools to dissect the differential biological functions of pro-survival proteins through cell biology.

[0188] Applicants recently initiated a program aimed at exploring the capacity of prodiginine natural products to selectively antagonize the Bcl-2 protein-protein contacts that regulate intrinsic apoptosis.¹⁵ In collaboration with Prof. Gordon Shore at the Morris Goodman Cancer Research Center (McGill University, Canada), Applicants have developed a synthetic small-

molecule with the capacity to antagonize the Mcl-1/Bak PPI in a cell-free functional assay. This lead structure, herein referred to JHF3056, is cytotoxic at micromolar concentrations to human myeloid leukemia cells (KMS-11) in which cell survival is dependent on Mcl-1 overexpression. This compelling in vitro data directly translates to anti-tumor activity in vitro. JHF3056 is non-toxic at pharmacologically relevant doses (minimum toxic dose = 80 mg/Kg) and sensitizes lymphoma tumor xenografts to doxorubicin in an isogenic mouse model. Taken together, these preliminary data suggest that JHF3056 and related structures are potential Mcl-1 inhibitors with direct and immediate application to human cancer. Specifically, JHF3056 has application as treatment for human breast and non-small cell lung cancer carcinomas, where Bcl-X_L is expressed at low-levels and Mcl-1 overexpression is required for disease maintenance.¹⁶

[0189] Despite the challenge of designing a small-molecule that targets the extend protein-protein interfaces involved in antagonism of pro-survival Bcl-2 proteins, efficacious BH3 mimetics can be developed. The prototype small molecule ABT-737 (**1**) and its orally available analog ABT-263 (**2**) represent the best extant examples of small-molecules that mimetic the BH3 α -helix (Fig. 1). These compounds, modeled after the BH3 peptide of Bim, were designed using NMR structure-based methods at Abbott and Genentech. ABT-737 inhibits Bcl-2, Bcl-X_L, and Bcl-w, at nanomolar concentrations. The X-ray structure of **1** in complex with Bcl-X_L highlights the binding of this mimetic to the hydrophobic groove of Bcl-X_L. As a result, **1** induces apoptosis in select cancer types driven by overexpression of these proteins. This seminal work has driven the recent structure-based design of related BH3 mimetics **3** and **4**, which also exhibit strong antitumor activity *in vivo* against cancers where Bcl-2/Bcl-X_L are overexpressed. The preclinical success of **1–4** provides strong proof-of-concept for further development in this area.

[0190] One important limitation of mimetics **1–4** is their inability to engage Mcl-1.¹⁷ Consequently, **1–4** are not broadly cytotoxic as a single agents and exhibit poor activity in cancer types with high endogenous levels of Mcl-1.¹⁸ Although the development of Mcl-1 inhibitors has been of considerable interest, efficacious small molecules have not entered the clinic. Walensky and colleagues have reported that ‘stapled’ Mcl-1 BH3 peptides are effective Mcl-1 inhibitors in preclinical trials. Several other small-molecules that reportedly inhibit Mcl-1 have been described. Cohen and coworkers have shown that among them only **2**, BI-97C1 (**5**), MIM-1 (**6**), and TW-37 (**7**) are able to target Mcl-1 and induce apoptosis via the intrinsic pathway in vitro (Fig. 1). Very recently, Fesik and coworkers have reported that small-molecule **8** has potent affinity for recombinant Mcl-1 in vitro. An X-ray crystal structure of this compound in complex with Mcl-1 is reported, however, no preclinical cellular data is available.

[0191] The most successful extant small-molecule antagonist of Mcl-1 in vivo is obatoclax (9). This pan-Bcl-2 inhibitor advanced to human clinical trials and is able to overcome Mcl-1-mediated resistance to apoptosis in cancer cell lines where ABT-737 (1) is ineffective.

Unfortunately, this compound also exhibits off mechanism cytotoxicity and has been shown to trigger apoptosis in the cells where the genes for *Bax* and *Bak* have been genetically deleted. Thus, obatoclax does not exclusively function as a Mcl-1 antagonist in vivo

[0192] JHF3056 (10) is a synthetic small-molecule derived from the heterocyclic side-chain of (+)-roseophilin. This bioactive substance directly antagonizes Mcl-1 in a functional assay and exhibits sub-micromolar cytotoxicity to human cancer cells dependent on Mcl-1 overexpression for survival. Moreover, we've evaluated 10 in a leukemia mouse model. Applicants' compound exhibits clear anti-tumor activity in combination with the chemotherapeutic doxorubicin in vivo. Key data and comparison of 10 relative to existing lead Mcl-1 inhibitors 8 and 9 is summarized below.

[0193] **In vitro data.** In vitro data for JHF3056 (10) in a liposome assay and in cell culture is summarized in Figure 2. The Shore lab has developed a functional assay utilizing recombinant proteins anchored in artificial liposomes that enables the evaluation of small-molecules to disrupt the Mcl-1/Bak PPI (Fig. 2A). In this assay, full-length functional single cysteine mutants of Mcl-1 and Bak were anchored into lipids (with PE's) utilizing the engineered cysteine residues as a handle. This allows Applicants to recapitulate Bak-mediated mitochondrial permeabilization and measure the various protein-protein and protein-membrane interactions involved in Mcl-1 regulation of Bak. The release of calcein (Cn) dye encapsulated in the liposome was used to quantify membrane permeabilization. When the system is untreated, Mcl-1 sequesters Bak by engaging its BH3 domain. Incubation with an active inhibitor neutralizes Mcl-1. This triggers Bak auto-oligomerization resulting in the formation of pores in the lipid membrane and release of Cn. By measuring UV emission from Cn, Applicants can quantify antagonism of Mcl-1 in real time.

[0194] Compound 10 exhibits promising activity in this functional assay. To gauge its performance, Applicants compared results using 10 to Fesik's compound 8 and obatoclax (9). The superior performance of JHF3056 (10) relative to 8 and 9, two of the most promising Mcl-1 inhibitors reported to date, is apparent. Based on these results, Applicants evaluated the cytotoxicity of 10 in cell culture against human KMS-11 myeloid leukemia cells, which require overexpression of Mcl-1 for survival. Compound 10 exhibits sub-micromolar single dose

cytotoxicity against this cell line. Moreover, **10** shows enhanced activity relative to obatoclax (**9**) at 1.0 μ M concentration. Reported Mcl-1 inhibitor **8** was inactive at all concentrations tested. This finding is significant because obatoclax has advanced to phase 2 human clinical trials as combination therapy for human leukemia. Importantly, JHF3056 (**10**) is a stable solid with promising drug-like properties and lacks the structural liabilities that contribute to off-mechanism cytotoxicity with **9**.

[0195] In vivo data. C57BL/6 mice were tail-vein injected with E μ -myc (myr) Akt lymphoma cells and palpable tumors (multiple sites per animal) allowed to develop. Animals were randomized for tumor burden and treated by intraperitoneal (IP) injection with vehicle, or vehicle containing obatoclax (10 mg/kg) or JHF3056 (40 mg/kg) daily x 5. In addition, animals received a single injection of doxorubicin (IP, 10 mg/kg) on day 2 of the injection regimen, either alone or in combination with the obatoclax (**9**) or JHF3056 (**10**) regimen. Animals were allowed to become tumor-free (no observable palpable tumors) and then tumor-free survival was measured (time to re-appearance of tumors). Data for these experiments are summarized in Figure 3.

[0196] Mcl-1 inhibitor JHF3056 (**10**) is prepared in three steps from known pyrrolylfuran **11** as summarized in Scheme 1.19 Applicants' group has recently published a convenient, five-step synthesis of **11**, which allows this heterocycle to be accessed on gram-scale (Frederich, J. H.; Matsui, J. K.; Chang, R. O.; Harran, P. G. *Tetrahedron Lett.* **2013**, 2645). To prepare **10**, methoxy furan **11** is deprotonated at -78°C using *n*-BuLi, treated with acetic anhydride, and warmed to room temperature. This sequence affords ketone **12** in 76% yield. The terminal heterocycle is then deprotected by exposing **12** to anhydrous TBAF to furnish pyrrole **13** in excellent yield. Reacting this material with tosyl chloride, Hunig's base, and catalytic DMAP generates JHF3056 (**10**) in 64% yield. This route has been utilized to prepare **10** in gram quantities and is sufficiently flexible to incorporate substituents at multiple points around the periphery of this heterocyclic pharmacophore.

[0197] 1-(5-(3-chloro-1-(triisopropylsilyl)-1H-pyrrol-2-yl)-3-methoxyfuran-2-yl)ethan-1-one (12**).** A solution of **11** (2.25 g, 6.36 mmol) in THF (30 mL) was cooled to -78°C and treated with a 1.6 M solution of *n*-BuLi in THF (4.4 mL, 7.0 mmol). After 30 min at -78°C , the reaction mixture was treated with freshly distilled Ac₂O (1.8 mL, 19.1 mmol). The resultant green solution was maintained at -78°C for 1 h then warmed to rt and maintained for 3 h. The reaction was quenched with 5 mL of saturated aq. NaHCO₃ and diluted with H₂O (50 mL). The

organic layer was separated and the aqueous wash was extracted with EtOAc (3 x 25 mL). The combined organic extracts were dried over MgSO₄ and concentrated. Purification by flash chromatography (SiO₂, 20:1 hexanes/EtOAc) afforded **12** (1.91 g, 4.83 mmol, 76%) as a yellow solid: ¹H NMR (400 MHz, CDCl₃) δ: 6.95 (d, *J* = 3.0, 1H), 6.64 (s, 1H), 6.33 (d, *J* = 3.0, 1H), 4.00 (s, 3H), 2.41 (s, 3H), 1.58 (sep, *J* = 7.5, 3H), 1.10 (d, *J* = 7.5, 18H).

[0198] 1-(5-(3-chloro-1*H*-pyrrol-2-yl)-3-methoxyfuran-2-yl)ethan-1-one (13). A solution of **12** (1.66 g, 4.19 mmol) in THF (20 mL) was treated with a 1.0 M solution of anhydrous TBAF in THF (8.4 mL, 8.4 mmol) at room temperature. After 30 min, the reaction was quenched with saturated aq. NaHCO₃ (25 mL). The organic material was separated and the aqueous layer was washed with EtOAc (3 x 25 mL). The combined organic extracts were dried over MgSO₄ and concentrated. Purification by flash chromatography (SiO₂, 1:1 hexanes/EtOAc) afforded **13** (964 mg, 4.02 mmol, 96%) as a colorless solid: ¹H NMR (400 MHz, CDCl₃) δ: 9.63 (br s, 1H), 6.83 (dd, *J* = 3.4, 2.9, 1H), 6.72 (s, 1H), 6.25 (dd, 3.4, 2.9, 1H), 4.00 (s, 3H), 2.43 (s, 3H).

[0199] 1-(5-(3-chloro-1-tosyl-1*H*-pyrrol-2-yl)-3-methoxyfuran-2-yl)ethan-1-one (10). A solution of **13** (871 mg, 3.63 mmol) and *i*-Pr₂NEt (0.82 mL, 4.00 mmol) in DCE/MeCN (5:1, 40 mL) was treated with TsCl (761 mg, 4.72 mmol) in a single portion. The reaction was stirred at rt for 5 min, then treated with DMAP (50 mg, 0.40 mmol) in a single portion. The resulting dark solution was maintained at room temperature. After 18 h, the mixture was treated with saturated aq. NaHCO₃ (100 mL) and rapidly stirred for 30 min. The organic material was partitioned by adding H₂O (50 mL) and separated. The aqueous layer was extracted with EtOAc (3 x 100 mL). The combined organic extracts were dried over MgSO₄ and concentrated. Purification by flash chromatography (SiO₂, 3:1 hexanes/EtOAc) afforded **10** (912 mg, 2.32 mmol, 64%) as a pale yellow solid: ¹H NMR (400 MHz, CDCl₃) δ: 7.38 (d, *J* = 8.2, 2H), 7.43 (d, *J* = 3.5, 1H), 7.37 (d, *J* = 8.2, 2H), 6.62 (s, 1H), 6.33 (d, *J* = 3.5, 1H), 3.99 (s, 3H), 2.43 (s, 3H), 2.42 (s, 3H).

[0200] References (Example 1)

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- 25 [0232] *Example 2. Tailored fragments of roseophilin selectively antagonize Mcl-1 in vitro*
- [0233] Compound numbering and references for Example 2 are local to Example 2, to the extent that any compound numbering or references differ from those provided elsewhere herein.
- [0234] Applicants have discovered a fragment of the natural product roseophilin, a member of the prodiginine family, that antagonizes Mcl-1 functions in a liposome-based assay for

mitochondrial membrane permeabilization. By tailoring this substance such that it can participate in salt bridging with the protein surface, Applicants have prepared the first prodiginine inspired structure that shows direct, saturable binding to a recombinant Bcl-2 family member *in vitro*.

[0235] Applicants' laboratory is interested in small molecule mimics of regulatory proteins.

5 Compounds that can restore apoptotic signaling in cancer cells are a particular focus. Applicants described the first Smac mimetics in 2004.¹ Those molecules subsequently helped identify compounds that activate the TRAIL receptor.² The TRAIL / Smac mimetic combination selectively stimulates apoptosis by de-repressing caspase activities.³ Attention has recently shifted to a second mechanism that results in apoptosis being suppressed in cancer; namely, the
10 failed release of pro-apoptotic factors (including Smac) from the outer membrane space of mitochondria as gated by Bcl-2 proteins. Pro-survival Bcl-2 proteins prevent pore formations in the mitochondrial membrane needed to propagate apoptosis. Bcl-2 activities are countered by interactions with 'BH3-only' regulatory proteins – which involve key α -helix / domain interactions. These contacts have been studied intensely for two decades.⁴ Early screens by one
15 of Applicants (GCS) identified the bacterial pigment streptorubin B (**1**, Figure 6) as an inhibitor of the Bcl-2 / Bax interaction.⁵ This discovery led to the development of obatoclax (**2**), a simplified indolic variant of **1** that entered human clinical trials as a pan Bcl-2 antagonist.⁶ In functional settings, obatoclax promotes apoptosis by countering activities of anti-apoptotic Bcl-2 family members, including myeloid cell leukemia protein 1 (Mcl-1). Mcl-1 based resistance has
20 limited other Bcl-2 inhibitor programs.⁷

[0236] Obatoclax is a valuable structure, but it does have liabilities. Its pyrrolylpyrromethene core can generate reactive oxygen species when bound by copper⁸ and, in protonated form, it can function as a chloride ion symporter.⁹ In an attempt to identify variants of **2** lacking these activities, Applicants looked to Applicants' recent synthesis of roseophilin (**3**)¹⁰ for candidates.
25 The heterocyclic domain of **3** harbors a furan in place of the central pyrrole present in **1** and **2**. Applicants anticipated the coordination chemistries of roseophilin-type substances would differ markedly from obatoclax.

