

ADENINE DERIVATIVES AS PROTEIN KINASE INHIBITORS

Field of the invention

The present invention is in the field of medicinal chemistry and pharmaceuticals.

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Background of the invention

Cells process environmental signals via signalling and transcriptional networks, also known as signal transduction pathways, that culminate with appropriate regulation of output genes.

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Protein kinases play a key role in almost all signal transduction pathways. The pivotal role of kinases is emphasized by the fact that the human genome encodes 518 protein kinases, representing one of the largest protein families. A kinase is a type of enzyme that transfers phosphate groups from high-energy donor molecules, such as adenosine triphosphate (ATP), to specific substrates, a process referred to as phosphorylation. The phosphorylation state of a substrate, whether it is a protein, lipid, or carbohydrate, can affect its activity, reactivity, and its ability to bind other molecules. Therefore, kinases are critical in metabolism, cell signalling, protein regulation, cellular transport, secretory processes, and many other cellular pathways.

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It is becoming increasingly appreciated that dysregulation of signal transduction pathways involving protein kinases may be involved in the generation or progression of many diseases. Inhibiting kinases, and therefore phosphorylation, can treat these diseases. Thus, development of new classes of cell permeable ligands or protein kinase inhibitors that can modulate disease-relevant pathways is an important area for therapeutics.

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During phosphorylation, the phosphate groups are usually added to the serine, threonine or tyrosine amino acid on the protein. Hence, protein kinase inhibitors can be subdivided or characterized by the amino acids whose phosphorylation is inhibited: most kinases act on both serine and threonine, the tyrosine kinases act on tyrosine, and some kinases act on all three amino

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acids. There are also protein kinases that phosphorylate other amino acids, such as histidine kinases.

5 Kinases have been implicated in diseases such as cancer, inflammatory disorders, cardiovascular diseases, viral induced diseases, circulatory diseases and fibro-proliferative diseases but kinases also play an important role in pain sensitization.

10 Inflammation is an evolutionarily conserved host reaction that is initiated in response to trauma, tissue damage and infection. It leads to changes in tissue homeostasis and blood flow, immune-cell activation and migration, and secretion of cytokines and mediators in a spatial-temporally coordinated manner. Progress in understanding of the mechanisms of the inflammatory response has identified various protein kinases that act as essential signalling components. Chronic inflammation is part of several disease states, such as rheumatoid arthritis, psoriasis, lupus erythematosus, inflammatory bowel disease and asthma. Increasing evidence suggests that
15 neuro-inflammation is a contributor to pathology in various neurological disorders such as Alzheimer's disease (AD), amyotrophic lateral sclerosis, autoimmune disorders, prion diseases, stroke and traumatic brain injury.

20 Suppressing inflammatory responses by employing protein kinase inhibitors may be beneficial as a therapeutic approach to slowing progression of these inflammatory disorders (Matthias Gaestel et al., Nature Reviews Drug Discovery 8, 480-499; D. Martin Watterson et al., Journal of Molecular Neuroscience, 19, 1-2, pp 89-93).

25 Although protein kinases were not favoured as targets for analgesics, studies in the last decade have demonstrated important roles of these kinases in regulating neuronal plasticity and pain sensitization. Pathological pain or clinical pain refers to tissue injury-induced inflammatory pain and nerve injury-induced neuropathic pain and is often chronic. Pathological pain is an expression of neural plasticity that occurs both in the peripheral nervous system, termed peripheral sensitization, and in the central nervous system, termed central sensitization. Multiple protein kinases have been implicated in
30 peripheral and central sensitization.

Inhibition of multiple protein kinases has been shown to attenuate inflammatory and neuropathic pain in different animal models (K.A Sluka, W.D Willis, Pain, Volume 71, Issue 2, June 1997, Pages 165-178).

5 Accordingly, there is still a great need to develop potent inhibitors of protein kinase that are useful in treating the various protein kinase-related conditions.

10 In the field of cancer, the first protein kinase inhibitors (e.g. Imatinib, Gefitinib) have already reached the market. In addition, a great number of protein kinase inhibitors are currently in various phases of clinical development.

WO 2004/022572 (Alchemia Pty Ltd) discloses classes of biologically active compounds interacting with kinases, and the preparation of these compounds.

15 EP 0269574 (Nippon Zoki Pharmaceutical Co. Ltd.) discloses adenosine compounds for use in the treatment of hypertension, cerebrovascular disease, cardiopathy or renal insufficiency.

20 WO 2003/104482 (Metabolic Engineering Laboratories Co., Ltd) discloses a composition for modulating cellular senescence and useful for the treatment of Alzheimer's disease or atherosclerosis, said composition comprising the inhibitor of protein kinase A such as adenosine 3'5'-cyclin phosphorothiolates.

25 WO 1996/040705 (Gensia Inc.) discloses adenosine kinase inhibitors compounds 149-175, 413-431, and 241-266, for use in the treatment of cardiovascular and cerebrovascular diseases, inflammation, arthritis, and cancer.

Palle et al. (Bioorganic & Medicinal Chemistry Letters 14 (2004) 535-539) discloses A1 adenosine partial or full agonists for use in the treatment of atrial fibrillation.

30 WO 2001/040245 (CV Therapeutics Inc.) discloses a method of cardioprotection by using adenosine A1 receptor partial or full agonists.

WO 2005/117882 (Incyte Corporation) discloses ligands of C5a receptor, for use in the treatment of diseases associated with metalloprotease

activity such as arthritis, cancer, cardiovascular disorders, skin disorders, inflammation or allergic conditions.

Cottam et al. (Journal of Medicinal Chemistry, 1993, Vol. 36, No. 22) discloses adenosine kinase inhibitors with oral anti-inflammatory activity.

5 There is a need for protein kinase inhibitors which may overcome the disadvantages of current protein kinase therapy such as side effects, limited efficacy, the emerging of resistance, and compliance failures.

Summary of the invention

10 It is an objective of the present invention to provide protein kinase inhibitors, which can be used to treat a plurality of diseases.

15 It is an objective of the present invention to provide a collection of protein kinase inhibitors, in order to build up a chemical library for testing specific protein kinase inhibition, or for testing inhibition of specific combinations of protein kinases. Each chemical of the library has associated information stored in a database, with information such as the chemical structure, purity, quantity, physicochemical characteristics, and biological activities of each of the compounds.

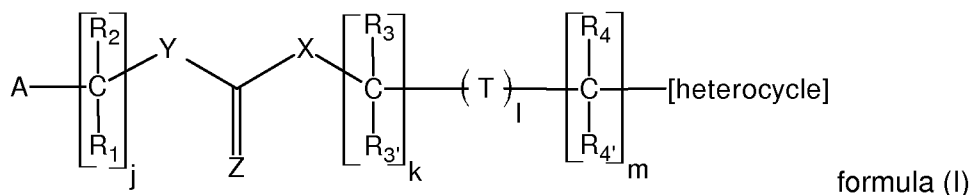
20 It is an objective of the present invention to provide a chemical library of candidate compounds for testing specific protein kinase inhibition, useful for the pharmaceutical industry in its (pre-)clinical selection of drug candidates.

 It is an objective of the present invention to provide a method of inhibiting protein kinase activity, whether in vitro, in vivo, or in silico.

25 The present invention relates to inhibitors of protein kinase as well as to a method of inhibiting protein kinase activity, which exhibit at least one improved property in view of the compounds of the prior art. In particular, the inhibitors of the present invention are interesting in one or more of the following pharmacological related properties, i.e. potency profile, potency against specific kinases, decreased toxicity, decreased cytotoxicity, improved pharmacokinetics, acceptable dosage, processing ease, and the like.

30 The present invention relates to a compound suitable for use as a kinase inhibitor according to general formula (I) [compound (C), herein after],

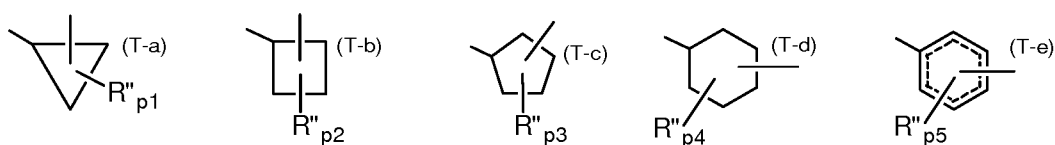
or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof,



wherein:

- 5 - each of A is independently selected from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl, wherein said alkyl, alkenyl, alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl, are optionally substituted with one or more substituents independently selected from the group consisting of halo, NO₂, alkyl, alkenyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, CF₃, CN, OR₁₁, SR₁₁, N(R₁₁)₂, OC(R₁₁)₂O, OC(R₁₁)₂C(R₁₁)₂O, S(O)R₁₂, SO₂R₁₂, SO₂N(R₁₁)₂, S(O)₃R₁₁, P(O)(OR₁₁)₂, SO₂NR₁₁COR₁₂, SO₂NR₁₁CO₂R₁₂, SO₂NR₁₁CON(R₁₁)₂, NR₁₁COR₁₂, NR₁₁CO₂R₁₂, NR₁₁CON(R₁₁)₂, NR₁₁C(NR₁₁)NHR₁₁, COR₁₁, CON(R₁₁)₂, CONR₁₁SO₂R₁₂, NR₁₁SO₂R₁₂, SO₂NR₁₁CO₂R₁₂, OCONR₁₁SO₂R₁₂, OC(O)R₁₁, C(O)OCH₂OC(O)R₁₁, and OCON(R₁₁)₂ and each optional alkyl, alkenyl, cycloalkyl, aryl, heterocyclyl, heteroaryl substituent is further optionally substituted with halo, NO₂, alkyl, cycloalkyl, aryl, CF₃, N(R₁₁)₂, alkyl or aryl or heteroaryl amide, NR₁₁COR₁₂, NR₁₁SO₂R₁₂, COR₁₁, CON(R₁₁)₂, NR₁₁CON(R₁₁)₂, OC(O)R₁₁, OC(O)N(R₁₁)₂, S(O)₃R₁₁, P(O)(OR₁₁)₂, SR₁₁, S(O)R₁₂, SO₂R₁₂, SO₂N(R₁₁)₂, CN, or OR₁₁; and wherein each of R₁₁ and R₁₂, independently from each other and at each occurrence, are selected from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, aralkyl and CF₃, wherein said alkyl, alkenyl, alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl substituents are optionally substituted with halo, alkyl, cycloalkyl, heterocyclyl, mono- or dialkylamino, alkyl or aryl or heteroaryl amide, CN, O—C₁₋₆alkyl, CF₃, aryl, or heteroaryl;

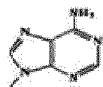
- each of X and Y, independently from each other and at each occurrence, are selected from O, C, S, NR₇; and wherein R₇ is selected from hydrogen, C₁₋₁₂ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group;
- each of Z is O, S, N—CN, N—OR₈; and wherein R₈ is selected from hydrogen, an C₁₋₁₂ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group;
- each of R₁ and R₂, independently from each other and at each occurrence, are selected from the group consisting of hydrogen; C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl and C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group; OR₁₃, SR₁₃ or N(R₁₃)₂ wherein each of R₁₃, independent from each other, is selected from hydrogen or C₁₋₁₂ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group, and j is an integer in the range from 0 to 7; with the proviso that when j = 0 and Y = NR₇, then A and R₇ may form together a saturated or unsaturated cyclic moiety;
- each of R₃, R_{3'}, R₄ and R_{4'}, independently from each other and at each occurrence, are selected from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl and C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group;
- each of T is selected from the group consisting of O, S, NR₉, or a divalent moiety of formula (T-a) to (T-e) wherein the second point of attachment can be at any carbon atom of the cyclic system, wherein the dash bond represents an optional double bond;



and wherein R₉ is selected from hydrogen or a C₁₋₁₂ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group;

and each of R" is selected independently and at each occurrence, from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl and C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group; and each of p₁ is an integer in the range from 0 to 4; each of p₂ is an integer in the range from 0 to 6; each of p₃ is an integer in the range from 0 to 8; each of p₄ is an integer in the range from 0 to 10; each of p₅ is an integer in the range from 0 to 8;

- each of k is an integer in the range from 0 to 7; each of l is an integer in the range from 0 to 1; and each of m is an integer in the range from 0 to 7 and with the proviso that the sum of k and m is equal to or greater than 1, and with the proviso that when m is 0, l and k is 1, T is of formula T-a, each of R", R₃ and R_{3'} is hydrogen, A is C₆H₅, X and Z is O, Y is NH and the heterocycle is of following formula



then j is an integer in the range from 1 to 7.

The present invention further relates to a pharmaceutical composition comprising a carrier, and as active ingredient an effective amount of a compound as defined in any one of the embodiments presented herein.

The present invention relates to a compound as defined in any one of the embodiments presented herein, for use as a medicament.

The present invention relates to a compound as defined in any one of the embodiments presented herein for use in the treatment of a disease selected from cancer, inflammatory disorders, cardiovascular diseases, viral induced diseases, circulatory diseases and fibro-proliferative diseases.

The present invention relates to a compound as defined in any one of the embodiments presented herein, for use in the treatment of pain sensitization.

The present invention further relates to a method of inhibiting protein kinase activity in a warm-blooded animal said method comprising the

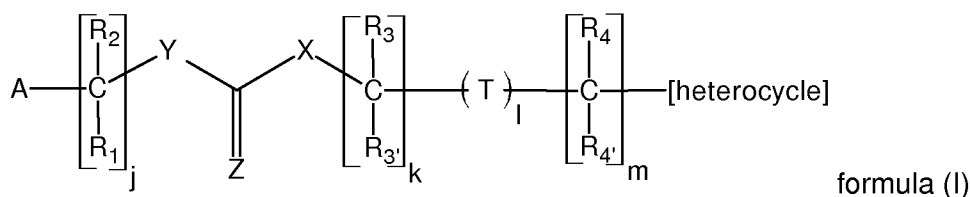
administration to an animal in need thereof, of a kinase-inhibitory effective amount of a compound according to any one of the embodiments presented herein.

The present invention further relates to a method of treating a disease selected from cancer, inflammatory disorders, cardiovascular diseases, viral induced diseases, circulatory diseases and fibro-proliferative diseases, in a warm-blooded animal said method comprising the administration to an animal in need thereof of an effective amount of a compound according to any one of the embodiments presented herein.

The present invention further relates to a method of treating pain sensitization, in a warm-blooded animal said method comprising the administration to an animal in need thereof of an effective amount of a compound according to any one of the embodiments presented herein.

Detailed description of the invention

The present invention relates to a compound suitable for use as a kinase inhibitor according to general formula (I) [compound (C), herein after], or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof,



wherein:

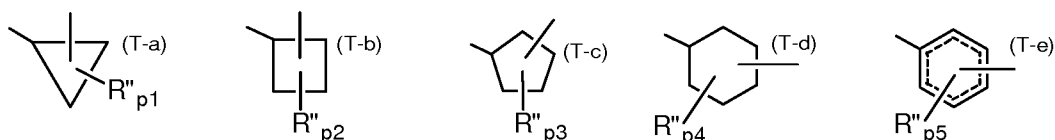
- each of A is independently selected from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl, wherein said alkyl, alkenyl, alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl, are optionally substituted with one or more substituents independently selected from the group consisting of halo, NO₂, alkyl, alkenyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, CF₃, CN, OR₁₁, SR₁₁, N(R₁₁)₂, OC(R₁₁)₂O, OC(R₁₁)₂C(R₁₁)₂O, S(O)R₁₂, SO₂R₁₂, SO₂N(R₁₁)₂, S(O)₃R₁₁, P(O)(OR₁₁)₂, SO₂NR₁₁COR₁₂, SO₂NR₁₁CO₂R₁₂,

$\text{SO}_2\text{NR}_{11}\text{CON}(\text{R}_{11})_2$, $\text{NR}_{11}\text{COR}_{12}$, $\text{NR}_{11}\text{CO}_2\text{R}_{12}$, $\text{NR}_{11}\text{CON}(\text{R}_{11})_2$,
 $\text{NR}_{11}\text{C}(\text{NR}_{11})\text{NHR}_{11}$, COR_{11} , $\text{CON}(\text{R}_{11})_2$, $\text{CONR}_{11}\text{SO}_2\text{R}_{12}$, $\text{NR}_{11}\text{SO}_2\text{R}_{12}$,
 $\text{SO}_2\text{NR}_{11}\text{CO}_2\text{R}_{12}$, $\text{OCONR}_{11}\text{SO}_2\text{R}_{12}$, $\text{OC}(\text{O})\text{R}_{11}$, $\text{C}(\text{O})\text{OCH}_2\text{OC}(\text{O})\text{R}_{11}$, and
 $\text{OCON}(\text{R}_{11})_2$ and each optional alkyl, alkenyl, cycloalkyl, aryl, heterocyclyl,
 5 heteroaryl substituent is further optionally substituted with halo, NO_2 , alkyl,
 cycloalkyl, aryl, CF_3 , $\text{N}(\text{R}_{11})_2$, alkyl or aryl or heteroaryl amide, $\text{NR}_{11}\text{COR}_{12}$,
 $\text{NR}_{11}\text{SO}_2\text{R}_{12}$, COR_{11} , $\text{CON}(\text{R}_{11})_2$, $\text{NR}_{11}\text{CON}(\text{R}_{11})_2$, $\text{OC}(\text{O})\text{R}_{11}$,
 $\text{OC}(\text{O})\text{N}(\text{R}_{11})_2$, $\text{S}(\text{O})_3\text{R}_{11}$, $\text{P}(\text{O})(\text{OR}_{11})_2$, SR_{11} , $\text{S}(\text{O})\text{R}_{12}$, SO_2R_{12} , $\text{SO}_2\text{N}(\text{R}_{11})_2$,
 10 CN , or OR_{11} ; and wherein each of R_{11} and R_{12} , independently from each
 other and at each occurrence, are selected from the group consisting of
 hydrogen, C_{1-15} alkyl, C_{2-15} alkenyl, C_{2-15} alkynyl, cycloalkyl, heterocyclyl,
 aryl, heteroaryl, aralkyl and CF_3 , wherein said alkyl, alkenyl, alkynyl,
 cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl substituents are
 optionally substituted with halo, alkyl, cycloalkyl, heterocyclyl, mono- or
 15 dialkylamino, alkyl or aryl or heteroaryl amide, CN , $\text{O}-\text{C}_{1-6}$ alkyl, CF_3 , aryl,
 or heteroaryl;

- each of X and Y, independently from each other and at each occurrence,
 are selected from O, C, S, NR_7 ; and wherein R_7 is selected from hydrogen,
 C_{1-12} alkyl which is optionally substituted by a halogen atom, an aryl group
 20 or an aralkyl group;
- each of Z is O, S, $\text{N}-\text{CN}$, $\text{N}-\text{OR}_8$; and wherein R_8 is selected from
 hydrogen, an C_{1-12} alkyl which is optionally substituted by a halogen atom,
 an aryl group or an aralkyl group;
- each of R_1 and R_2 , independently from each other and at each occurrence,
 25 are selected from the group consisting of hydrogen; C_{1-15} alkyl, C_{2-15} alkenyl
 and C_{2-15} alkynyl, wherein said C_{1-15} alkyl, C_{2-15} alkenyl, C_{2-15} alkynyl are
 optionally substituted with a halogen atom, an aryl group or an aralkyl
 group; OR_{13} , SR_{13} or $\text{N}(\text{R}_{13})_2$ wherein each of R_{13} , independent from each
 other, is selected from hydrogen or C_{1-12} alkyl which is optionally
 30 substituted by a halogen atom, an aryl group or an aralkyl group, and j is
 an integer in the range from 0 to 7; with the proviso that when j = 0 and Y

= NR₇, then A and R₇ may form together a saturated or unsaturated cyclic moiety;

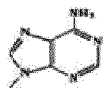
- each of R₃, R_{3'}, R₄ and R_{4'}, independently from each other and at each occurrence, are selected from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl and C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group;
- each of T is selected from the group consisting of O, S, NR₉, or a divalent moiety of formula (T-a) to (T-e) wherein the second point of attachment can be at any carbon atom of the cyclic system, wherein the dash bond represents an optional double bond;



and wherein R₉ is selected from hydrogen or a C₁₋₁₂ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group;

- each of R'' is selected independently and at each occurrence, from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl and C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group; and each of p₁ is an integer in the range from 0 to 4; each of p₂ is an integer in the range from 0 to 6; each of p₃ is an integer in the range from 0 to 8; each of p₄ is an integer in the range from 0 to 10; each of p₅ is an integer in the range from 0 to 8;
- each of k is an integer in the range from 0 to 7; each of l is an integer in the range from 0 to 1; and each of m is an integer in the range from 0 to 7 and with the proviso that the sum of k and m is equal to or greater than 1,

and with the proviso that when m is 0, l and k is 1, T is of formula T-a, each of R'', R₃, and R_{3'} is hydrogen, A is C₆H₅, X and Z is O, Y is NH and the heterocycle is of following formula



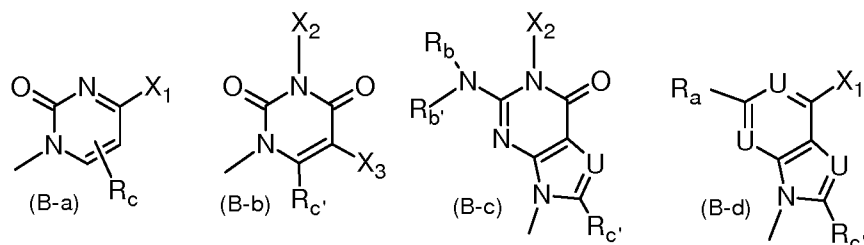
then j is an integer in the range from 1 to 7.