[0237] Synthetic **3**, along with numerous intermediates and their derivatives were assayed in a model system for mitochondrial outer membrane permeabilization (MOMP). This liposome
30 based experiment recapitulates a signaling axis involving pro-apoptotic Bak, anti-apoptotic Mcl-1, and an active, truncated 15 kDa subunit of the pro-death protein Bid (tBid).¹¹ Bak and Mcl-1 are transmembrane proteins constitutively anchored in the mitochondrial outer membrane. tBid

translocates to mitochondria upon cleavage of Bid by caspase-8 and stimulates MOMP by directly activating free Bak and by disengaging any activated Bak from Mcl-1. Applicants' assay mimics these events using recombinant, lipidated Mcl-1 and Bak that are constitutively bound to unilamellar liposomes encapsulating calcein dye. tBid addition initiates Bak homo oligomerization and pore formations, which in turn results in calcein release and a fluorescence signal. Mcl-1 counters this tBid dependent activation of Bak, which is overcome by small molecule Mcl-1 antagonists (Figure 6).

[0238] The majority of compounds Applicants screened in this assay behaved like roseophilin itself. Namely, they showed little activity. However, an N-tosylated derivative of the pyrrolylfuran segment of the natural product did function in this format. At 2 μ M concentrations (vs. 0.4 μ M Mcl-1 in liposomes), compound **4** caused calcein release at a rate approaching that of obatoclox (data not shown). Additional experiments with **4** were complicated by its limited stability. However, acetylated variant **5** was a bench stable solid (m.p. = 162–165 °C) that was near equipotent to **4** in the liposome assay (Figure 6).¹³

[0239] An intriguing characteristic of obatoclox was that it blocked functions of Mcl-1 and other anti-apoptotic Bcl-2 proteins in membrane environments, yet showed limited/variable affinity for those proteins in isolation.¹⁴ Applicants asked whether this was also true of **5**. Recombinant Mcl-1 was expressed and purified from *E. coli*. Applicants synthesized a 21-residue helical peptide from the BH3 domain of Mcl-1 and used that oligomer as a positive control for isothermal titration microcalorimetry (ITC) experiments.¹² Neither **2** nor **5** demonstrated measurable affinity for Mcl-1 by ITC (Figure 7). Compound **5** did not induce release of calcein from liposomes lacking Mcl-1, suggesting its effects were not derived from interactions with Bak. Likewise, the compound showed no binding to truncated Bid (data not shown) – prepared by cleaving the full-length protein with TEV protease.¹⁵ Like obatoclox, the functional attributes of **5** were not easily traceable to a binding event with isolated protein.

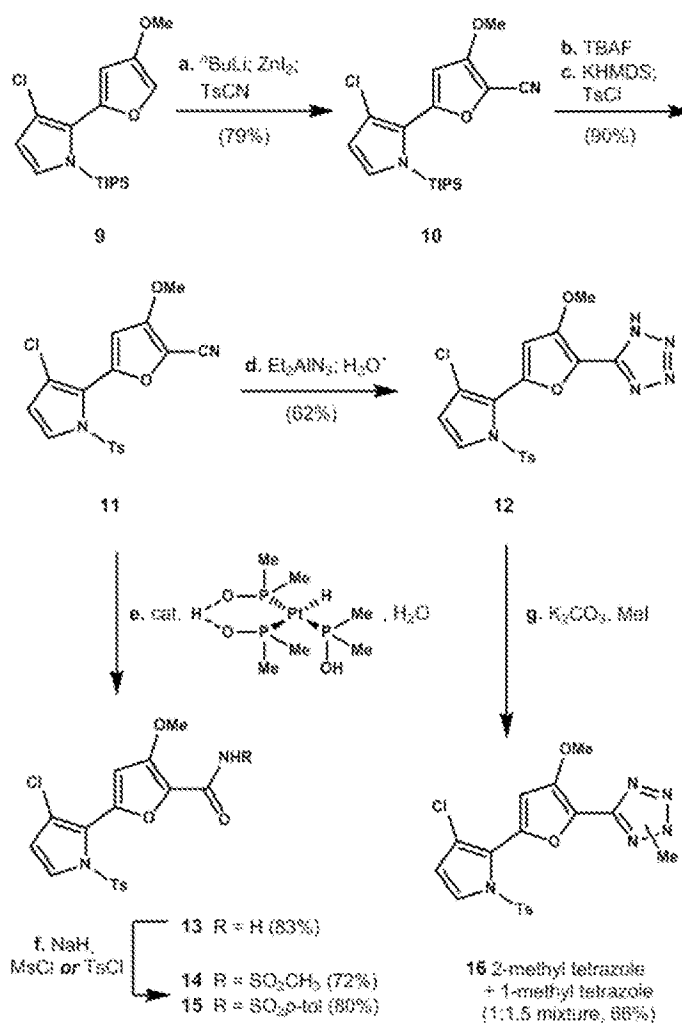
[0240] In 2013 Fesik reported a small molecule having quantifiable affinity for purified Mcl-1.¹⁶ Benzothiophene carboxylate **7** (Figure 8A) was identified using Fesik's seminal fragment-based discovery methods.¹⁷ X-ray co-crystallography showed the compound inserted into a binding pocket beneath the groove used by BH3 helical peptides to bind at the Mcl-1 surface (Figure 8C). Its carboxylic acid lay at the mouth of this pocket and formed a salt-bridge with R263 – an interaction normally made from the opposite direction by a conserved aspartic acid residue in BH3 peptides (see protein data bank entry 4HW4).

[0241] While benzothiophene **7** and acetyl furan **5** were discovered independently using completely different lines of inquiry, the resemblance of key elements in the structures was uncanny. In the Mcl-1 bound conformation of **7**, the distance between the carboxylate carbon and the center of the chlorodimethylphenoxy substituent was 8.4 Å. Applicants could dock compound **5** into the same space occupied on Mcl-1 by **7** without unfavorable steric interactions (using AutoDock Vina).¹⁸ In the docked conformation of **5**, wherein the carbonyl oxygen was in closest proximity to R263, the distance between the carbonyl carbon and the center of the tolyl group was 8.3 Å. Applicants also observed that primary alcohol **8**, derived from reducing carboxylic acid **7** with LiAlH₄, no longer had affinity for Mcl-1 measurable by ITC (Figure 8B). This suggested that salt bridging was a critical aspect of the **7** / Mcl-1 interaction and that giving **5** the ability to interact with the protein similarly may be advantageous. Based on the docking experiments above, Applicants chose to replace the methyl ketone in **5** with a carboxylic acid isostere – hoping to increase its affinity for Mcl-1 in the absence of membranes.

[0242] Applicants metalated pyrrolofuran **9**¹⁹ selectively at its 5' position with *n*-butyl lithium. Treatment of the lithiated species with ZnI₂ followed by tosylcyanide gave furanylnitrile **10** in 79% yield.²⁰

[0243] Desilylation of **10** and derivatization with *p*-TsCl afforded **11** in high yield. To complete the target isostere, azide was cycloadded to the nitrile in **11** using diethylaluminum azide.²¹ This provided furanyl tetrazole **12** after careful workup with a Na₂HPO₄/H₃PO₄ buffer solution (pH = 2.1).²² The overall yield of **12** from **9** was 33% (Scheme 1). A mixture of regioisomeric *N*-methyl tetrazoles **16**, which are unable to ionize via proton transfer, were prepared as controls.²³

[0244] **Scheme 1.** Reagents and conditions: (a) n -BuLi, THF, $-78\text{ }^{\circ}\text{C}$, 15 min; ZnI_2 , $0\text{ }^{\circ}\text{C}$, 3 min; TsCN, $-78\text{ }^{\circ}\text{C}$ to rt, 3 h, 79%; (b) TBAF, THF, rt, 10 min; (c) KHMDS, THF, $0\text{ }^{\circ}\text{C}$, 15 min; TsCl, $0\text{ }^{\circ}\text{C}$ to rt, 1 h, 90% (two steps); (d) Et_2AlN_3 , PhMe, $85\text{ }^{\circ}\text{C}$, 24 h; H_3O^+ , rt, 30 min, 62%; (e) 20 mol % Parkin's catalyst, H_2O , $100\text{ }^{\circ}\text{C}$, 8 h, 83%; (f) NaH, MsCl, THF, $0\text{ }^{\circ}\text{C}$ to rt, 3 h, 72%; or NaH, TsCl, THF, $0\text{ }^{\circ}\text{C}$ to rt, 3 h, 80%; (g) K_2CO_3 , MeI, MeCN/THF (1:1), $0\text{ }^{\circ}\text{C}$ to rt, 5 h, 66%.



[0245] Tetrazoles 12 and 16 were tested for specific binding to Mcl-1 using ITC. To

Applicants' delight, compound 12 showed strong, saturable binding to the protein, whereas its N-methylated congeners 16 did not (Figure 9A). Compound 12 bound Mcl-1 in an apparent 1:1 stoichiometry with $K_D = 0.7\text{ }\mu\text{M}$. There was no indication of solubility differences in ITC buffer that would account for its improved performance relative to 5 and 16.

[0246] Compound 12 also successfully drove pore formations in the artificial membranes of Applicants' liposomal assay (Figure 9B). Its activity exceeded that of 5 and obatoclax and was Mcl-1 dependent. Bak loaded proteoliposomes lacking Mcl-1 did not release calcein dye when

treated with **12**. Moreover, when Mcl-1 was replaced with Bcl-xL in the assay, **12** also had no effect (Figure 10). This suggested a selectivity for Mcl-1 over Bcl-xL which could be of value going forward. Toxic thrombocytopenia caused by ABT-737 *in vivo* has been correlated with Bcl-xL inhibition.²⁵

5 [0247] The discovery of Mcl-1 antagonist **5** and a rational means to convert that molecule into a prodigine-like structure (i.e. **12**) having specific affinity for purified Mcl-1 holds considerable promise. Inhibition of anti-apoptotic Bcl-2 proteins by obatoclax is thought dependent on a supporting membrane environment. This could be true for **5** as well wherein its activity in liposomes (Figure 6) may be driven by hydrophobic effects. In contrast, data for the **12** / Mcl-1
10 interaction suggests a significant electrostatic component. Consistent with this idea, comparably performing Mcl-1 ligands could be generated using ionizable groups other than a tetrazole. Applicants synthesized N-acyl sulfonamides **14** and **15** via primary carboxamide **13** as outlined in Scheme 1.^{26,27} Both **14** and **15** functioned in the liposomal assay and bound to recombinant Mcl-1 *in vitro* (Figure 9C). While their affinity for the purified protein ($K_D = 3.4$ and $2.3 \mu\text{M}$
15 respectively) was less than that for **12**, these derivatives are amenable to further medicinal chemistry. Applicants are currently attempting to confirm hypothetical binding modes for **12** (Figure 8D), **14** and/or **15** using X-ray co-crystallography.

[0248] **References** (Example 2):

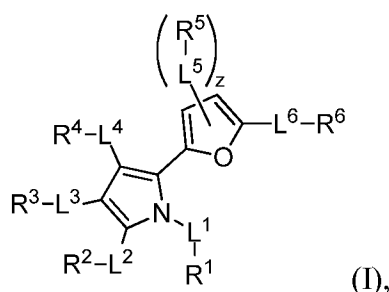
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25 Chem. Eur. J. 2011, 17, 14074–14083; [10]. Frederich, J. H. & Harran, P. G. J. Am. Chem. Soc. 2013, 135, 3788–3791; [11]. Ruffolo, S. C. & Shore, G. C. J. Biol. Chem. 2003, 278, 25039–25045; [12]. Stewart, M. L., et al., Nat. Chem. Biol. 2010, 6, 595–601; [13]. As a neat oil, pyrrolofuran 4 would degrade to a deep purple mixture of, as yet unidentified, products within hours at room temperature. Acetylation blocked this process. For details of the preparation see:
30 Harran, P. G., et al., US Provisional Patent Application No. 61/947,211. Filed March 3, 2014; [14]. Nguyen, M., et al., PNAS 2007, 104, 19512–19517; [15]. Wang, Y. & Tjandra, N. J. Biol. Chem. 2013, 288, 35840–35851; [16]. Friberg, A., et al., J. Med. Chem. 2013, 56, 15–30;

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10 [0250] Embodiments

[0251] Embodiments disclosed herein include the following:

[0252] Embodiment 1. A compound having the formula:



(I),

wherein, L¹, L², L³, L⁴, L⁵, and L⁶ are independently a bond, -C(O)-, -C(O)O-, -C(O)NR⁷-, -O-,
 15 -S(O)_n-, -S(O)NR⁷-, -C(O)NR⁷S(O)₂-, -NR⁷-, substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene; R⁷ is independently hydrogen, halogen, -N₃, -NO₂, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -OH, -NH₂, -COOH, -CONH₂, -NO₂, -SH, -SO₂Cl, -SO₃H, -
 20 SO₂Ph, -SO₂NH₂, -NHNH₂, -ONH₂, -OCH₃, -NHCNHNH₂, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; n is 0, 1, or 2; R¹ is hydrogen, halogen, -N₃, -CF₃, -CCl₃, -CBr₃, -Cl₃, -CN, -CHO, =O, -OR^{1A}, -NR^{1B}R^{1C}, -COOR^{1A}, -CONR^{1B}R^{1C}, -NO₂, -SR^{1D}, -SO_{n1}R^{1B}, -S(O)_{n1}OR^{1B},
 25 -S(O)_{n1}NR^{1B}R^{1C}, -NHNR^{1B}R^{1C}, -ONR^{1B}R^{1C}, -NHC(O)NHNR^{1B}R^{1C}, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or

unsubstituted heteroaryl, wherein R^1 and R^2 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; R^2 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{2A}$, $-NR^{2B}R^{2C}$, $-COOR^{2A}$, $-CONR^{2B}R^{2C}$, NO_2 , SR^{2D} , $-SO_{n2}R^{2B}$, $-SO_{n2}OR^{2B}$, $-SO_{n2}NR^{2B}R^{2C}$, $-NHN R^{2B}R^{2C}$, $-ONR^{2B}R^{2C}$, $-NHC(O)NHN R^{2B}R^{2C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^2 and R^3 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; R^3 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{3A}$, $-NR^{3B}R^{3C}$, $-COOR^{3A}$, $-CONR^{3B}R^{3C}$, NO_2 , SR^{3D} , $-SO_{n3}R^{3B}$, $-SO_{n3}OR^{3B}$, $-SO_{n3}NR^{3B}R^{3C}$, $-NHN R^{3B}R^{3C}$, $-ONR^{3B}R^{3C}$, $-NHC(O)NHN R^{3B}R^{3C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^3 and R^4 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; R^4 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{4A}$, $-NR^{4B}R^{4C}$, $-COOR^{4A}$, $-CONR^{4B}R^{4C}$, NO_2 , SR^{4D} , $-SO_{n4}R^{4B}$, $-SO_{n4}OR^{4B}$, $-SO_{n4}NR^{4B}R^{4C}$, $-NHN R^{4B}R^{4C}$, $-ONR^{4B}R^{4C}$, $-NHC(O)NHN R^{4B}R^{4C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; R^5 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{5A}$, $-NR^{5B}R^{5C}$, $-COOR^{5A}$, $-CONR^{5B}R^{5C}$, NO_2 , SR^{5D} , $-SO_{n5}R^{5B}$, $-SO_{n5}OR^{5B}$, $-SO_{n5}NR^{5B}R^{5C}$, $-NHN R^{5B}R^{5C}$, $-ONR^{5B}R^{5C}$, $-NHC(O)NHN R^{5B}R^{5C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^5 and R^6 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; R^6 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{6A}$, $-NR^{6B}R^{6C}$, $-COOR^{6A}$, $-CONR^{6B}R^{6C}$, NO_2 , SR^{6D} , $-SO_{n6}R^{6B}$, $-SO_{n6}OR^{6B}$, $-SO_{n6}NR^{6B}R^{6C}$, $-NHN R^{6B}R^{6C}$, $-ONR^{6B}R^{6C}$, $-NHC(O)NHN R^{6B}R^{6C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or

unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; R^{1A} , R^{2A} , R^{3A} , R^{4A} , R^{5A} , R^{6A} , R^{1B} , R^{2B} , R^{3B} , R^{4B} , R^{5B} , R^{6B} , R^{1C} , R^{2C} , R^{3C} , R^{4C} , R^{5C} , R^{6C} , R^{1D} , R^{2D} , R^{3D} , R^{4D} , R^{5D} , and R^{6D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted

- 5 heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^{6B} and R^{6C} are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; n_1 , n_2 , n_3 , n_4 , n_5 , and n_6 are independently 1 or 2; and z is 1 or 2.

[0253] Embodiment 2. The compound of embodiment 1 wherein L^1 is a bond, $-S(O)_2-$, or substituted or unsubstituted alkylene.

[0254] Embodiment 3. The compound of any one of embodiments 1 to 2, wherein L^1 is a bond, or $-S(O)_2-$.

- 15 **[0255]** Embodiment 4. The compound of any one of embodiments 1 to 3, wherein L^2 and L^3 are independently a bond or substituted or unsubstituted alkylene.

[0256] Embodiment 5. The compound of any one of embodiments 1 to 4, wherein L^2 and L^3 are a bond.

- 20 **[0257]** Embodiment 6. The compound of any one of embodiments 1 to 5, wherein L^4 is a bond, $S(O)_2-$, or substituted or unsubstituted alkylene.

[0258] Embodiment 7. The compound of any one of embodiments 1 to 6, wherein L^4 is a bond or $S(O)_2-$.

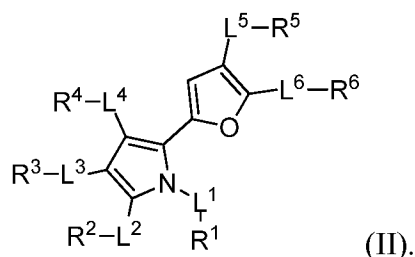
[0259] Embodiment 8. The compound of any one of embodiments 1 to 7, wherein L^5 is a bond, $-O-$, or substituted or unsubstituted alkylene.

- 25 **[0260]** Embodiment 9. The compound of any one of embodiments 1 to 8, wherein L^5 is a bond or $-O-$.

[0261] Embodiment 10. The compound of any one of embodiments 1 to 9, wherein L^6 is a bond, $-C(O)-$, $-C(O)NR^7$, $-S(O)_2-$, or substituted or unsubstituted alkylene.

- 30 **[0262]** Embodiment 11. The compound of any one of embodiments 1 to 10, wherein L^6 is a bond or $-C(O)-$.

[0263] Embodiment 12. The compound of any one of embodiments 1 to 11 having the formula:



[0264] Embodiment 13. The compound of any one of embodiments 1 to 12, wherein R⁴ is halogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted aryl or joined together with R³ to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, or substituted or unsubstituted aryl.

[0265] Embodiment 14. The compound of any one of embodiments 1 to 13, wherein R⁴ is halogen.

[0266] Embodiment 15. The compound of any one of embodiments 1 to 13, wherein R⁴ is R¹¹-substituted or unsubstituted alkyl.

[0267] Embodiment 16. The compound of embodiment 15, wherein R¹¹ is halogen, oxo, -OH, substituted or unsubstituted alkyl or substituted or unsubstituted aryl.

[0268] Embodiment 17. The compound of any one of embodiments 1 to 13, wherein R⁴ is R¹¹-substituted or unsubstituted aryl.

[0269] Embodiment 18. The compound of any one of embodiments 1 to 13, wherein R⁴ and R³ to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, or substituted or unsubstituted aryl.

[0270] Embodiment 19. The compound of any one of embodiments 1 to 18, wherein R² is hydrogen, joined together with R¹ to form a substituted or unsubstituted cycloalkyl or substituted or unsubstituted heterocycloalkyl, or joined together with R³ to form substituted or unsubstituted heterocycloalkyl or substituted or unsubstituted aryl.

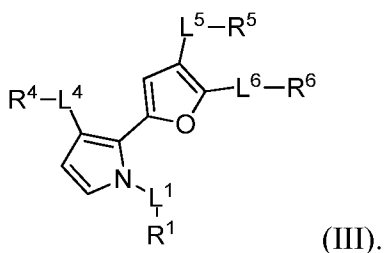
[0271] Embodiment 20. The compound of any one of embodiments 1 to 19, wherein R² is hydrogen.

[0272] Embodiment 21. The compound of any one of embodiments 1 to 19, wherein R² is joined together with R³ to form a substituted or unsubstituted aryl.

[0273] Embodiment 22. The compound of any one of embodiments 1 to 19, wherein R^2 is joined together with R^1 to form a substituted or unsubstituted heterocycloalkyl.

[0274] Embodiment 23. The compound of any one of embodiments 1 to 22, wherein R^3 is hydrogen.

5 [0275] Embodiment 24 The compound of any one of embodiments 1 to 23 having the formula:



[0276] Embodiment 25. The compound of any one of embodiments 1 to 24, wherein R^5 is $-OR^{5A}$, CF_3 , substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or
10 unsubstituted heteroaryl.

[0277] Embodiment 26. The compound of any one of embodiments 1 to 25, wherein R^5 is $-OR^{5A}$, wherein R^{5A} is R^{13} -substituted or unsubstituted alkyl, R^{13} -substituted or unsubstituted heteroalkyl; R^{13} is halogen $-OH$, $=O$, CF_3 , $-NR^{13A}R^{13B}$, substituted or unsubstituted alkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; R^{13A} and R^{13B} are
15 independently hydrogen or substituted or unsubstituted alkyl.

[0278] Embodiment 27. The compound of any one of embodiments 1 to 24, wherein R^5 is joined together with R^6 to form a substituted or unsubstituted heterocycloalkyl or substituted or unsubstituted heteroaryl.

[0279] Embodiment 28. The compound of any one of embodiments 1 to 27, wherein R^6 is
20 halogen, $-CN$, substituted or unsubstituted alkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl.

[0280] Embodiment 29. The compound of any one of embodiments 1 to 28, wherein R^6 is R^{16} -substituted or unsubstituted alkyl, wherein R^{16} is $NR^{16a}R^{16b}$, R^{17} -substituted or unsubstituted heterocycloalkyl, R^{17} -substituted or unsubstituted aryl; R^{16a} and R^{16b} are independently
25 substituted or unsubstituted alkyl, joined together to form a heterocycloalkyl; R^{17} is halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, substituted or unsubstituted alkyl,

substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl.

[0281] Embodiment 30. The compound of any one of embodiments 1 to 29, wherein R¹ is substituted or unsubstituted alkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl, or wherein R¹ and R² are joined together to form a substituted or unsubstituted heterocycloalkyl.

[0282] Embodiment 31. The compound of any one of embodiments 1 to 29, wherein R¹ and R² are joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl.

[0283] Embodiment 32. The compound of any one of embodiments 1 to 29, wherein R² and R³ are joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl.

[0284] Embodiment 33. The compound of any one of embodiments 1 to 29, wherein R³ and R⁴ are joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl.

[0285] Embodiment 34. The compound of any one of embodiments 1 to 33, wherein R¹ is substituted or unsubstituted alkyl.

[0286] Embodiment 35 The compound of any one of embodiments 1 to 33, wherein R¹ is substituted or unsubstituted C₁-C₁₀ alkyl.

[0287] Embodiment 36 The compound of any one of embodiments 1 to 35, wherein R¹ is substituted or unsubstituted C₁-C₅ alkyl.

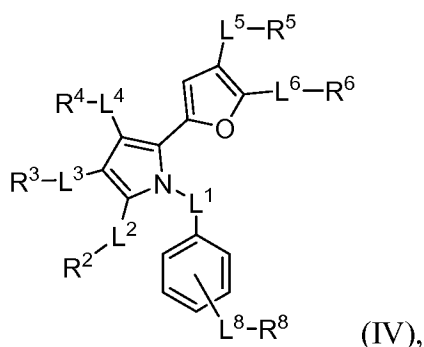
[0288] Embodiment 37. The compound of any one of embodiments 1 to 34, wherein R¹ is R⁹-substituted C₂ alkyl and R⁹ is methyl.

[0289] Embodiment 38. The compound of any one of embodiments 1 to 34, wherein R¹ is substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl.

[0290] Embodiment 39. The compound of any one of embodiments 1 to 34, wherein R^1 is substituted or unsubstituted 5-8 membered aryl or substituted or unsubstituted 5-8 membered heteroaryl.

[0291] Embodiment 40. The compound of any one of embodiments 1 to 38, wherein R^1 and R^2 are joined together to form an R-substituted or unsubstituted heterocycloalkyl, wherein R is substituted or unsubstituted alkyl or $-S(O)_2$.

[0292] Embodiment 41. The compound of embodiment 1 having the formula:



wherein, L^8 is independently a bond, $-C(O)-$, $-C(O)O-$, $-OC(O)-$, $-C(O)NR^7-$, $-NR^7C(O)-$, $-O-$, $-S(O)_n-$, $-S(O)NR^7-$, $-C(O)NR^7S(O)_2-$, $-NR^7-$, $OR^7OP(O)-$, $NR^7S(O)_2-$, $-(NR^7)NP(O)-$, substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene; R^8 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-CI_3$, $-CN$, $-CHO$, $=O$, $-OR^{8A}$, $-NR^{8B}R^{8C}$, $-COOR^{8A}$, $-CONR^{8B}R^{8C}$, NO_2 , SR^{8D} , $-SO_{n8}R^{8B}$, $-SO_{n8}OR^{8B}$, $-SO_{n8}NR^{8B}R^{8C}$, $-NHNr^{8B}R^{8C}$, $-ONR^{8B}R^{8C}$, $-NHC(O)NHNr^{8B}R^{8C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; R^{8A} , R^{8B} , R^{8C} , and R^{8D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; and n_8 is 1, 2, 3, 4, or 5.

[0293] Embodiment 42. The compound of embodiment 41, wherein L^1 is a bond, $-S(O)_2-$, or substituted or unsubstituted C_1-C_5 alkylene.

[0294] Embodiment 43. The compound of any one of embodiments 41-42, wherein L^8 is a bond or substituted or unsubstituted C_1-C_5 alkylene.

[0295] Embodiment 44. The compound of any one of embodiments 41-43, wherein R⁸ is hydrogen, halogen or substituted or unsubstituted C₁-C₅ alkyl.

[0296] Embodiment 45. The compound of any one of embodiments 41-44, wherein R⁸ is methyl.

5 [0297] Embodiment 46. The compound of any one of embodiments 41-45, wherein L² and L³ are independently a bond, or substituted or unsubstituted C₁-C₅ alkylene.

[0298] Embodiment 47. The compound of any one of embodiments 41-46, wherein R² and R³ are independently hydrogen or are joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl or
10 substituted or unsubstituted heteroaryl.

[0299] Embodiment 48. The compound of any one of embodiments 41-47 wherein R² and R³ are joined together to form an unsubstituted aryl.

[0300] Embodiment 49. The compound of any one of embodiments 41-48, wherein R² and R³ are joined together to form an unsubstituted phenyl.

15 [0301] Embodiment 50. The compound of any one of embodiments 41-49, wherein L⁴ is a bond or substituted or unsubstituted C₁-C₅ alkylene.

[0302] Embodiment 51. The compound of any one of embodiments 41-50, wherein R⁴ is hydrogen, halogen or substituted or unsubstituted C₁-C₅ alkyl.

[0303] Embodiment 52. The compound of any one of embodiments 41-51, wherein R⁴ is -Cl
20 or -Br.

[0304] Embodiment 53. The compound of any one of embodiments 41-52, wherein L⁵ is a bond, -O-, substituted or unsubstituted C₁-C₅ alkylene or substituted or unsubstituted 1-5 membered heteroalkylene.