For the purpose of the present invention, the expression "[heterocycle]" refers to natural nucleobases and/or modified nucleobases.

5 For the purpose of the present invention, the expression "nucleobases" is intended to denote bases comprising purines and pyrimidines which include, for example the specific bases adenine, guanine, thymine, cytosine and uracil.

As such, modified nucleobases typically refers modified adenine, guanine, thymine, cytosine and/or uracil bases.

10 In one embodiment, the present invention provides modified nucleobases selected from the group consisting of (B-a) to (B-d):



wherein:

- each of R_c and $R_{c'}$, independently and at each occurrence, are selected from the group consisting of hydrogen, halo, C_{1-15} alkyl, C_{2-15} alkenyl, C_{2-15} alkynyl, heterocyclyl, aryl, and heteroaryl, wherein said alkyl, alkenyl, alkynyl, heterocyclyl, aryl, and heteroaryl are optionally substituted with one or more substituents selected from halo or an alkyl group; and each of c is an integer in the range from 0 to 2;
- each of R_a is independently selected from the group consisting of hydrogen, halo, CF_3 , $N(R_{14})_2$, CN, C_{1-15} alkyl, C_{2-15} alkenyl, C_{2-15} alkynyl, cycloalkyl, heterocyclyl, aryl, and heteroaryl, wherein said alkyl, cycloalkyl, heterocyclyl, aryl, and heteroaryl are optionally substituted with one or more substituents selected from halo, C_{1-15} alkyl or $O-C_{1-6}$ alkyl; and wherein each of R_{14} , independent from each other, is selected from hydrogen, C_{1-15} alkyl, or cycloalkyl; preferably each of R_a is independently

selected from the group consisting of hydrogen, halo, $N(R_{14})_2$, heterocyclyl, and heteroaryl, wherein said heterocyclyl, and heteroaryl are optionally substituted with one or more substituents selected from halo or C_{1-4} alkyl; preferably each of R_{14} , independent from each other, is selected from hydrogen, C_{1-4} alkyl or cycloalkyl; or preferably each of R_a is selected from C_{1-15} alkyl, C_{1-15} cycloalkyl, C_{2-15} alkenyl, C_{2-15} alkynyl, more preferably each of R_a is C_{1-10} alkyl, C_{1-6} cycloalkyl, C_{2-10} alkenyl, or C_{2-10} alkynyl.

- each of X_1 is independently selected from the group consisting of hydrogen, halo, and $N(R_b)_2$ wherein R_b is hydrogen or a C_{1-15} alkyl which is optionally substituted by a halogen atom, an aryl, a heterocyclyl or an aralkyl group, preferably R_b is selected from hydrogen or a C_{1-5} alkyl which is optionally substituted by an aryl, a heterocyclyl or an aralkyl group, most preferably R_b is hydrogen;
- each of X_2 is selected from hydrogen or C_{1-15} alkyl which is optionally substituted with one or more substituents selected from halo, C_{1-15} alkyl, or $O-C_{1-6}$ alkyl; preferably X_2 is hydrogen or C_{1-4} alkyl;
- each of X_3 is selected from hydrogen, halo or C_{1-15} alkyl which is optionally substituted with one or more substituents selected from halo, C_{1-15} alkyl, or $O-C_{1-6}$ alkyl; preferably X_3 is hydrogen, halo or C_{1-4} alkyl;
- each of U is independently selected from N or $C-R_d$ wherein R_d is hydrogen, C_{1-5} alkyl or halo; preferably U is N or $C-R_d$ wherein R_d is hydrogen or halo; more preferably U is N;

In a preferred embodiment of the present invention, A is independently selected from the group consisting of hydrogen, C_{1-10} alkyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl, wherein said alkyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl, are optionally substituted with one or more substituents independently selected from the group consisting of halo, alkyl, alkenyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, CF_3 , CN, OR_{11} , $N(R_{11})_2$, $OC(R_{11})_2O$, $OC(R_{11})_2C(R_{11})_2O$, $S(O)R_{12}$, SO_2R_{12} , $SO_2N(R_{11})_2$, $SO_2NR_{11}COR_{12}$, $NR_{11}COR_{12}$, $NR_{11}CON(R_{11})_2$, COR_{11} , $CON(R_{11})_2$, $OC(O)R_{11}$, $C(O)OCH_2OC(O)R_{11}$, and $OCON(R_{11})_2$ and each optional alkyl, alkenyl, cycloalkyl, aryl, heterocyclyl, heteroaryl substituent is further optionally

substituted with halo, alkyl, cycloalkyl, aryl, $N(R_{11})_2$, COR_{11} , $CON(R_{11})_2$, SR_{11} , SO_2R_{12} , CN, or OR_{11} . More preferably A is independently selected from the group consisting of hydrogen, C_{1-6} alkyl, cycloalkyl, heterocyclyl, aryl, and heteroaryl, wherein said alkyl, cycloalkyl, heterocyclyl, aryl, heteroaryl are
5 optionally substituted with one or more substituents independently selected from the group consisting of halo, alkyl, alkenyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, CF_3 , CN, OR_{11} , $N(R_{11})_2$, $OC(R_{11})_2O$, $OC(R_{11})_2C(R_{11})_2O$, SO_2R_{12} , and $SO_2N(R_{11})_2$, and each optional alkyl, alkenyl, cycloalkyl, aryl, heterocyclyl, heteroaryl substituent is further optionally substituted with halo, alkyl,
10 cycloalkyl, aryl, $N(R_{11})_2$, $CON(R_{11})_2$, SO_2R_{12} , or CN. Most preferably A is independently selected from the group consisting of hydrogen, aryl and heteroaryl, wherein said aryl, heteroaryl are optionally substituted with one or more substituents independently selected from the group consisting of halo, alkyl, OR_{11} , $OC(R_{11})_2O$, $OC(R_{11})_2C(R_{11})_2O$, SO_2R_{12} , and $SO_2N(R_{11})_2$ and in one
15 embodiment of the present invention, each of R_{11} and R_{12} , independently from each other and at each occurrence, are selected selected from the group consisting of hydrogen, C_{1-5} alkyl, heterocyclyl, aryl, aralkyl and CF_3 , wherein said alkyl, heterocyclyl, aryl and aralkyl substituents are optionally substituted with halo or heterocyclyl.

20 In a preferred embodiment of compound (C) according to the present invention, X in compound (C) of general formula (I) is independently selected from O or NR_7 wherein R_7 is hydrogen or C_{1-5} alkyl, preferably X in compound (C) of general formula (I) is O.

25 In a preferred embodiment of compound (C) according to the present invention, Y in compound (C) of general formula (I) is independently selected from O or NR_7 wherein R_7 is hydrogen or C_{1-6} alkyl such as methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl, pentyl, hexyl and the like, preferably Y in compound (C) of general formula (I) is NR_7 wherein R_7 is hydrogen or methyl.

30 In a preferred embodiment of compound (C) according to the present invention, Z in compound (C) of general formula (I) is independently selected from O or S, preferably Z in compound (C) of general formula (I) is O.

In one embodiment of the present invention, each of R_1 and R_2 , independently from each other and at each occurrence are selected from the group consisting of hydrogen; C_{1-10} alkyl wherein said alkyl is optionally substituted with a halogen atom or an aryl group; OR_{13} or $N(R_{13})_2$ wherein each of R_{13} , independent from each other, is selected from hydrogen or an C_{1-10} alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group. Preferably each of R_1 and R_2 , independently from each other and at each occurrence are selected from the group consisting of hydrogen; C_{1-6} alkyl wherein said alkyl is optionally substituted with a halogen atom or an aryl group; OR_{13} or $N(R_{13})_2$ wherein each of R_{13} , independent from each other, is selected from hydrogen or an C_{1-10} alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group. More preferably each of R_1 and R_2 , independently from each other and at each occurrence are selected from the group consisting of hydrogen and C_{1-4} alkyl such as methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl, and the like.

In one embodiment of the present invention, each of R_3 , $R_{3'}$, R_4 and $R_{4'}$, independently from each other and at each occurrence, are selected from the group consisting of hydrogen, C_{1-10} alkyl and C_{2-10} alkenyl wherein said alkyl and alkenyl, are optionally substituted with a halogen atom, an aryl group or an aralkyl group. Preferably each of R_3 , $R_{3'}$, R_4 and $R_{4'}$, independently from each other and at each occurrence, are selected from the group consisting of hydrogen and C_{1-5} alkyl wherein said alkyl is optionally substituted with a halogen atom. More preferably each of R_3 , $R_{3'}$, R_4 and $R_{4'}$, independently from each other and at each occurrence, are selected from the group consisting of hydrogen and C_{1-4} alkyl such as methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl and the like. Most preferably each of R_3 , $R_{3'}$, R_4 and $R_{4'}$ are hydrogen.

In one embodiment of the present invention, each of R'' is selected independently and at each occurrence, from the group consisting of hydrogen, C_{1-10} alkyl and C_{2-10} alkenyl wherein said alkyl and alkenyl, are optionally substituted with a halogen atom, an aryl group or an aralkyl group. Preferably each of R'' is selected independently and at each occurrence, from the group

consisting of hydrogen and C₁₋₅ alkyl wherein said alkyl is optionally substituted with a halogen atom. More preferably each of R'' is selected independently and at each occurrence, from the group consisting of hydrogen and C₁₋₄ alkyl such as methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl and the like. Most preferably R'' is hydrogen.

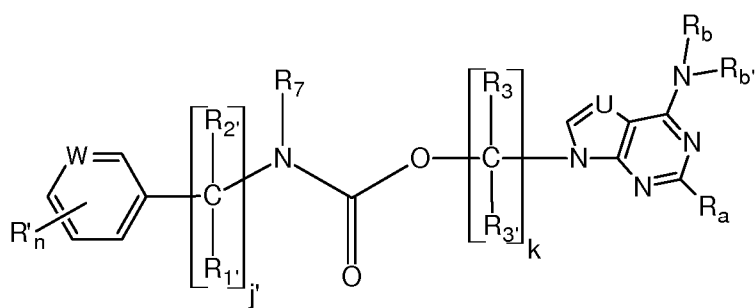
In one embodiment of the present invention, j is an integer in the range from 0 to 5, preferably j is an integer in the range from 0 to 3.

In one embodiment of the present invention, k is an integer in the range from 0 to 7, preferably k is an integer in the range from 2 to 5, more preferably k is 4 or 2.

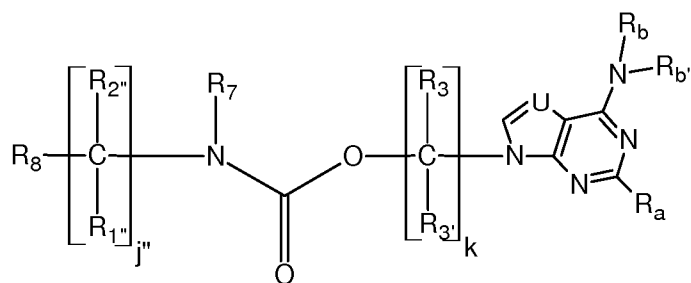
In one embodiment of the present invention, m is an integer in the range from 0 to 7, preferably m is an integer in the range from 0 to 5, more preferably m is an integer in the range from 0 to 3, most preferably m is 0 or 1.

In one embodiment of the present invention, the compound (C) for use as a kinase inhibitor according to general formula (I), or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, is used in the treatment of a disease mediated by a protein kinase, wherein the protein kinase is selected from the group consisting of ABL1, ACVR1B (ALK4), AKT1 (PKB alpha), AMPK A1/B1/G1, AURKA (Aurora A), BTK, CDK1/cyclin B, CHEK1 (CHK1), CSNK1G2 (CK1 gamma 2), CSNK2A1 (CK2 alpha 1), DYRK3, EGFR (ErbB1), EPHA2, ERBB2 (HER2), FGFR1, FLT3, FRAP1 (mTOR), GSK3B (GSK3 beta), IGF1R, IKBKB (IKK beta), INSR, IRAK4, JAK3, KDR (VEGFR2), KIT, LCK, MAP2K1 (MEK1), MAP4K4 (HGK), MAPK1 (ERK2), MAPK14 (p38 alpha), MAPK3 (ERK1), MAPK8 (JNK1), MARK2, MET (cMet), NEK1, PAK4, PDGFRB (PDGFR beta), PHKG2, PIM1, PLK1, PRKACA (PKA), PRKCB1 (PKC beta I), ROCK1, RPS6KA3 (RSK2), RPS6KB1 (p70S6K), SRC, SYK, and TEK (Tie2).

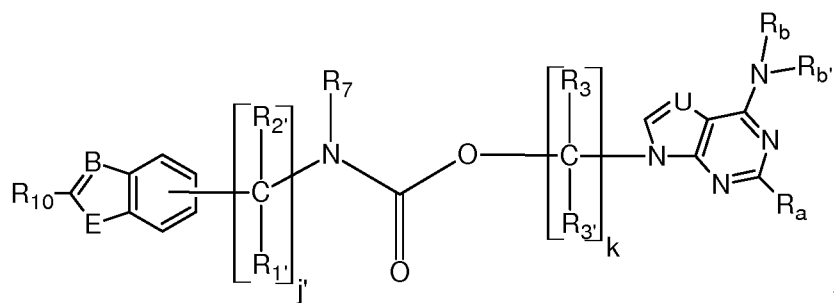
According to one embodiment of the present invention, the compound (C) for use as a kinase inhibitor, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, preferably is a compound chosen among those of formulae (II) to (V) [compounds (C) of class (I), herein after]:



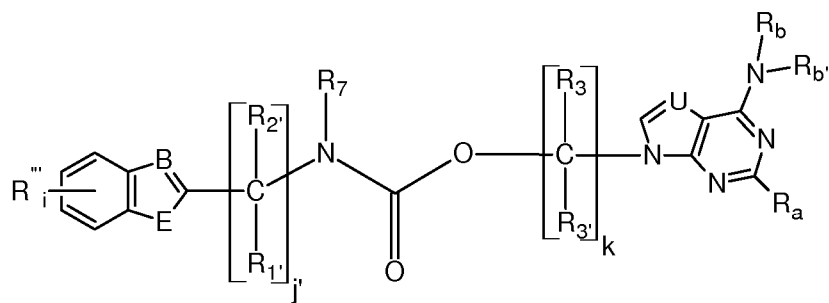
formula (II)



formula (III)



formula (IV)



formula (V)

wherein R_a and U have the same meaning as defined above and wherein:

- each of R' and R''' independently from each other and at each occurrence, are selected from halo, C₁₋₆ alkyl, C₁₋₆ alkenyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, CF₃, CN, OR₂₁, N(R₂₁)₂, OC(R₂₁)₂O, OC(R₂₁)₂C(R₂₁)₂O, SO₂R₂₂ or SO₂N(R₂₁)₂, wherein said alkyl, alkenyl, cycloalkyl, aryl, heterocyclyl, heteroaryl group is further optionally substituted with one or more substituents selected from halo, alkyl, cycloalkyl, aryl, N(R₂₁)₂, CON(R₂₁)₂, SO₂R₂₂, or CN; wherein each of R₂₁ and R₂₂ are independently selected from the group consisting of hydrogen, C₁₋₅ alkyl, heterocyclyl, aryl, aralkyl and CF₃, wherein said alkyl, heterocyclyl, aryl and aralkyl substituents are optionally substituted with halo or heterocyclyl; and wherein R' may be attached to two carbon atoms of the aryl group thereby forming a bicyclic system; or alternatively when W is a nitrogen, R' may be attached to one carbon atom and the nitrogen atom of the aryl group thereby forming a bicyclic system and n is an integer in the range from 0 to 4, preferably n is an integer in the range from 0 to 3; and i is an integer in the range from 0 to 4, preferably i is 0 or 1;
- each of R_{1'}, R_{2'}, R₃ and R_{3'}, independently from each other and at each occurrence, are selected from the group consisting of hydrogen, C₁₋₁₀ alkyl and C₂₋₁₀ alkenyl wherein said alkyl and alkenyl, are optionally substituted with a halogen atom, an aryl group or an aralkyl group; preferably each of R_{1'}, R_{2'}, R₃ and R_{3'}, independently from each other and at each occurrence, are selected from hydrogen or an C₁₋₄ alkyl;
- each of R_{1''} and R_{2''}, independently from each other and at each occurrence are selected from the group consisting of hydrogen; C₁₋₁₀ alkyl wherein said alkyl is optionally substituted with a halogen atom or an aryl group; OR₂₃ or N(R₂₃)₂ wherein each of R₂₃, independent from each other, is selected from hydrogen or an C₁₋₁₀ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group; preferably each of R_{1''} and R_{2''}, independently from each other and at each occurrence are selected from the group consisting of

hydrogen; C₁₋₅ alkyl; OR₂₃ wherein each of R₂₃, independent from each other, is selected from hydrogen or C₁₋₄ alkyl;

- each of R_b and R_{b'}, independent from each other and at each occurrence, are selected from hydrogen; an C₁₋₁₅ alkyl which is optionally substituted by a halogen atom, an aryl, a heterocyclyl or an aralkyl group; preferably each of R_b and R_{b'}, independent from each other and at each occurrence, are each selected from hydrogen; a C₁₋₅ alkyl which is optionally substituted by an aryl, a heterocyclyl or an aralkyl group, most preferably R_b is hydrogen;

- each of R₇ is independently selected from hydrogen or C₁₋₆ alkyl such as, for example, methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl, pentyl, hexyl and the like; preferably R₇ is hydrogen;

- each of k is an integer in the range from 2 to 5;

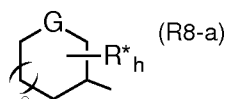
- each of W is selected, independently and at each occurrence, from C-halo, C-R₂₄, O or N; and wherein R₂₄ is selected from hydrogen or an C₁₋₁₀ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group, preferably W is selected, independently and at each occurrence, from C-halo, C-R₂₄ or N; and preferably R₂₄ is hydrogen or C₁₋₅ alkyl;

- each of E is independently selected from CH₂, O, CH-halo or NR₂₅; and wherein R₂₅ is selected from hydrogen or an C₁₋₁₀ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group; preferably each of E is independently selected from CH₂, O, or NR₂₅; and preferably R₂₅ is selected from hydrogen or C₁₋₅ alkyl;

- each of B is selected, independently and at each occurrence, from C-halo, C-R₂₆, O, or N; and wherein R₂₆ is selected from hydrogen or an C₁₋₁₀ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group; preferably each of B is selected, independently and at each occurrence, from C-R₂₆, O, N; and preferably R₂₆ is selected from hydrogen; C₁₋₅ alkyl;

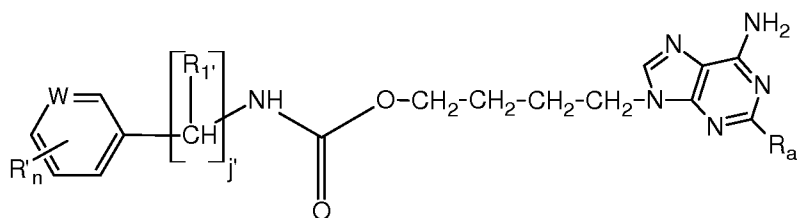
- each of j' is an integer in the range from 0 to 5, preferably j' is an integer in the range from 1 to 3;

- each of j'' is an integer in the range from 0 to 15, preferably j'' is an integer in the range from 0 to 8, more preferably j'' is an integer in the range from 0 to 4;
- each of R_8 is independently selected from the group consisting of hydrogen, or the moiety of formula (R8-a) wherein G is N or C; wherein R^* is selected from C_{1-6} alkyl, OH, O- C_{1-6} alkyl, an aryl or aralkyl group and R^* may be attached to one atom, including G, or two atoms of the cyclic group thereby forming a bicyclic system; wherein h is an integer in the range between 0 to 4; and wherein o is an integer in the range between 0 to 1; preferably each of R_8 is independently selected from the group consisting of hydrogen, or the moiety of formula (R8-a) wherein G is N or C; preferably R^* is selected from OH, an aryl or aralkyl group and R^* may be attached to one atom, including G, or two atoms of the cyclic group thereby forming a bicyclic system; preferably h is an integer in the range between 1 to 3; preferably o is 0;