[0305] Embodiment 54. The compound of any one of embodiments 41-53, wherein R⁵ is
25 hydrogen or substituted or unsubstituted C₁-C₅ alkyl.

[0306] Embodiment 55. The compound of any one of embodiments 41-54, wherein R⁵ is unsubstituted C₁-C₅ alkyl.

[0307] Embodiment 56. The compound of any one of embodiments 41-55, wherein R⁵ is methyl.

[0308] Embodiment 57. The compound of any one of embodiments 41-54, wherein R⁵ is substituted C₁-C₅ alkyl.

[0309] Embodiment 58. The compound of any one of embodiments 41-54 or 57, wherein R⁵ is R¹³-substituted C₁-C₃ alkyl and R¹³ is substituted or unsubstituted 6 membered heterocycloalkyl or substituted or unsubstituted 6 membered heteroaryl.

[0310] Embodiment 59. The compound of any one of embodiments 41-54 or 57-58, wherein R⁵ is R¹³-substituted C₁-C₃ alkyl and R¹³ is unsubstituted morpholinyl or unsubstituted pyridinyl.

[0311] Embodiment 60. The compound of any one of embodiments 41-59, wherein L⁶ is a bond, -C(O)-, -C(O)O-, -C(O)NR⁷S(O)₂-, or substituted or unsubstituted C₁-C₅ alkylene.

10 [0312] Embodiment 61. The compound of embodiment 60, wherein R⁶ is -C(O)OR^{6A}, substituted or unsubstituted C₁-C₅ alkyl, substituted or unsubstituted C₁-C₅ heteroalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl.

[0313] Embodiment 62. The compound of any one of embodiments 60-61, wherein R⁶ is -C(O)OR^{6A} and R^{6A} is hydrogen.

15 [0314] Embodiment 63. The compound of any one of embodiments 60-61, wherein R⁶ is unsubstituted C₁-C₃ alkyl.

[0315] Embodiment 64. The compound of any one of embodiments 60-61 and 63, wherein R⁶ is methyl.

20 [0316] Embodiment 65. The compound of any one of embodiments 60-61, wherein R⁶ is substituted or unsubstituted C₁-C₃ alkyl.

[0317] Embodiment 66. The compound of any one of embodiments 60-61 and 65, wherein R⁶ is R¹⁶-substituted or unsubstituted C₃ alkyl and R¹⁶ is substituted or unsubstituted 6 membered heterocycloalkyl.

25 [0318] Embodiment 67. The compound of any one of embodiments 60-61 and 65, wherein R⁶ is R¹⁶-substituted or unsubstituted C₁ alkyl and R¹⁶ is substituted or unsubstituted aryl.

[0319] Embodiment 68. The compound of any one of embodiments 60-61 and 67, wherein R⁶ is R¹⁶-substituted C₁ alkyl, R¹⁶ is R¹⁷-substituted or unsubstituted phenyl and R¹⁷ is -NH₂.

[0320] Embodiment 69. The compound of any one of embodiments 60-61, wherein R^6 is R^{16} -substituted or unsubstituted C_1 alkyl and R^{16} is substituted or unsubstituted 6 membered heteroaryl.

5 [0321] Embodiment 70. The compound of any one of embodiments 60-61 and 69, wherein R^6 is R^{16} -substituted C_1 alkyl and R^{16} is unsubstituted pyridinyl.

[0322] Embodiment 71. The compound of any one of embodiments 60-61, wherein R^6 is R^{16} -substituted C_1 - C_3 heteroalkyl and R^{16} is $-O$ or $-OH$.

[0323] Embodiment 72. The compound of any one of embodiments 60-61, wherein R^6 is substituted or unsubstituted 5-8 membered aryl.

10 [0324] Embodiment 73. The compound of any one of embodiments 60-61 or 72, wherein R^6 is R^{16} -substituted or unsubstituted 5-6 membered aryl and R^{16} is hydrogen, halogen, $=O$, $-OH$, or substituted or unsubstituted C_1 - C_5 alkyl.

[0325] Embodiment 74. The compound of any one of embodiments 60-61 or 72-73, wherein R^6 is R^{16} -substituted or unsubstituted phenyl and R^{16} is hydrogen, $-OH$, halogen or unsubstituted
15 C_1 - C_3 alkyl.

[0326] Embodiment 75. The compound of any one of embodiments 60-61 or 72-73, wherein R^6 is R^{16} -substituted or unsubstituted cyclopentadienyl and R^{16} is $-O$ or $-OH$.

[0327] Embodiment 76. The compound of any one of embodiments 60-61, wherein R^6 is substituted or unsubstituted 5-8 membered heteroaryl.

20 [0328] Embodiment 77. The compound of any one of embodiments 60-61 or 76, wherein R^6 is unsubstituted triazolyl, tetrazolyl, pyrrolyl, pyridinyl or oxodiazolyl.

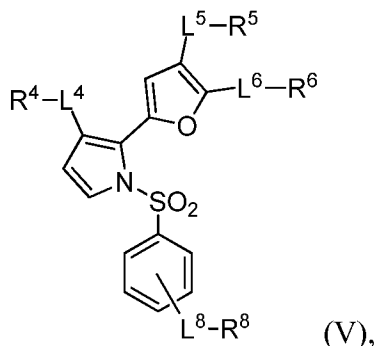
[0329] Embodiment 78. The compound of any one of embodiments 60-61 or 76, wherein R^6 is R^{16} -substituted 5-8 membered heteroaryl, R^{16} is R^{17} -substituted or unsubstituted 5 membered heteroalkyl and R^{17} is $=O$ or methyl.

25 [0330] Embodiment 79. The compound of any one of embodiments 60-61 or 76, wherein R^6 is R^{16} -substituted 5-8 membered heteroaryl, R^{16} is R^{17} -substituted or unsubstituted C_1 - C_3 alkyl and R^{17} is unsubstituted morpholinyl.

[0331] Embodiment 80. The compound of any one of embodiments 60-61 or 76, wherein R^6 is R^{16} -substituted 5-8 membered heteroaryl and R^{16} is unsubstituted C_1 - C_3 alkyl.

[0332] Embodiment 81. The compound of any one of embodiments 60-61 or 76-80, wherein R^6 is R^{16} -substituted triazolyl, tetrazolyl, pyrrolyl, pyridinyl or oxodiazolyl.

[0333] Embodiment 82. The compound of embodiment 1 having the formula:



- 5 wherein, L^8 is independently a bond, $-C(O)-$, $-C(O)O-$, $-OC(O)-$, $-C(O)NR^7-$, $-NR^7C(O)-$, $-O-$, $-S(O)_n-$, $-S(O)NR^7-$, $-C(O)NR^7S(O)_2-$, $-NR^7-$, $OR^7OP(O)-$, $NR^7S(O)_2-$, $-(NR^7)NP(O)-$, substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene; R^8 is independently
- 10 hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-CI_3$, $-CN$, $-CHO$, $=O$, $-OR^{8A}$, $-NR^{8B}R^{8C}$, $-COOR^{8A}$, $-CONR^{8B}R^{8C}$, NO_2 , SR^{8D} , $-SO_{n8}R^{8B}$, $-SO_{n8}OR^{8B}$, $-SO_{n8}NR^{8B}R^{8C}$, $-NHNr^{8B}R^{8C}$, $-ONR^{8B}R^{8C}$, $-NHC(O)NHNr^{8B}R^{8C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;
- 15 R^{8A} , R^{8B} , R^{8C} , and R^{8D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; and n_8 is 1, 2, 3, 4, or 5.

[0334] Embodiment 83. The compound of embodiment 41, wherein L^8 is a bond or

20 substituted or unsubstituted alkylene.

[0335] Embodiment 84. The compound of embodiment 41 or 83, wherein R^8 is hydrogen, halogen, or substituted or unsubstituted alkyl.

[0336] Embodiment 85. A pharmaceutical composition comprising a compound of any one of embodiments 1 to 84 and a pharmaceutically acceptable excipient.

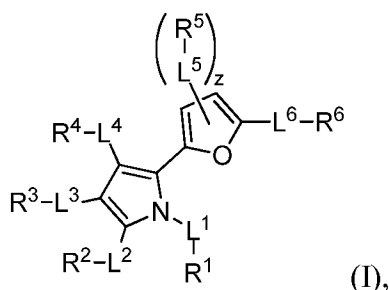
[0337] Embodiment 86. A method of treating cancer in a subject in need thereof, said method comprising administering an effective amount of a compound of any one of embodiments 1 to 85 to the subject.

[0338] Embodiment 87. The method of embodiment 86, wherein said cancer is leukemia.

- 5 [0339] Embodiment 88. A method of antagonizing Mcl-1, said method comprising contacting a Mcl-1 mixture with a compound of any one of embodiments 1 to 84.

WHAT IS CLAIMED IS:

1. A compound having the formula:



wherein,

L^1 , L^2 , L^3 , L^4 , L^5 , and L^6 are independently a bond, $-C(O)-$, $-C(O)O-$, $-C(O)NR^7-$, $-O-$, $-S(O)_n-$, $-S(O)NR^7-$, $-C(O)NR^7S(O)_2-$, $-NR^7-$, substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene;

R^7 is independently hydrogen, halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $-NH_2$, $-COOH$, $-CONH_2$, $-NO_2$, $-SH$, $-SO_2Cl$, $-SO_3H$, $-SO_2Ph$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHCNHNH_2$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

n is 0, 1, or 2;

R^1 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{1A}$, $-NR^{1B}R^{1C}$, $-COOR^{1A}$, $-CONR^{1B}R^{1C}$, $-NO_2$, $-SR^{1D}$, $-SO_{n1}R^{1B}$, $-S(O)_{n1}OR^{1B}$, $-S(O)_{n1}NR^{1B}R^{1C}$, $-NHNR^{1B}R^{1C}$, $-ONR^{1B}R^{1C}$, $-NHC(O)NHNR^{1B}R^{1C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^1 and R^2 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^2 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{2A}$, $-NR^{2B}R^{2C}$, $-COOR^{2A}$, $-CONR^{2B}R^{2C}$, NO_2 , SR^{2D} , $-SO_{n2}R^{2B}$, $-SO_{n2}OR^{2B}$, $-SO_{n2}NR^{2B}R^{2C}$, $-NHNR^{2B}R^{2C}$, $-ONR^{2B}R^{2C}$, $-NHC(O)NHNR^{2B}R^{2C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^2 and R^3 are optionally joined together to form a substituted or unsubstituted

cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^3 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{3A}$, $-NR^{3B}R^{3C}$, $-COOR^{3A}$, $-CONR^{3B}R^{3C}$, NO_2 , SR^{3D} , $-SO_{n3}R^{3B}$, $-SO_{n3}OR^{3B}$, $-SO_{n3}NR^{3B}R^{3C}$, $-NHNr^{3B}R^{3C}$, $-ONR^{3B}R^{3C}$, $-NHC(O)NHNr^{3B}R^{3C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^3 and R^4 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^4 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{4A}$, $-NR^{4B}R^{4C}$, $-COOR^{4A}$, $-CONR^{4B}R^{4C}$, NO_2 , SR^{4D} , $-SO_{n4}R^{4B}$, $-SO_{n4}OR^{4B}$, $-SO_{n4}NR^{4B}R^{4C}$, $-NHNr^{4B}R^{4C}$, $-ONR^{4B}R^{4C}$, $-NHC(O)NHNr^{4B}R^{4C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^5 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{5A}$, $-NR^{5B}R^{5C}$, $-COOR^{5A}$, $-CONR^{5B}R^{5C}$, NO_2 , SR^{5D} , $-SO_{n5}R^{5B}$, $-SO_{n5}OR^{5B}$, $-SO_{n5}NR^{5B}R^{5C}$, $-NHNr^{5B}R^{5C}$, $-ONR^{5B}R^{5C}$, $-NHC(O)NHNr^{5B}R^{5C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^5 and R^6 are optionally joined together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^6 is hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{6A}$, $-NR^{6B}R^{6C}$, $-COOR^{6A}$, $-CONR^{6B}R^{6C}$, NO_2 , SR^{6D} , $-SO_{n6}R^{6B}$, $-SO_{n6}OR^{6B}$, $-SO_{n6}NR^{6B}R^{6C}$, $-NHNr^{6B}R^{6C}$, $-ONR^{6B}R^{6C}$, $-NHC(O)NHNr^{6B}R^{6C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^{1A} , R^{2A} , R^{3A} , R^{4A} , R^{5A} , R^{6A} , R^{1B} , R^{2B} , R^{3B} , R^{4B} , R^{5B} , R^{6B} , R^{1C} , R^{2C} , R^{3C} , R^{4C} , R^{5C} , R^{6C} , R^{1D} , R^{2D} , R^{3D} , R^{4D} , R^{5D} , and R^{6D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl, wherein R^{6B} and R^{6C} are optionally joined together to

form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

n1, n2, n3, n4, n5, and n6 are independently 1 or 2; and

z is 1 or 2.

2. The compound of claim 1, wherein L^1 is a bond, $-S(O)_2-$, or substituted or unsubstituted alkylene.

3. The compound of any one of claims 1 to 2, wherein L^1 is a bond, $-S(O)_2-$.

4. The compound of any one of claims 1 to 3, wherein L^2 and L^3 are independently a bond or substituted or unsubstituted alkylene.

5. The compound of any one of claims 1 to 4, wherein L^2 and L^3 are a bond.

6. The compound of any one of claims 1 to 5, wherein L^4 is a bond, $S(O)_2-$, or substituted or unsubstituted alkylene.

7. The compound of any one of claims 1 to 6, wherein L^4 is a bond or $S(O)_2-$.

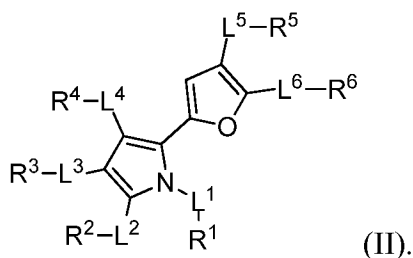
8. The compound of any one of claims 1 to 7, wherein L^5 is a bond, $-O-$, or substituted or unsubstituted alkylene.

9. The compound of any one of claims 1 to 8, wherein L^5 is a bond or $-O-$.

10. The compound of any one of claims 1 to 9, wherein L^6 is a bond, $-C(O)-$, $-C(O)NR^7$, $-S(O)_2-$, or substituted or unsubstituted alkylene.