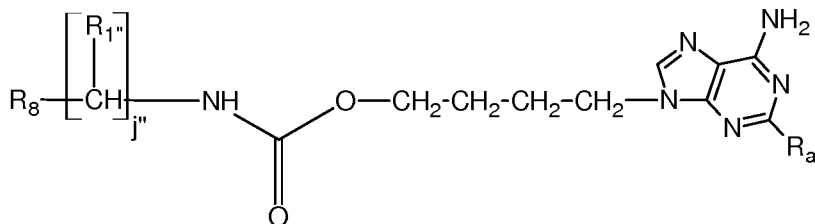


- each of R_{10} is independently selected from hydrogen, halo, C_{1-6} alkyl, C_{1-6} alkenyl, cycloalkyl or $N(R_{27})_2$; and wherein R_{27} is independently selected from hydrogen or an C_{1-10} alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group, preferably each of R_{10} is independently selected from hydrogen, C_{1-4} alkyl, cycloalkyl, or $N(R_{27})_2$; and preferably R_{27} is independently selected from hydrogen or an C_{1-5} alkyl;

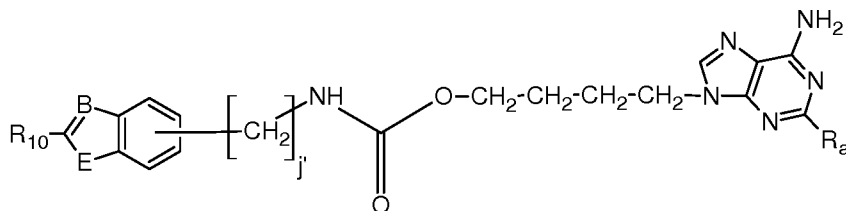
In compounds (C) according to the present invention, preferably R_1 , R_2 , R_2' , R_3 , R_4 , R_3' , R_4' , R_7 , R_b and R_b' are hydrogen and U is N. Preferred compounds (C) of class (I) are thus selected from those of formula (II-a) to (IV-a) herein below:



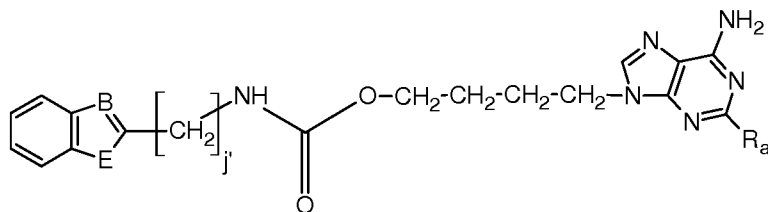
formula (II-a)



formula (III-a)



formula (IV-a)



formula (V-a)

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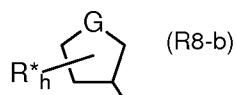
wherein R' has the same meaning as defined above for formula (II) to (V) and wherein:

- each of R_a is independently selected from the group consisting of hydrogen, halo, $N(R_{14})_2$, heterocyclyl, and heteroaryl, wherein said heterocyclyl, and heteroaryl are optionally substituted with one or more substituents selected from halo or C_{1-4} alkyl; preferably each of R_{14} , independent from each other, is selected from hydrogen, C_{1-4} alkyl, or cycloalkyl; or preferably each of R_a is selected from C_{1-15} alkyl, C_{1-15} cycloalkyl, C_{2-15} alkenyl, or C_{2-15} alkynyl, more preferably each of R_a is selected from C_{1-10} alkyl, C_{1-6} cycloalkyl, C_{2-10} alkenyl, C_{2-10} alkynyl;
- each of $R_{1'}$ is independently selected from hydrogen or C_{1-4} alkyl;

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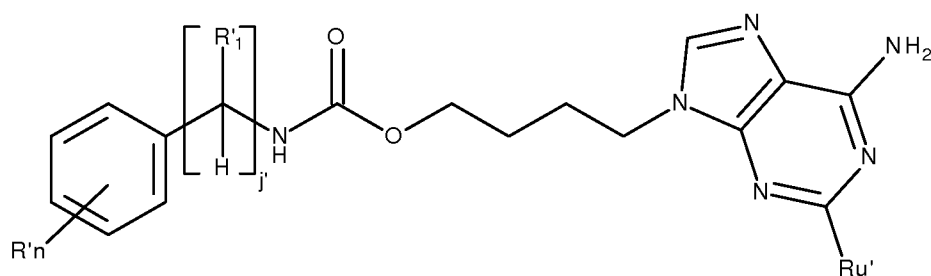
- each of $R_{1''}$ is independently selected from hydrogen, C_{1-5} alkyl, or OR_{23} wherein each of R_{23} , independent from each other, is selected from hydrogen or C_{1-4} alkyl;
- each of W is selected, independently and at each occurrence, from C-halo, $C-R_{24}$ or N; and wherein R_{24} is hydrogen or C_{1-5} alkyl;
- each of R_8 is independently selected from the group consisting of hydrogen, or the moiety of formula (R8-a) wherein G is N or C; and wherein R^* is selected from OH, an aryl or aralkyl group and each R^* may be attached to one atom, including G, or two atoms of the cyclic group thereby forming a bicyclic system; and h is an integer in the range between 1 to 3;



- each of E is independently selected from CH_2 , O or NR_{25} ; and R_{25} is selected from hydrogen or C_{1-5} alkyl;
- each of B is selected, independently and at each occurrence, from $C-R_{26}$, O or N; and preferably R_{26} is selected from hydrogen or C_{1-5} alkyl;
- each of R_{10} is independently selected from hydrogen, C_{1-4} alkyl, cycloalkyl or $N(R_{27})_2$; and R_{27} is selected from hydrogen or C_{1-5} alkyl;
- each of j' is an integer in the range from 1 to 3;
- each of j'' is an integer in the range from 0 to 4.

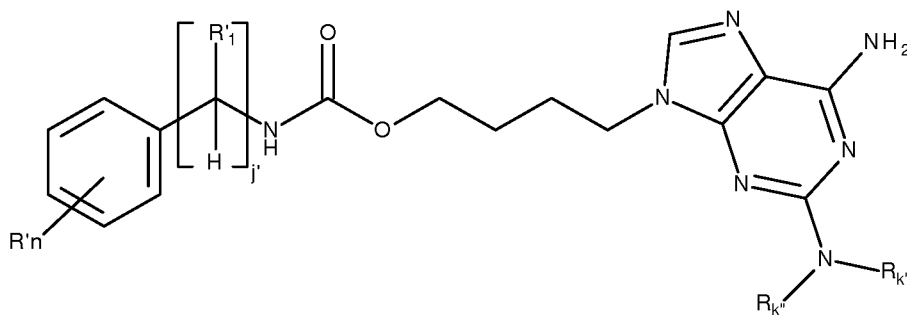
In one embodiment of the present invention, the compounds (C) of class (I) are selected from those of formula (II-a) and (IV-a).

In a preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (II-a) is a compound chosen among those of formulae (II-a-1) to (II-a-7) to herein below:



formula (II-a-1)

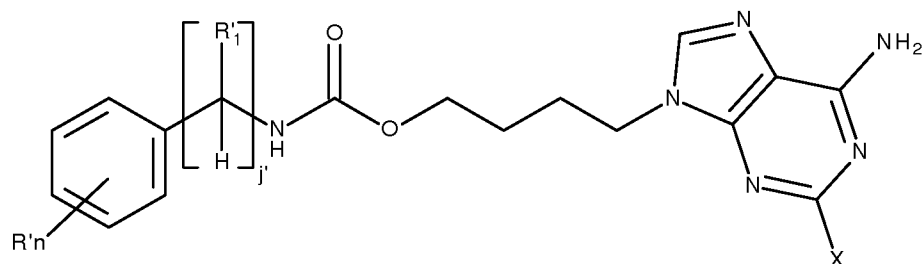
wherein Ru' is hydrogen; C_6H_5 ; heteroaryl selected from the group consisting of furanyl, pyrrolyl, isoxazolyl, pyrazolyl, and pyridinyl, wherein said heteroaryl is optionally further substituted with methyl; aryl and wherein said aryl is optionally further substituted with $-CN$, $-CH_3$, F , or $-OCH_3$; and each of R' is selected from the group consisting of CF_3 ; hydrogen; halo; heterocyclyl; C_6H_5 ; OCH_3 ; CH_3 ; heteroaryl selected from the group consisting of furanyl, pyrrolyl, isoxazolyl, pyrazolyl, and pyridinyl and wherein said heteroaryl is optionally further substituted with methyl; and aryl wherein said aryl is optionally substituted with CN or $CONH_2$; and n is an integer in the range from 0 to 3; and each of R'_1 is an hydrogen or a linear or branched C_zH_{2z+1} wherein z is an integer from 1 to 5 and j' is an integer in the range from 1 to 3.



formula (II-a-2)

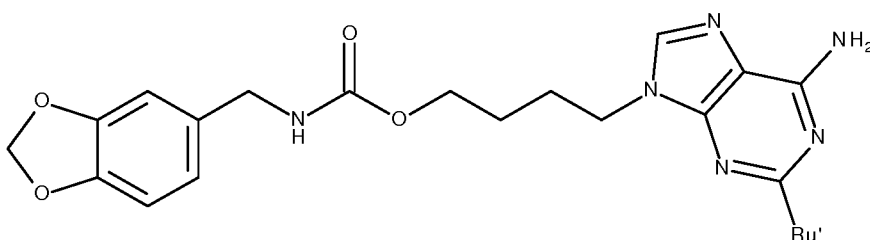
wherein each of R' is selected from the group consisting of hydrogen, halo, CF_3 , heterocyclyl, aryl, and a linear or branched C_wH_{2w+1} wherein w is an integer from 1 to 5, and n is an integer in the range from 0 to 3 and each of R'_1 is an hydrogen or a linear or branched C_zH_{2z+1} wherein z is an integer from 1 to 5 and j' is an integer in the range from 1 to 3 and $R_{k'}$ and $R_{k''}$ are independently from each other and at each occurrence selected from H , C_{1-4} alkyl and C_{1-4}

cycloalkyl, $R_{K'}$ and $R_{K''}$ may also form together with the nitrogen N a heterocyclyl such as azetidine or pyrrolidine, preferably $R_{K'}$ and $R_{K''}$ are hydrogen, methyl, isobutyl and cyclopropyl.



formula (II-a-3)

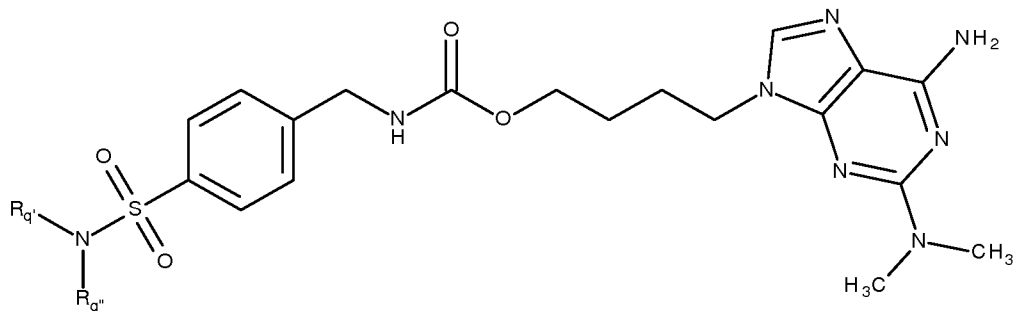
wherein each of R' is selected from the group consisting of hydrogen; halo; heterocyclyl; C_{1-5} cycloalkyl; C_{1-3} alkenyl; C_{1-3} alkynyl; C_6H_5 ; CF_3 ; CH_3 ; CN; heteroaryl selected from the group consisting of furanyl, pyrrolyl, isoxazolyl, pyrazolyl, and pyridinyl and wherein said heteroaryl is optionally further substituted with methyl; aryl wherein said aryl is optionally substituted with CN or $CONH_2$; OR_{21} ; $N(R_{21})_2$ wherein each of R_{21} is independently selected from the group consisting of hydrogen, C_{1-5} alkyl, heterocyclyl, aryl, aralkyl, and CF_3 ; and a linear or branched C_wH_{2w+1} wherein w is an integer from 1 to 5, and n is an integer in the range from 0 to 3, and R'_1 is an hydrogen or a linear or branched C_zH_{2z+1} wherein z is an integer from 1 to 5 and j' is an integer in the range from 1 to 3 and X is Cl or F.



formula (II-a-4)

wherein Ru' is hydrogen; halo; cyclopropyl; heteroaryl selected from the group consisting of furanyl, pyrrolyl, isoxazolyl, pyrazolyl, and pyridinyl; C_6H_5

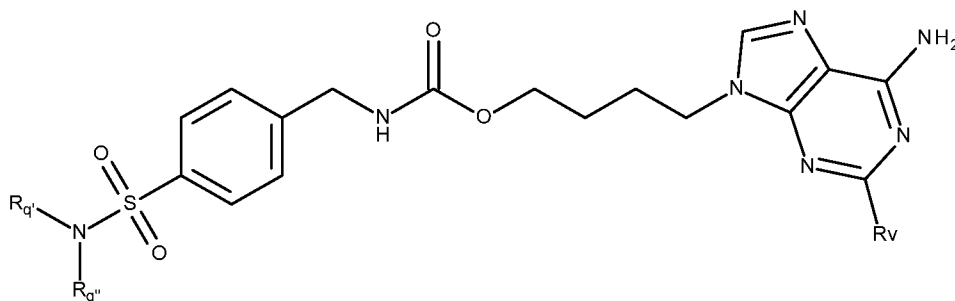
and wherein said heteroaryl is optionally further substituted with methyl; $N(R_{21})_2$, and wherein each of R_{21} is independently selected from the group consisting of hydrogen, methyl, cyclopropyl, and isobutyl.



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formula (II-a-5)

wherein each of $R_{q'}$ and $R_{q''}$ are independently from each other and at each occurrence selected from H, C_{1-5} alkyl, heterocyclyl, aryl, and aralkyl, wherein said aryl is optionally further substituted with a C_{1-5} alkyl, halo or CF_3 .

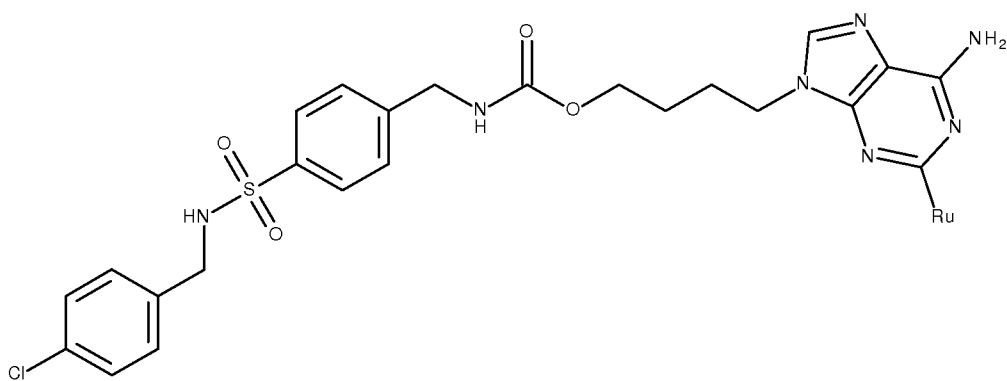


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formula (II-a-6)

wherein each of $R_{q'}$ and $R_{q''}$ are independently from each other and at each occurrence selected from H, C_{1-5} alkyl, cycloalkyl, heterocyclyl, aryl, aralkyl and heteroaralkyl wherein said aryl is optionally further substituted with a C_{1-5} alkyl, halo, OMe, CN, or CF_3 and R_v is selected from halo or $OR_{k''}$ wherein $R_{k''}$ is selected from C_{1-5} alkyl or C_{1-5} cycloalkyl, preferably $R_{k''}$ is methyl, ethyl, propyl, isopropyl, isobutyl, methylcyclopentyl.

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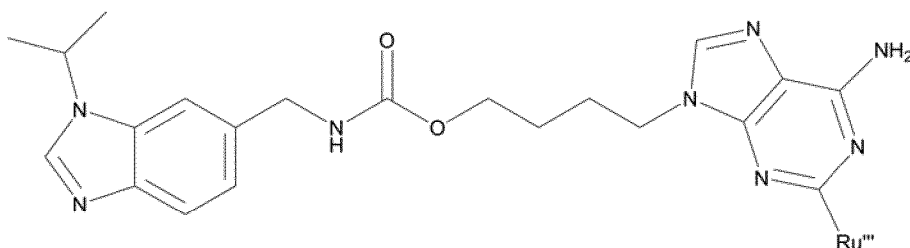


formula (II-a-7)

wherein R_u is selected from the group consisting of $-SR_m$, C_{1-5} alkyl, C_{1-3} alkenyl or C_{1-3} alkynyl wherein R_m is a linear or branched C_zH_{2z+1} wherein z is an integer from 1 to 5.

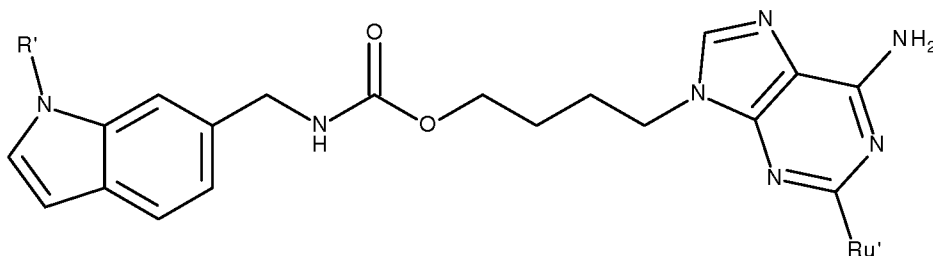
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In a preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (IV-a) is a compound of formula (IV-a-1) or formula (IV-a-2), herein below:



formula (IV-a-1)

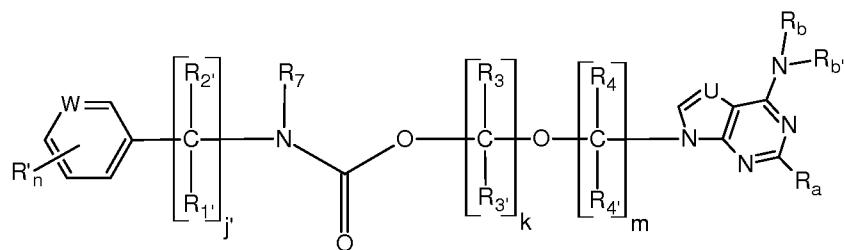
wherein Ru''' is selected from the group consisting of halo, azetidine, aryl, heteroaryl selected from the group consisting of furanyl, pyrrolyl, isoxazolyl, pyrazolyl and pyridinyl and wherein said aryl is optionally further substituted with $-CN$, $-CH_3$, F , or $-OCH_3$.



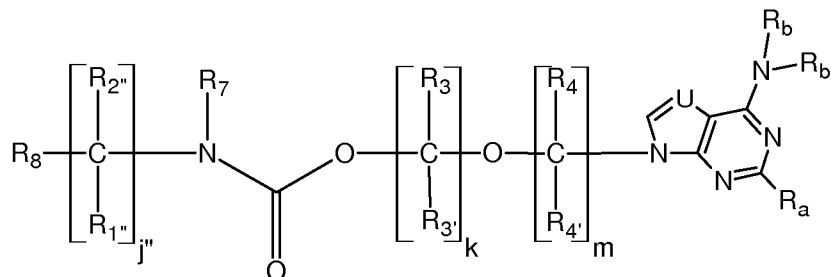
formula (IV-a-2)

wherein Ru' is selected from the group consisting of halo; heteroaryl selected from the group consisting of furanyl, pyrrolyl, isoxazolyl, pyrazolyl, and pyridinyl; aryl and wherein said aryl is optionally further substituted with -CN, -CH₃, F, or -OCH₃; R' is hydrogen or C₁₋₅ alkyl.