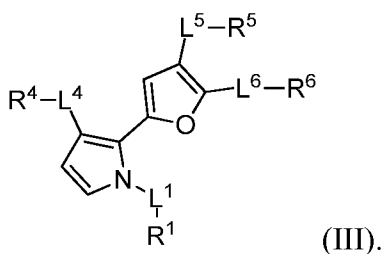
11. The compound of any one of claims 1 to 10, wherein L^6 is a bond or $-C(O)-$.

12. The compound of any one of claims 1 to 11 having the formula:



(II).

- 1 13. The compound of any one of claims 1 to 12, wherein R⁴ is halogen,
2 substituted or substituted alkyl, substituted or unsubstituted heteroalkyl, substituted or
3 unsubstituted aryl or joined together with R³ to form a substituted or unsubstituted cycloalkyl,
4 substituted or unsubstituted heterocycloalkyl, or substituted or unsubstituted aryl.
- 1 14. The compound of any one of claims 1 to 13, wherein R⁴ is halogen.
- 1 15. The compound of any one of claims 1 to 13, wherein R⁴ is R¹¹-substituted
2 or unsubstituted alkyl.
- 1 16. The compound of claim 15, wherein R¹¹ is halogen, oxo, -OH, substituted
2 or unsubstituted alkyl or substituted or unsubstituted aryl.
- 1 17. The compound of any one of claims 1 to 13, wherein R⁴ is R¹¹-substituted
2 or unsubstituted aryl.
- 1 18. The compound of any one of claims 1 to 13, wherein R⁴ and R³ to form a
2 substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, or
3 substituted or unsubstituted aryl.
- 1 19. The compound of any one of claims 1 to 18, wherein R² is hydrogen,
2 joined together with R¹ to form a substituted or unsubstituted cycloalkyl or substituted or
3 unsubstituted heterocycloalkyl, or joined together with R³ to form substituted or unsubstituted
4 heterocycloalkyl or substituted or unsubstituted aryl.
- 1 20. The compound of any one of claims 1 to 19, wherein R² is hydrogen.
- 1 21. The compound of any one of claims 1 to 19, wherein R² is joined together
2 with R³ to form a substituted or unsubstituted aryl.
- 1 22. The compound of any one of claims 1 to 19, wherein R² is joined together
2 with R¹ to form a substituted or unsubstituted heterocycloalkyl.
- 1 23. The compound of any one of claims 1 to 22, wherein R³ is hydrogen.
- 1 24. The compound of any one of claims 1 to 23 having the formula:



25. The compound of any one of claims 1 to 24, wherein R^5 is $-OR^{5A}$, CF_3 , substituted or unsubstituted alkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl.

26. The compound of any one of claims 1 to 25, wherein R^5 is $-OR^{5A}$, wherein R^{5A} is R^{13} -substituted or unsubstituted alkyl, R^{13} -substituted or unsubstituted heteroalkyl;

R^{13} is halogen $-OH$, $=O$, CF_3 , $-NR^{13A}R^{13B}$, substituted or unsubstituted alkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^{13A} and R^{13B} are independently hydrogen or substituted or unsubstituted alkyl.

27. The compound of any one of claims 1 to 24, wherein R^5 is joined together with R^6 to form a substituted or unsubstituted heterocycloalkyl or substituted or unsubstituted heteroaryl.

28. The compound of any one of claims 1 to 27, wherein R^6 is halogen, $-CN$, substituted or unsubstituted alkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, substituted or unsubstituted heteroaryl.

29. The compound of any one of claims 1 to 28, wherein R^6 is R^{16} -substituted or unsubstituted alkyl, wherein R^{16} is $NR^{16a}R^{16b}$, R^{17} -substituted or unsubstituted heterocycloalkyl, R^{17} -substituted or unsubstituted aryl

R^{16a} and R^{16b} are independently substituted or unsubstituted alkyl, joined together to form a heterocycloalkyl;

R^{17} is halogen, $-N_3$, $-NO_2$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-OH$, $=O$, $-NH_2$, $-COOH$, $-CONH_2$, $-SH$, $-SO_3H$, $-SO_4H$, $-SO_2NH_2$, $-NHNH_2$, $-ONH_2$, $-OCH_3$, $-NHC(O)NHNH_2$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl.

1 30. The compound of any one of claims 1 to 29, wherein R¹ is substituted or
2 unsubstituted alkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted
3 aryl, substituted or unsubstituted heteroaryl, or wherein R¹ and R² are joined together to form a
4 substituted or unsubstituted heterocycloalkyl.

1 31. The compound of any one of claims 1 to 29, wherein R¹ and R² are joined
2 together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted
3 heterocycloalkyl, substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl.

1 32. The compound of any one of claims 1 to 29, wherein R² and R³ are joined
2 together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted
3 heterocycloalkyl, substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl.

1 33. The compound of any one of claims 1 to 29, wherein R³ and R⁴ are joined
2 together to form a substituted or unsubstituted cycloalkyl, substituted or unsubstituted
3 heterocycloalkyl, substituted or unsubstituted aryl or substituted or unsubstituted heteroaryl.

1 34. The compound of any one of claims 1 to 33, wherein R¹ is substituted or
2 unsubstituted alkyl.

1 35. The compound of any one of claims 1 to 33, wherein R¹ is substituted or
2 unsubstituted C₁-C₁₀ alkyl.

1 36. The compound of any one of claims 1 to 35, wherein R¹ is substituted or
2 unsubstituted C₁-C₅ alkyl.

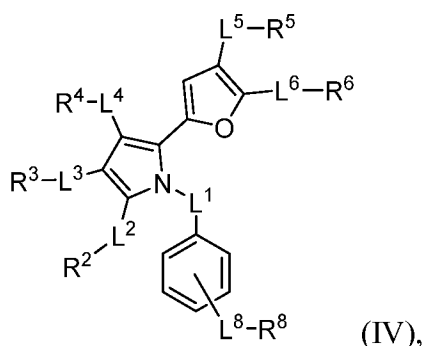
1 37. The compound of any one of claims 1 to 34, wherein R¹ is R⁹-substituted
2 C₂ alkyl and R⁹ is methyl.

1 38. The compound of any one of claims 1 to 34, wherein R¹ is substituted or
2 unsubstituted aryl or substituted or unsubstituted heteroaryl.

1 39. The compound of any one of claims 1 to 34, wherein R¹ is substituted or
2 unsubstituted 5-8 membered aryl or substituted or unsubstituted 5-8 membered heteroaryl.

1 40. The compound of any one of claims 1 to 38, wherein R¹ and R² are joined
2 together to form an R-substituted or unsubstituted heterocycloalkyl, wherein R is substituted or
3 unsubstituted alkyl or -S(O)₂.

41. The compound of claim 1 having the formula:



wherein,

L^8 is independently a bond, $-C(O)-$, $-C(O)O-$, $-OC(O)-$, $-C(O)NR^7-$, $-NR^7C(O)-$, $-O-$, $-S(O)_n-$, $-S(O)NR^7-$, $-C(O)NR^7S(O)_2-$, $-NR^7-$, $OR^7OP(O)-$, $NR^7S(O)_2-$, $-(NR^7)NP(O)-$, substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene;

R^8 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{8A}$, $-NR^{8B}R^{8C}$, $-COOR^{8A}$, $-CONR^{8B}R^{8C}$, NO_2 , SR^{8D} , $-SO_{n8}R^{8B}$, $-SO_{n8}OR^{8B}$, $-SO_{n8}NR^{8B}R^{8C}$, $-NHN R^{8B}R^{8C}$, $-ONR^{8B}R^{8C}$, $-NHC(O)NHN R^{8B}R^{8C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^{8A} , R^{8B} , R^{8C} , and R^{8D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; and

n_8 is 1, 2, 3, 4, or 5.

42. The compound of claim 41, wherein L^1 is a bond, $-S(O)_2-$, or substituted or unsubstituted C_1-C_5 alkylene.

43. The compound of any one of claims 41-42, wherein L^8 is a bond or substituted or unsubstituted C_1-C_5 alkylene.

44. The compound of any one of claims 41-43, wherein R^8 is hydrogen, halogen or substituted or unsubstituted C_1-C_5 alkyl.

- 1 45. The compound of any one of claims 41-44, wherein R⁸ is methyl.
- 1 46. The compound of any one of claims 41-45, wherein L² and L³ are
2 independently a bond, or substituted or unsubstituted C₁-C₅ alkylene.
- 1 47. The compound of any one of claims 41-46, wherein R² and R³ are
2 independently hydrogen or are joined together to form a substituted or unsubstituted cycloalkyl,
3 substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl or substituted or
4 unsubstituted heteroaryl.
- 1 48. The compound of any one of claims 41-47, wherein R² and R³ are joined
2 together to form an unsubstituted aryl.
- 1 49. The compound of any one of claims 41-48, wherein R² and R³ are joined
2 together to form an unsubstituted phenyl.
- 1 50. The compound of any one of claims 41-49, wherein L⁴ is a bond or
2 substituted or unsubstituted C₁-C₅ alkylene.
- 1 51. The compound of any one of claims 41-50, wherein R⁴ is hydrogen,
2 halogen or substituted or unsubstituted C₁-C₅ alkyl.
- 1 52. The compound of any one of claims 41-51, wherein R⁴ is -Cl or -Br.
- 1 53. The compound of any one of claims 41-52, wherein L⁵ is a bond, -O-,
2 substituted or unsubstituted C₁-C₅ alkylene or substituted or unsubstituted 1-5 membered
3 heteroalkylene.
- 1 54. The compound of any one of claims 41-53, wherein R⁵ is hydrogen or
2 substituted or unsubstituted C₁-C₅ alkyl.
- 1 55. The compound of any one of claims 41-54, wherein R⁵ is unsubstituted
2 C₁-C₅ alkyl.
- 1 56. The compound of any one of claims 41-55, wherein R⁵ is methyl.
- 1 57. The compound of any one of claims 41-54, wherein R⁵ is substituted C₁-
2 C₅ alkyl.

1 58. The compound of any one of claims 41-54 or 57, wherein R⁵ is R¹³-
2 substituted C₁-C₃ alkyl and R¹³ is substituted or unsubstituted 6 membered heterocycloalkyl or
3 substituted or unsubstituted 6 membered heteroaryl.

1 59. The compound of any one of claims 41-54 or 57-58, wherein R⁵ is R¹³-
2 substituted C₁-C₃ alkyl and R¹³ is unsubstituted morpholinyl or unsubstituted pyridinyl.

1 60. The compound of any one of claims 41-59, wherein L⁶ is a
2 bond, -C(O)-, -C(O)O-, -C(O)NR⁷S(O)₂-, or substituted or unsubstituted C₁-C₅ alkylene.

1 61. The compound of claim 60, wherein R⁶ is -C(O)OR^{6A}, substituted or
2 unsubstituted C₁-C₅ alkyl, substituted or unsubstituted C₁-C₅ heteroalkyl, substituted or
3 unsubstituted aryl, or substituted or unsubstituted heteroaryl.

1 62. The compound of any one of claims 60-61, wherein R⁶ is -C(O)OR^{6A} and
2 R^{6A} is hydrogen.

1 63. The compound of any one of claims 60-61, wherein R⁶ is unsubstituted
2 C₁-C₃ alkyl.

1 64. The compound of any one of claims 60-61 and 63, wherein R⁶ is methyl.

1 65. The compound of any one of claims 60-61, wherein R⁶ is substituted or
2 unsubstituted C₁-C₃ alkyl.

1 66. The compound of any one of claims 60-61 and 65, wherein R⁶ is R¹⁶-
2 substituted or unsubstituted C₃ alkyl and R¹⁶ is substituted or unsubstituted 6 membered
3 heterocycloalkyl.

1 67. The compound of any one of claims 60-61 and 65, wherein R⁶ is R¹⁶-
2 substituted or unsubstituted C₁ alkyl and R¹⁶ is substituted or unsubstituted aryl.

1 68. The compound of any one of claims 60-61 and 67, wherein R⁶ is R¹⁶-
2 substituted C₁ alkyl, R¹⁶ is R¹⁷-substituted or unsubstituted phenyl and R¹⁷ is -NH₂.

1 69. The compound of any one of claims 60-61, wherein R⁶ is R¹⁶-substituted
2 or unsubstituted C₁ alkyl and R¹⁶ is substituted or unsubstituted 6 membered heteroaryl.

1 70. The compound of any one of claims 60-61 and 69, wherein R⁶ is
2 R¹⁶-substituted C₁ alkyl and R¹⁶ is unsubstituted pyridinyl.

1 71. The compound of any one of claims 60-61, wherein R⁶ is R¹⁶-substituted
2 C₁-C₃ heteroalkyl and R¹⁶ is -O or -OH.

1 72. The compound of any one of claims 60-61, wherein R⁶ is substituted or
2 unsubstituted 5-8 membered aryl.

1 73. The compound of any one of claims 60-61 or 72, wherein R⁶ is R¹⁶-
2 substituted or unsubstituted 5-6 membered aryl and R¹⁶ is hydrogen, halogen, =O, -OH, or
3 substituted or unsubstituted C₁-C₅ alkyl.

1 74. The compound of any one of claims 60-61 or 72-73, wherein R⁶ is R¹⁶-
2 substituted or unsubstituted phenyl and R¹⁶ is hydrogen, -OH, halogen or unsubstituted C₁-C₃
3 alkyl.

1 75. The compound of any one of claims 60-61 or 72-73, wherein R⁶ is R¹⁶-
2 substituted or unsubstituted cyclopentadienyl and R¹⁶ is -O or -OH.

1 76. The compound of any one of claims 60-61, wherein R⁶ is substituted or
2 unsubstituted 5-8 membered heteroaryl.

1 77. The compound of any one of claims 60-61 or 76, wherein R⁶ is
2 unsubstituted triazolyl, tetrazolyl, pyrrolyl, pyrridinyl or oxodiazolyl.