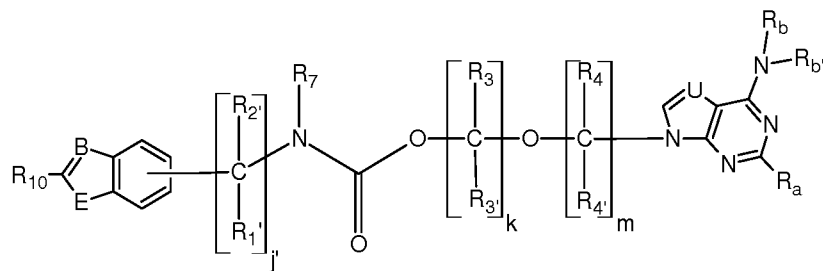
According to one embodiment of the present invention, the compound (C) for use as a kinase inhibitor, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, preferably is a compound chosen among those of formulae (VI) to (IX) [compounds (C) of class (II), herein after]:



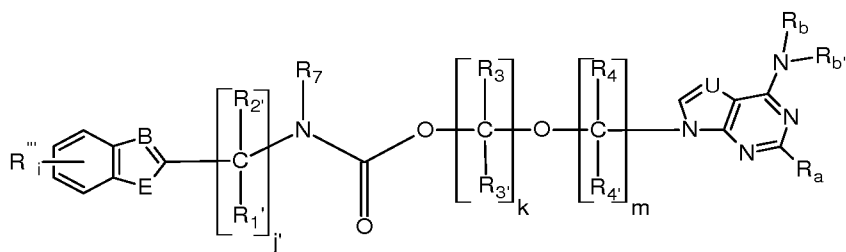
formula (VI)



formula (VII)



formula (VIII)

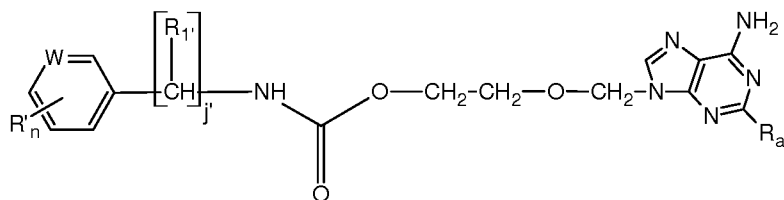


formula (IX)

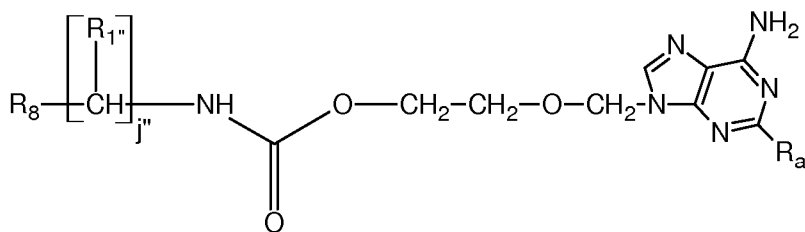
wherein R' , R'' , R_1' , R_2' , R_1'' , R_2'' , R_3 , R_4 , R_3' , R_4' , R_8 , R_{10} , R_a , R_b , $R_{b'}$, U , W , B , E , j' , j'' , i and n have the same meaning as defined above for formula (II) to (V); and wherein k and m are each independently and at each occurrence selected from an integer in the range from 1 to 4, preferably k is 2 and m is 1.

5

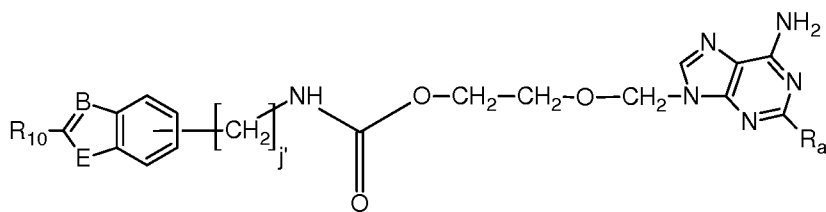
In compounds (C) according to the present invention, preferably, R_1'' , R_2' , R_2'' , R_3 , R_4 , R_3' , R_4' , R_7 , R_b and $R_{b'}$ are hydrogen and U is N. Preferred compounds (C) of class (II) are thus selected from those of formula (VI-a) to (IX-a) herein below:



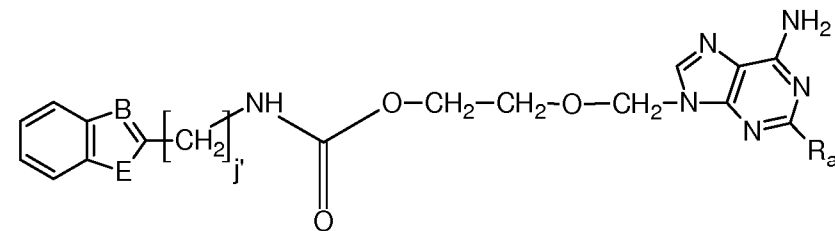
formula (VI-a)



formula (VII-a)



formula (VIII-a)



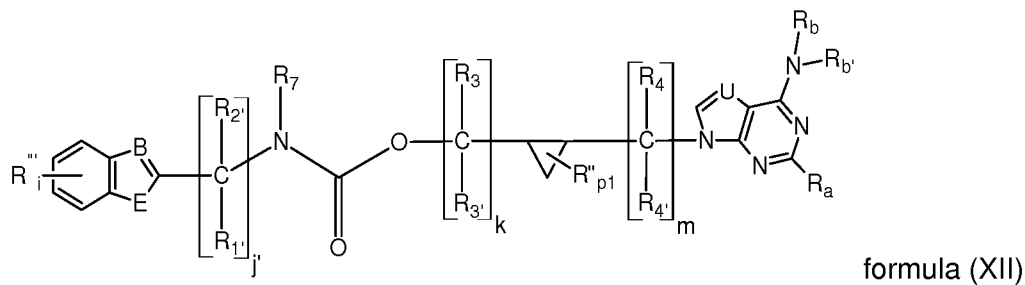
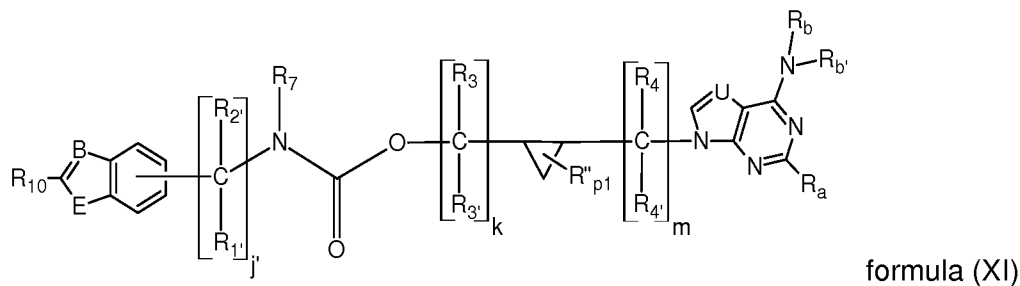
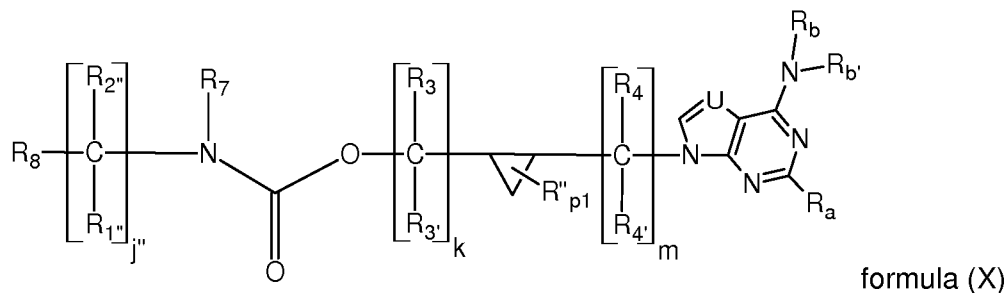
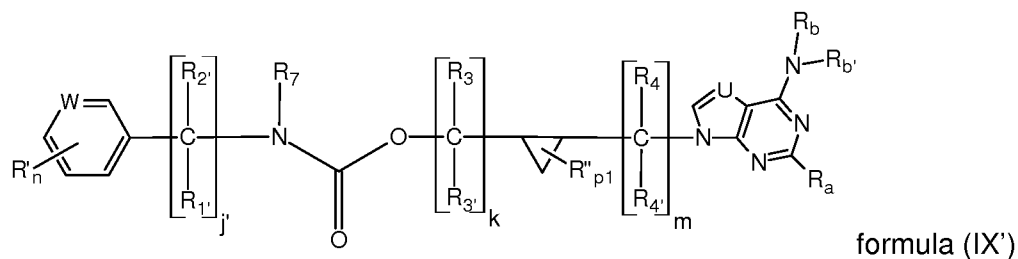
formula (IX-a)

10

wherein W, B, E, R', R_{1'}, R_{1''}, R₈, R₁₀, R_a, j', j'' and n have the same meaning as defined above for formula (II-a) to (V-a).

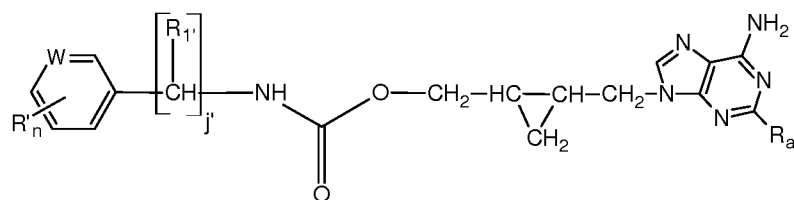
In one embodiment of the present invention, the compounds (C) of class (II) are selected from those of formula (VI-a) and (VIII-a).

5 According to one embodiment of the present invention, the compound (C) for use as a kinase inhibitor, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, preferably is a compound chosen among those of formulae (IX') to (XII) [compounds (C) of class (III), herein after]:

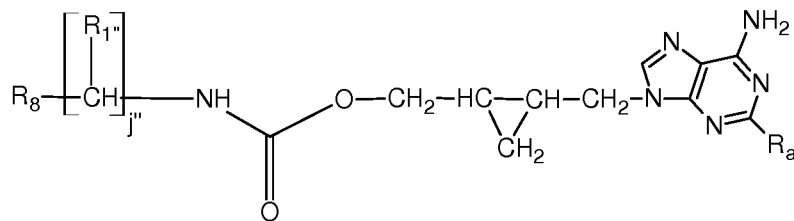


wherein R', R'', R_{1'}, R_{2'}, R_{1''}, R_{2''}, R₃, R₄, R_{3'}, R_{4'}, R₈, R₁₀, R_a, R_b, R_{b'}, U, W, B, E, j', j'', i and n have the same meaning as defined above for formula (II) to (V); and wherein k and m are each independently and at each occurrence selected from an integer in the range from 0 to 4, preferably k and m are 1; wherein p1 is an integer in the range from 0 to 2, preferably p1 is 0; and wherein R'' is independently selected from hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl or C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group, preferably R'' is independently selected from hydrogen or C₁₋₄ alkyl such as methyl, ethyl, propyl, isopropyl, butyl, tert-butyl, isobutyl and the like, and with the proviso when in formula (IX'), W is C-H, R' and R'' is hydrogen, m is 0, k is 1, R₃, R_{3'} and R₇ is hydrogen then j' is an integer in the range from 1 to 3.