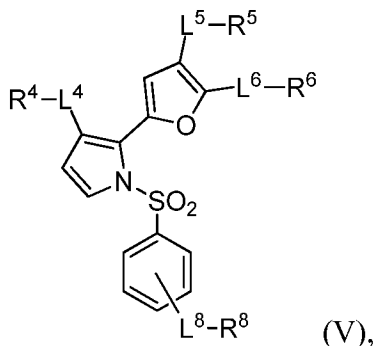
1 78. The compound of any one of claims 60-61 or 76, wherein R⁶ is R¹⁶-
2 substituted 5-8 membered heteroaryl, R¹⁶ is R¹⁷- substituted or unsubstituted 5 membered
3 heteroalkyl and R¹⁷ is =O or methyl.

1 79. The compound of any one of claims 60-61 or 76, wherein R⁶ is R¹⁶-
2 substituted 5-8 membered heteroaryl, R¹⁶ is R¹⁷- substituted or unsubstituted C₁-C₃ alkyl and R¹⁷
3 is unsubstituted morpholinyl.

1 80. The compound of any one of claims 60-61 or 76, wherein R⁶ is R¹⁶-
2 substituted 5-8 membered heteroaryl and R¹⁶ is unsubstituted C₁-C₃ alkyl.

81. The compound of any one of claims 60-61 or 76-80, wherein R^6 is R^{16} -substituted triazolyl, tetrazolyl, pyrrolyl, pyrridinyl or oxodiazolyl.

82. The compound of claim 1 having the formula:



wherein,

L^8 is independently a bond, $-C(O)-$, $-C(O)O-$, $-OC(O)-$, $-C(O)NR^7-$, $-NR^7C(O)-$, $-O-$, $-S(O)_n-$, $-S(O)NR^7-$, $-C(O)NR^7S(O)_2-$, $-NR^7-$, $OR^7OP(O)-$, $NR^7S(O)_2-$, $-(NR^7)NP(O)-$, substituted or unsubstituted alkylene, or substituted or unsubstituted heteroalkylene, substituted or unsubstituted cycloalkylene, substituted or unsubstituted heterocycloalkylene, substituted or unsubstituted arylene, or substituted or unsubstituted heteroarylene;

R^8 is independently hydrogen, halogen, $-N_3$, $-CF_3$, $-CCl_3$, $-CBr_3$, $-Cl_3$, $-CN$, $-CHO$, $=O$, $-OR^{8A}$, $-NR^{8B}R^{8C}$, $-COOR^{8A}$, $-CONR^{8B}R^{8C}$, NO_2 , SR^{8D} , $-SO_{n8}R^{8B}$, $-SO_{n8}OR^{8B}$, $-SO_{n8}NR^{8B}R^{8C}$, $-NHN R^{8B}R^{8C}$, $-ONR^{8B}R^{8C}$, $-NHC(O)NHN R^{8B}R^{8C}$, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl;

R^{8A} , R^{8B} , R^{8C} , and R^{8D} are independently hydrogen, substituted or unsubstituted alkyl, substituted or unsubstituted heteroalkyl, substituted or unsubstituted cycloalkyl, substituted or unsubstituted heterocycloalkyl, substituted or unsubstituted aryl, or substituted or unsubstituted heteroaryl; and

n_8 is 1, 2, 3, 4, or 5.

83. The compound of claim 41, wherein L^8 is a bond or substituted or unsubstituted alkylene.

84. The compound of claim 41 or 83, wherein R^8 is hydrogen, halogen, or substituted or unsubstituted alkyl.

1 85. A pharmaceutical composition comprising a compound of any one of
2 claims 1 to 84 and a pharmaceutically acceptable excipient.

1 86. A method of treating cancer in a subject in need thereof, said method
2 comprising administering an effective amount of a compound of any one of claims 1 to 85 to the
3 subject.

1 87. The method of claim 86, wherein said cancer is leukemia.

1 88. A method of antagonizing Mcl-1, said method comprising contacting an
2 Mcl-1 with a compound of any one of claims 1 to 84 thereby antagonizing said Mcl-1.

Figure 1

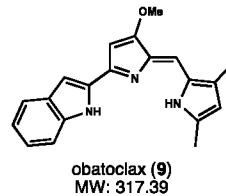
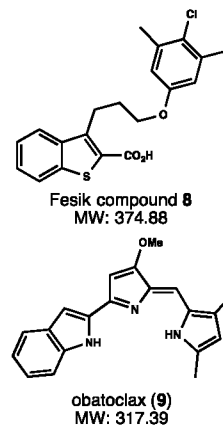
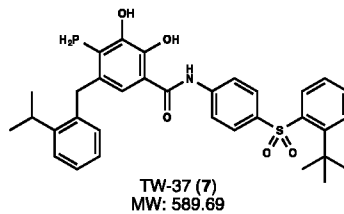
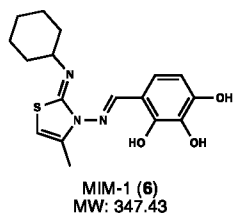
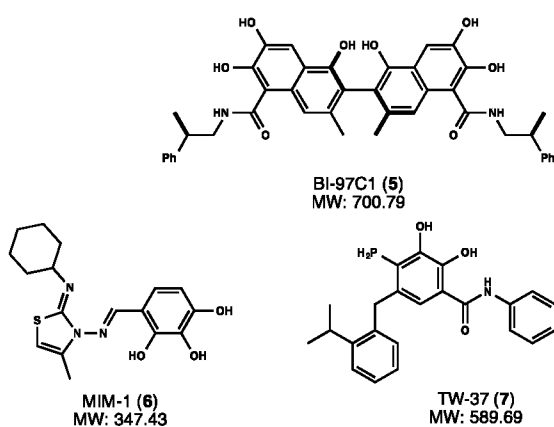
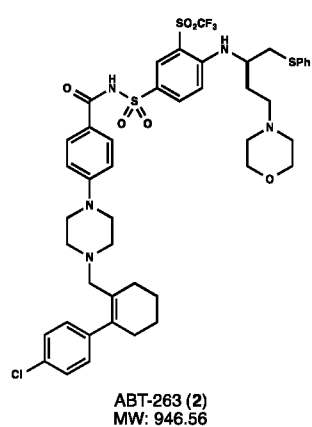


Figure 2

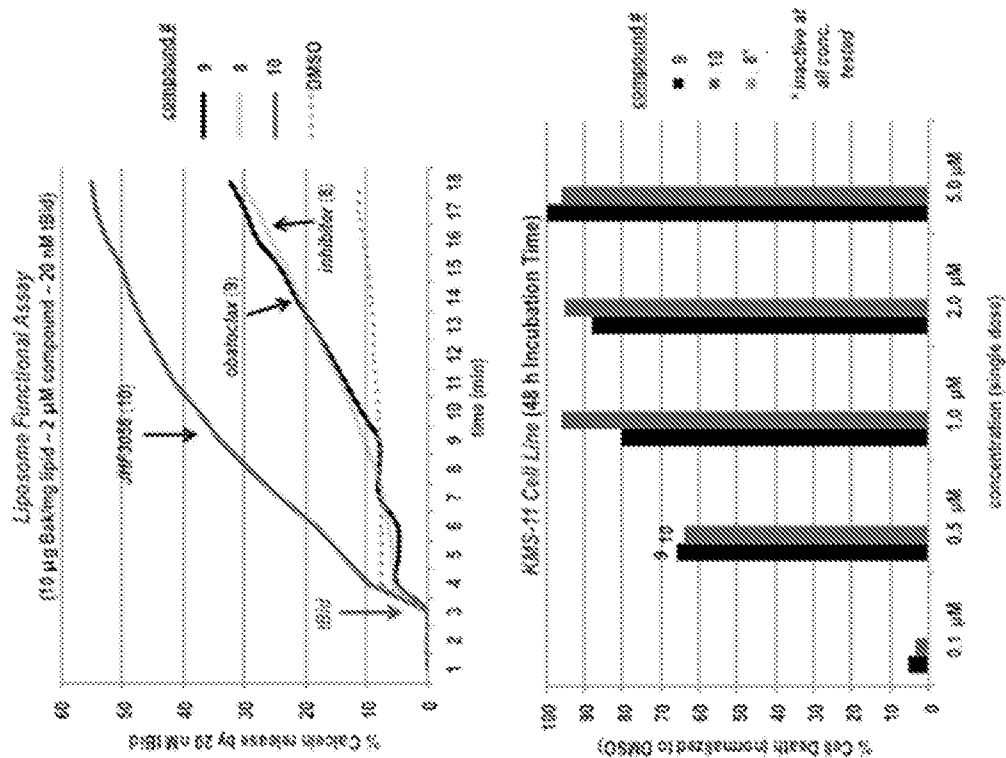


Figure 2A

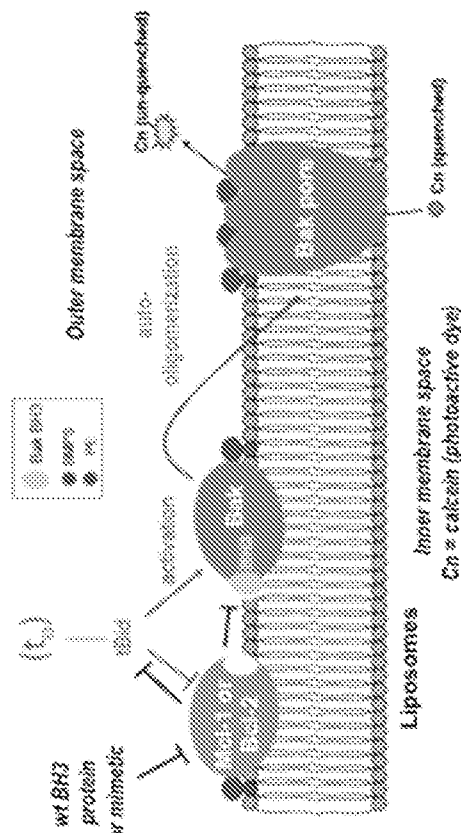


Figure 2B

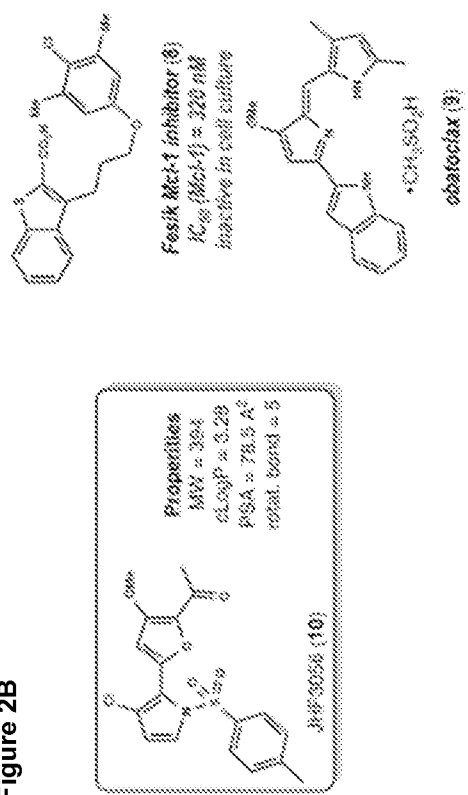


Figure 3

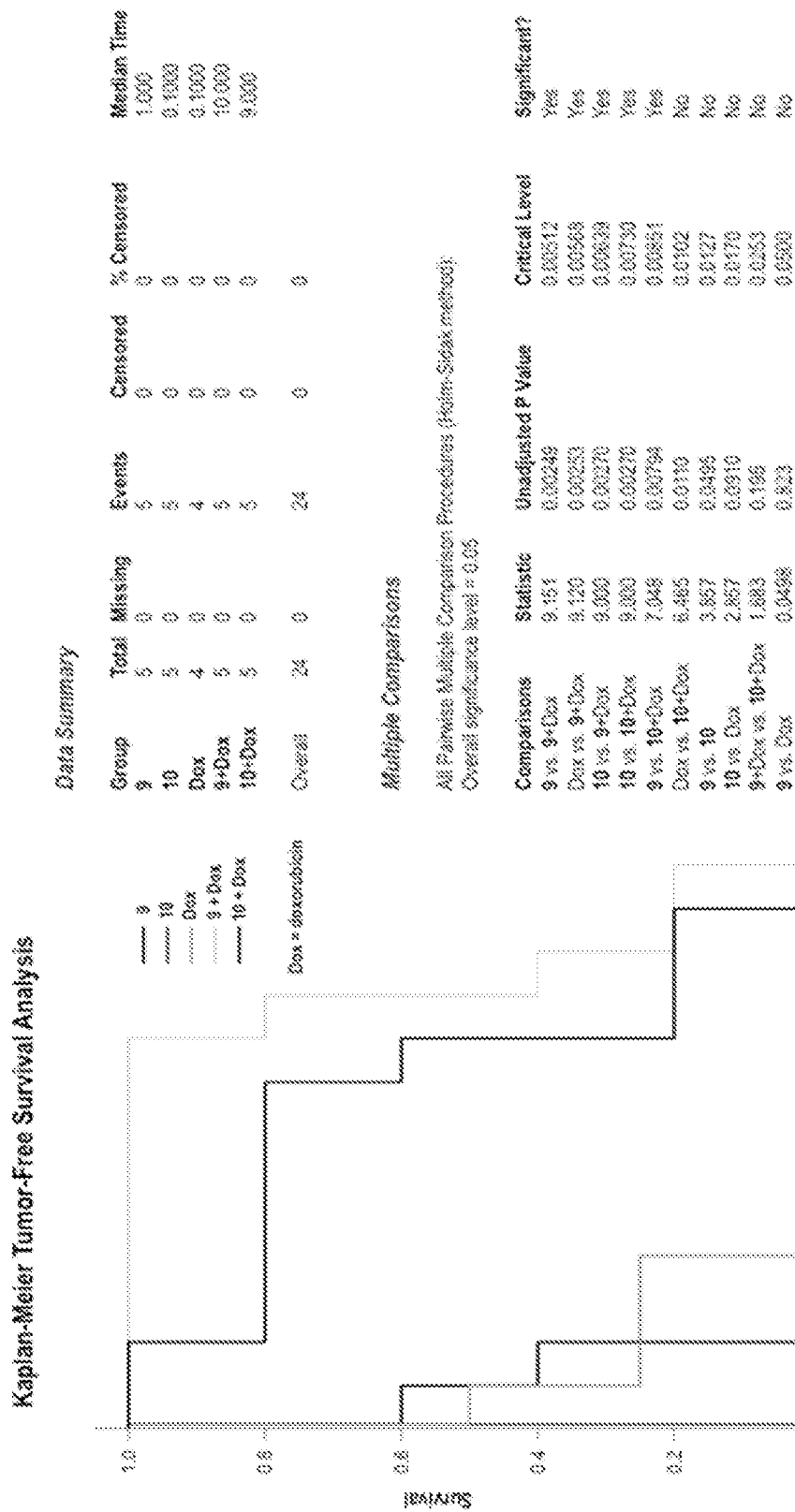


Figure 4

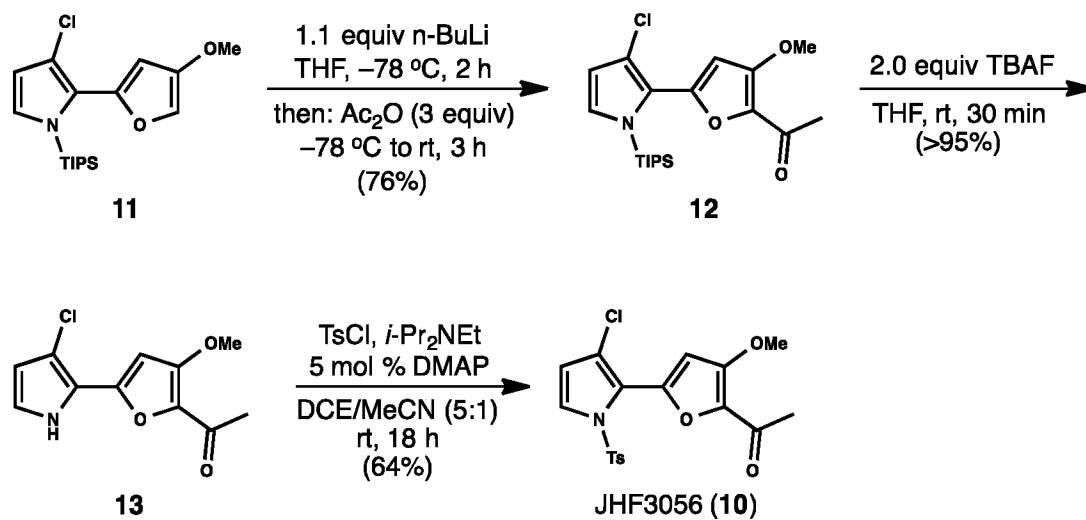


Figure 5

Figure 5A
Data for Active Substances

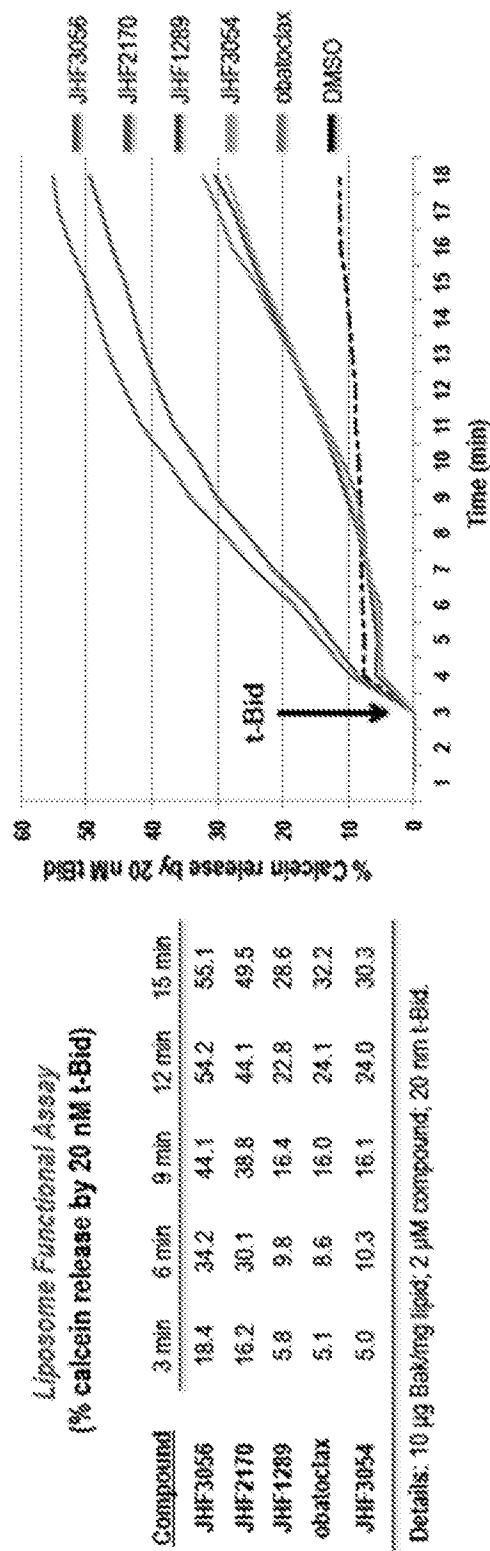


Figure 5B

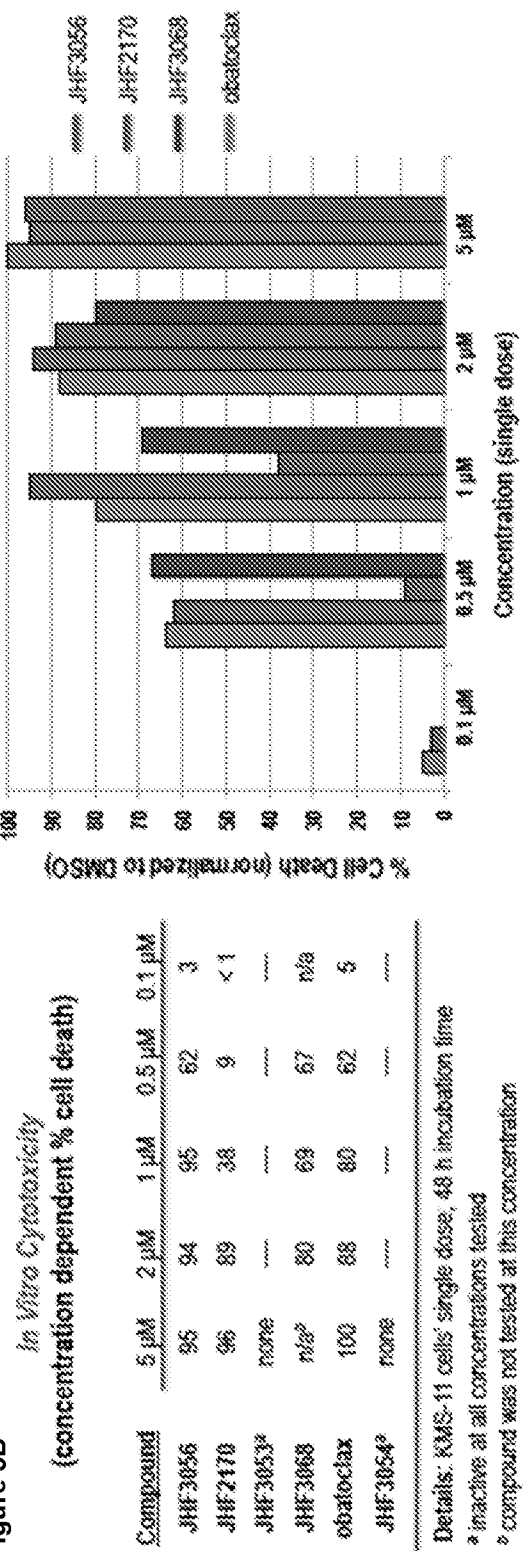


Figure 6

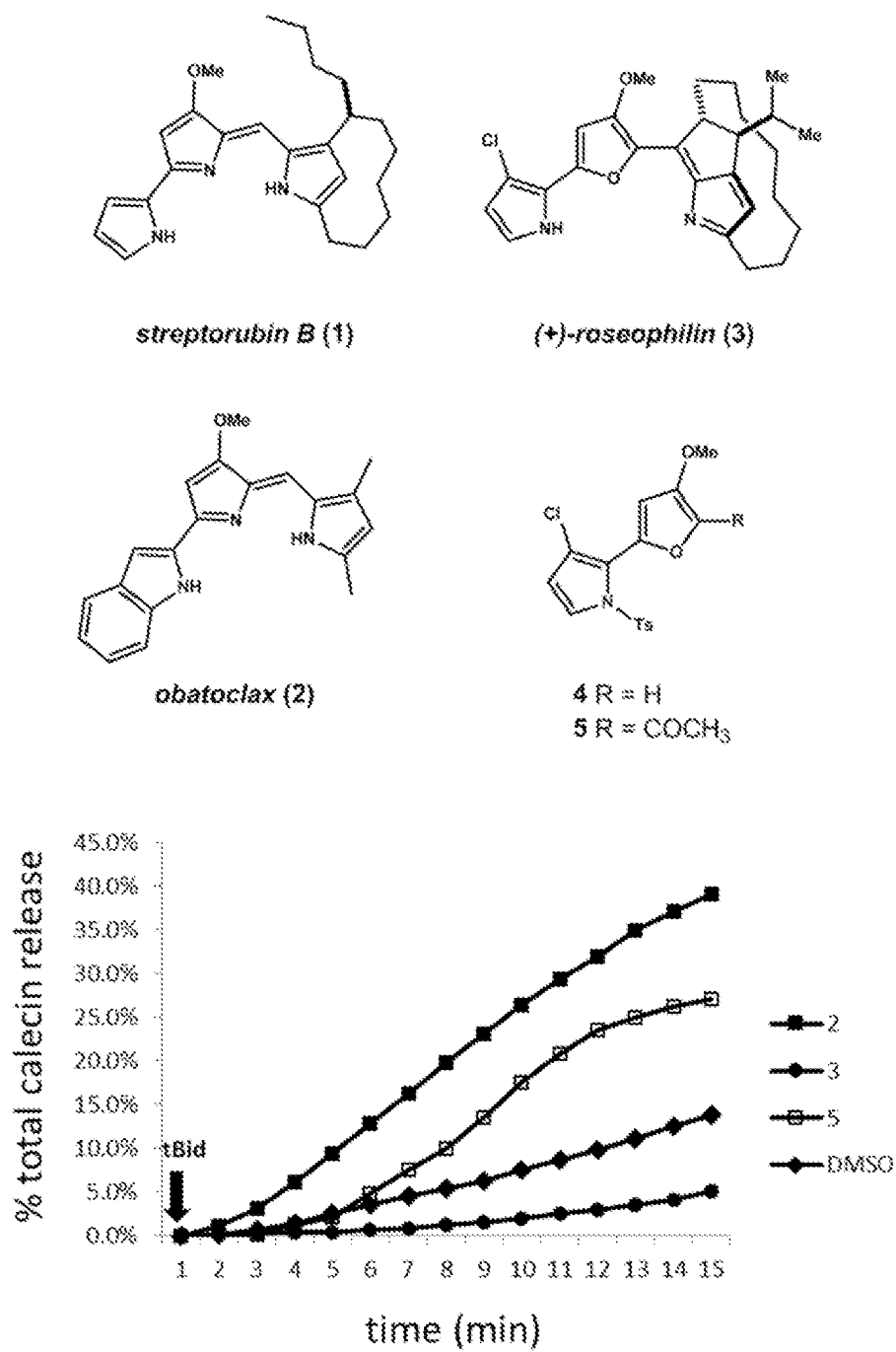


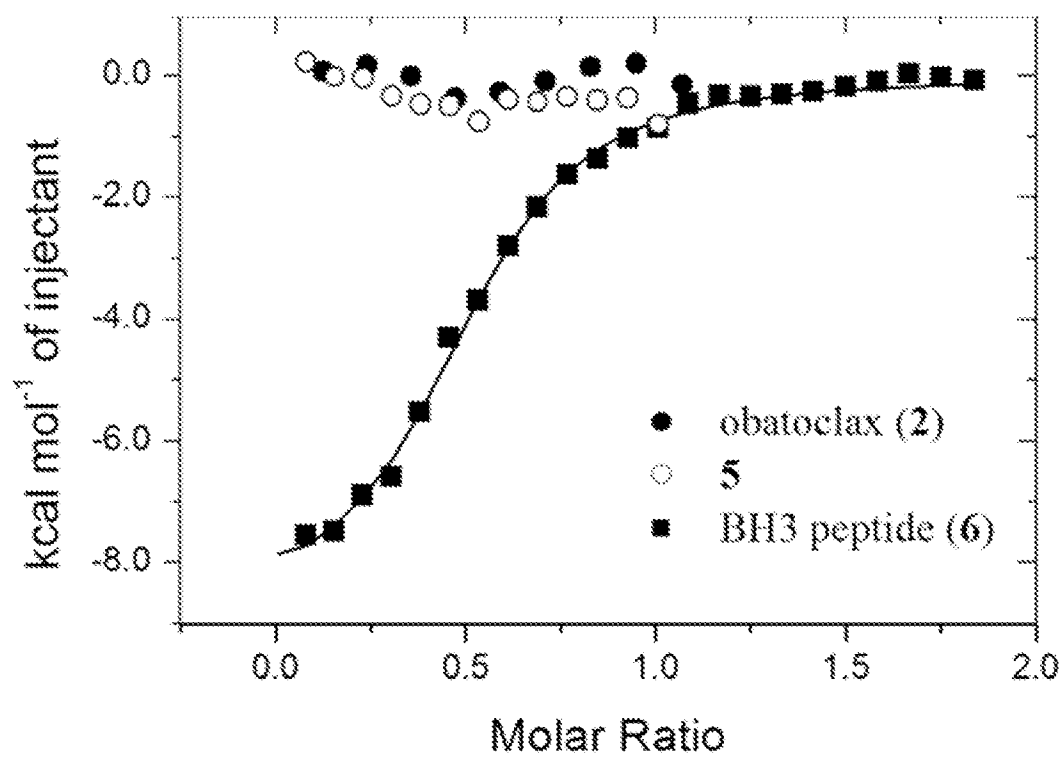
Figure 7

Figure 8A

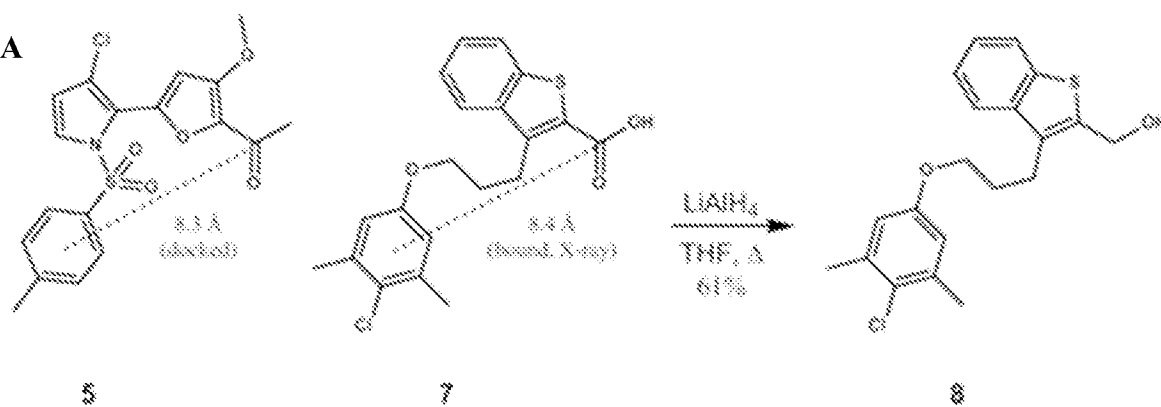


Figure 8B

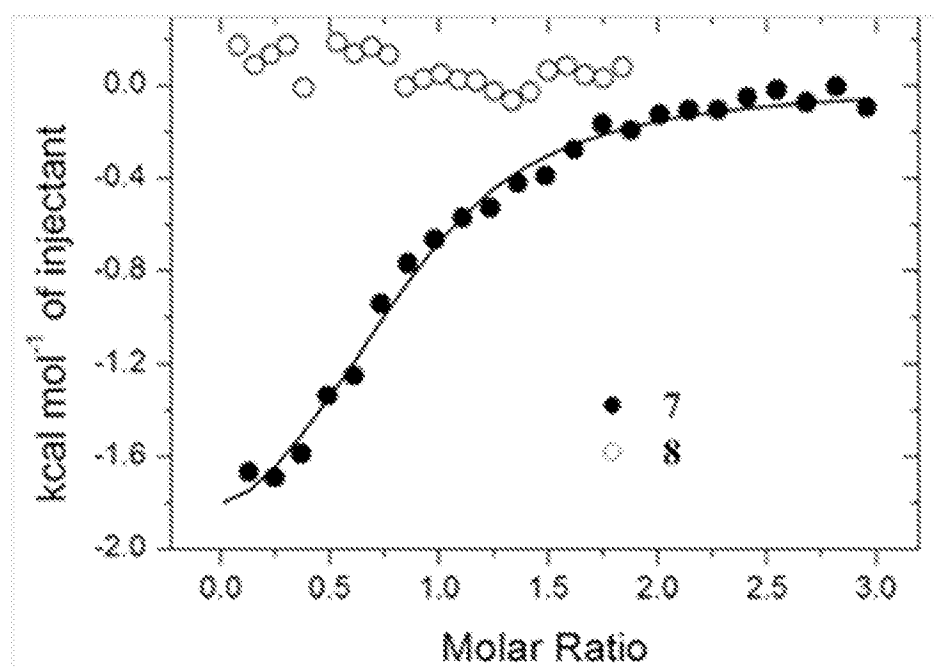


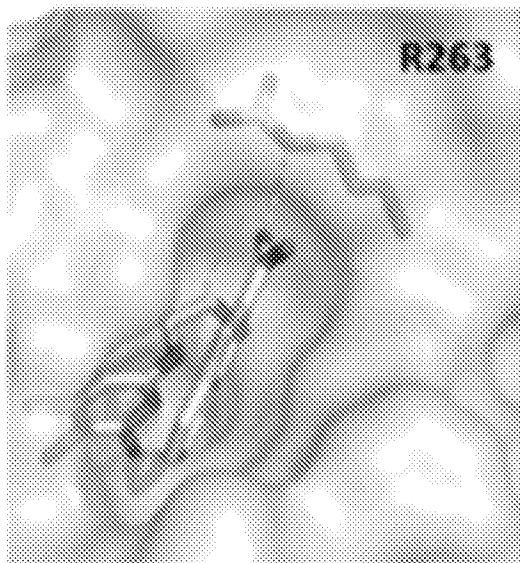
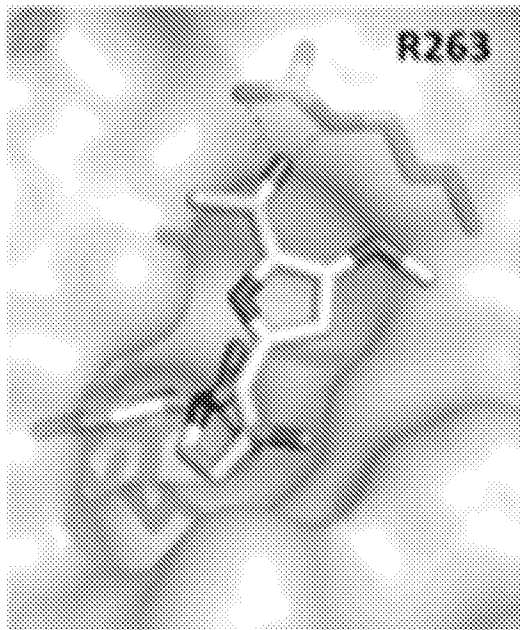
Figure 8C**Figure 8D**

Figure 9A

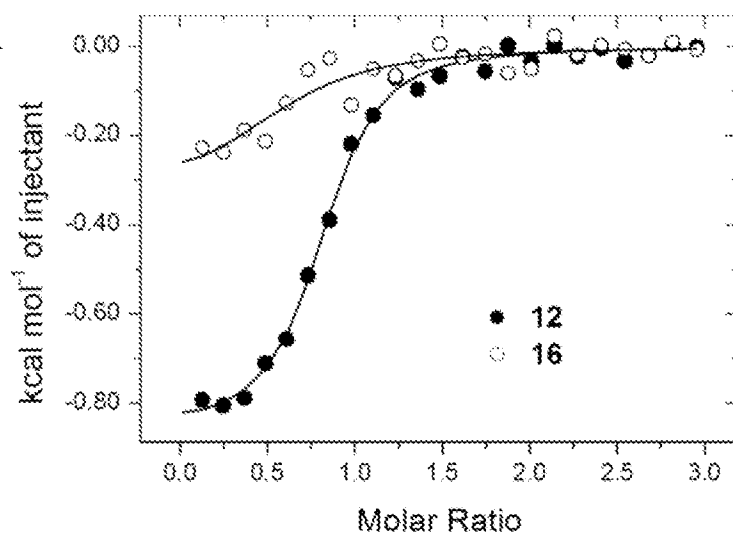


Figure 9B

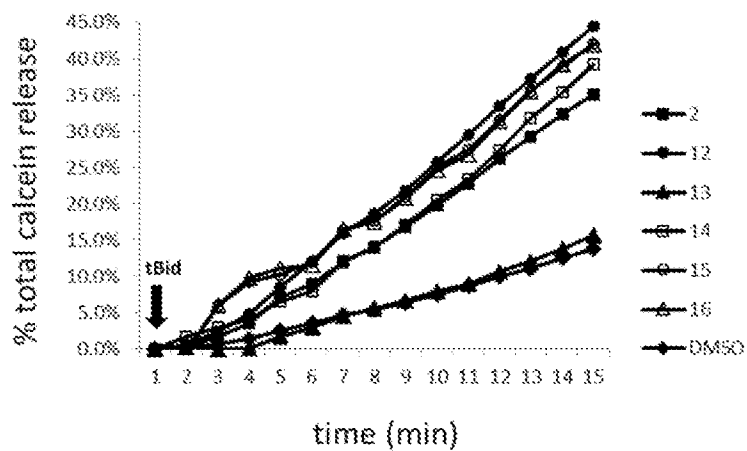


Figure 9C

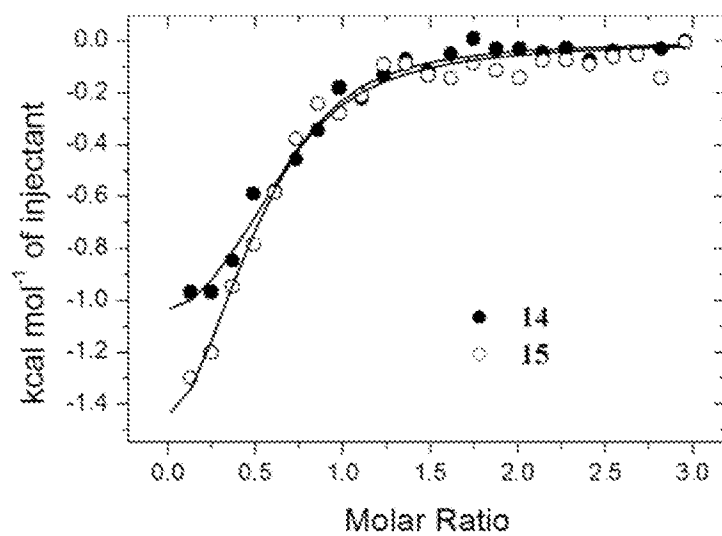
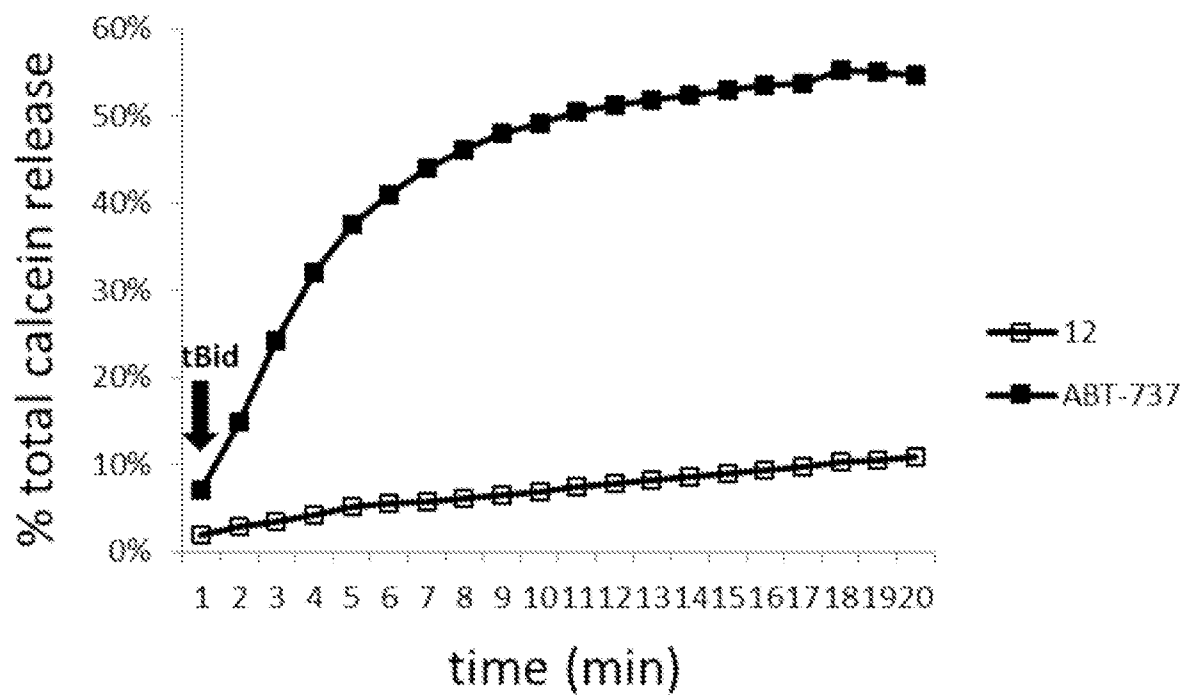


Figure 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/18540

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61K 31/40, 31/4025; C07D 405/04 (2015.01)

CPC - A61K 31/4025; C07D 207/48, 405/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): A61K 31/40, 31/4025; C07D 405/04 (2015.01)

CPC: A61K 31/4025; C07D 207/48, 405/04 USPC: 514/422; 548/517

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PATSEER (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); ProQuest; Google Scholar; IP.com; EBSCO;

KEYWORDS: Mcl 1, antagonist*, pyrrol*, furan*, Mcl 1 antagonist*, treat* cancer*, leukemia*, pharmaceutical composition*, excipient*, carrier*, Bcl 2, sulfonyl, benzenesulfonyl, pyrrol* furan*, benzenesulfonyl pyrrol*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,321,041 A (ADACHI, J et al.) 14 June 1994; column 22, Table 10, see compound No. 112	1-2, 3/1-2, 41-42, 43/41-42, 82-83, 84/41, 84/83
A	FREDERICH, JH et al., Modular Access to Complex Prodigines: Total Synthesis of (+)-Roseophilin via its 2-Azafulvene Prototropisomer, J. Am. Chem. Soc. 135, pages 3788-3791, 2013; [retrieved on 2015-04-24]. Retrieved from the Internet: <URL: http://www.chem.ucla.edu/harran/pdfs/ja400473v.pdf> <DOI: 10.1021/ja400473v>; entire document	1-2, 3/1-2, 41-42, 43/41-42, 82-83, 84/41, 84/83
A	US 2003/0119894 A1 (MURTHY, MSR et al.) 26 June 2003; paragraph [0063], see Table 3	1-2, 3/1-2, 41-42, 43/41-42, 82-83, 84/41, 84/83
A	DALFAVE, DS et al., Inhibition of Antiapoptotic BCL-XL, BCL-2, and MCL-1 Proteins by Small Molecule Mimetics, Cancer Informatics 9, pages 169-177, 2010; [retrieved on 2015-04-24]. Retrieved from the Internet: <URL: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2935820/pdf/cin-2010-169.pdf>; entire document	1-2, 3/1-2, 41-42, 43/41-42, 82-83, 84/41, 84/83

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

26 April 2015 (26.04.2015)

Date of mailing of the international search report

10 JUN 2015

Name and mailing address of the ISA/

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents

P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Shane Thomas

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/18540

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 4-40, 44-81 and 85-88
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.