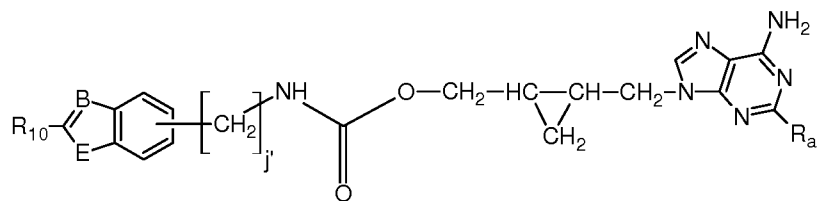
In compounds (C) according to the present invention, preferably, R_{1''}, R_{2'}, R_{2''}, R₃, R₄, R_{3'}, R_{4'}, R₇, R_b and R_{b'} are hydrogen and U is N. Preferred compounds (C) of class (III) are thus selected from those of formula (IX-a) to (XII-a) herein below:



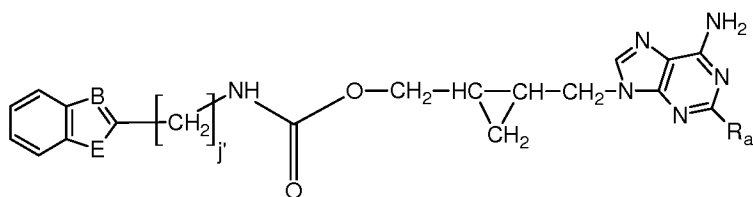
formula (IX-a)



formula (X-a)



formula (XI-a)

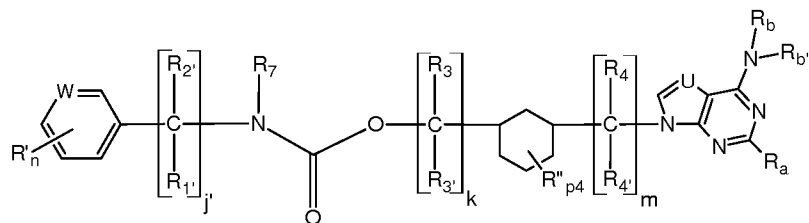


formula (XII-a)

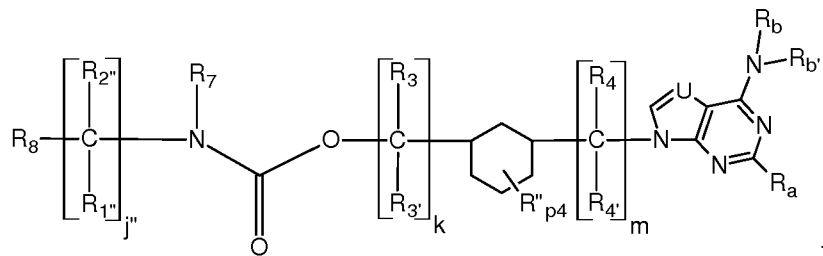
wherein W, B, E, R', R₁', R₁'', R₈, R₁₀, R_a, j', j'' and n have the same meaning as defined above for formula (II-a) to (V-a).

In one embodiment of the present invention, the compounds (C) of class (III) are selected from those of formula (IX-a) and (XI-a).

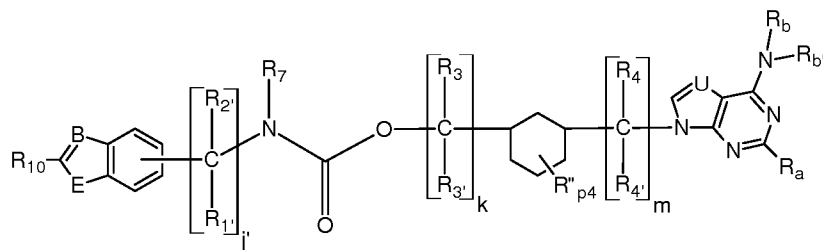
According to one embodiment of the present invention, the compound (C) for use as a kinase inhibitor, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, preferably is a compound chosen among those of formulae (XIII) to (XVI) [compounds (C) of class (IV), herein after]:



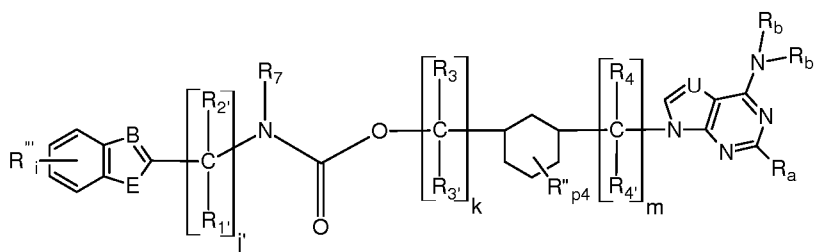
formula (XIII)



formula (XIV)



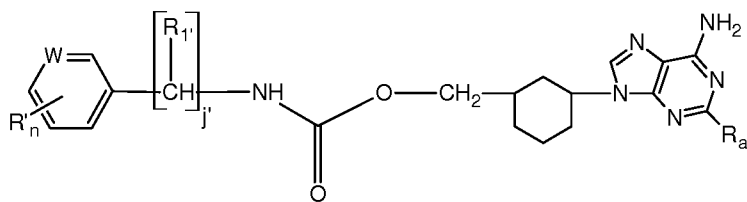
formula (XV)



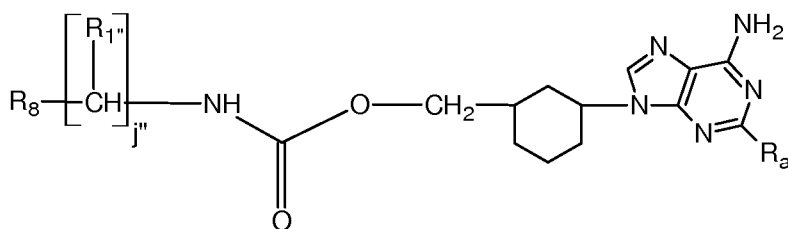
formula (XVI)

wherein R', R'', R₁', R₂', R₁'', R₂'', R₃, R₄, R₃', R₄', R₈, R₁₀, R_a, R_b, R_b', U, W, B, E, j', j'', i and n have the same meaning as defined above for formula (II) to (V); wherein R'' has the same meaning as defined above for formula (IX) to (XII); wherein k and m are each independently and at each occurrence selected from an integer in the range from 0 to 4, preferably k is 0 and m is 0; wherein p₄ is an integer in the range from 0 to 6, preferably p₄ is an integer in the range from 0 to 3, more preferably p₄ is 0.

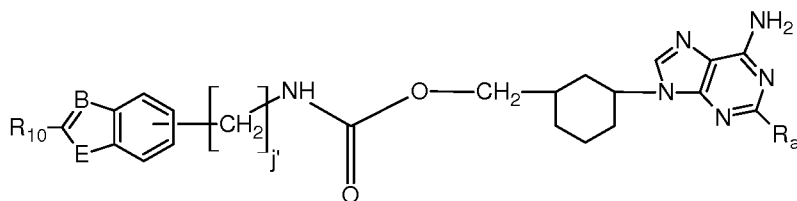
In compounds (C) according to the present invention, preferably, R₁'', R₂', R₂'', R₃, R₄, R₃', R₄', R₇, R_b and R_b' are hydrogen and U is N. Preferred compounds (C) of class (IV) are thus selected from those of formula (XIII-a) to (XVI-a) herein below:



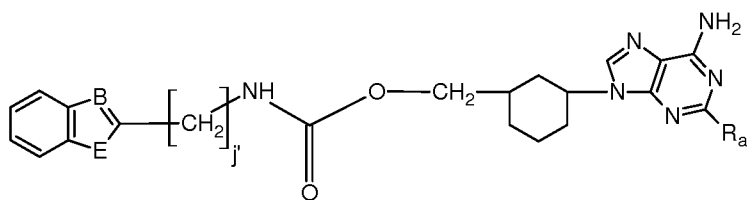
formula (XIII-a)



formula (XIV-a)



formula (XV-a)

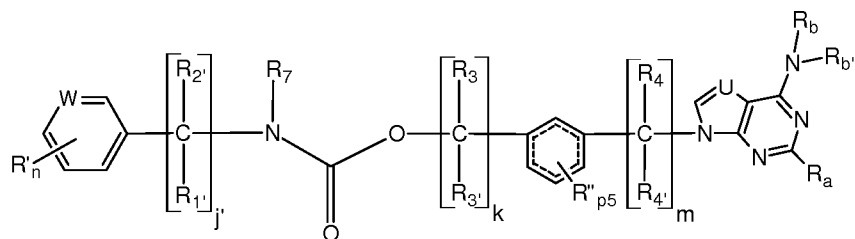


formula (XVI-a)

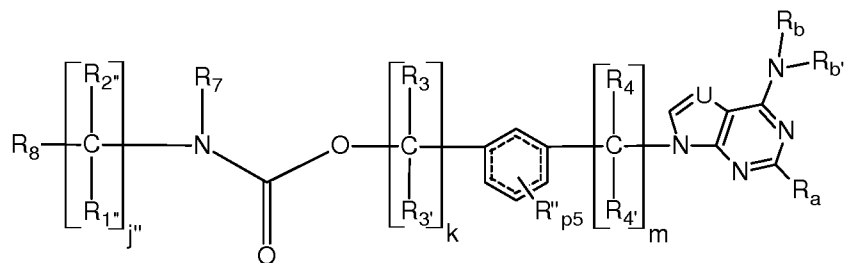
wherein W, B, E, R', R₁', R₁'', R₈, R₁₀, R_a, j', j'' and n have the same meaning as defined above for formula (II-a) to (V-a).

5 In one embodiment of the present invention, the compounds (C) of class (IV) are selected from those of formula (XIII-a) and (XV-a).

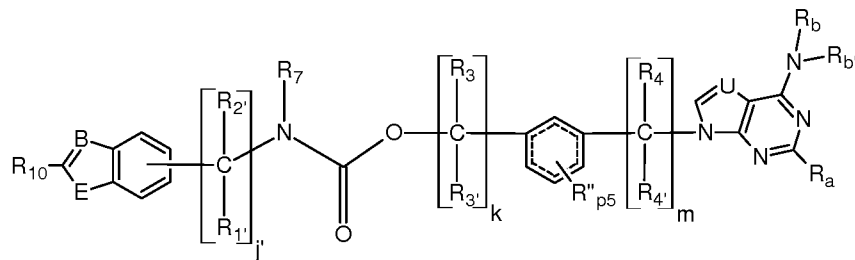
According to one embodiment of the present invention, the compound (C) for use as a kinase inhibitor, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, preferably
10 is a compound chosen among those of formulae (XVII) to (XX) [compounds (C) of class (V), herein after]:



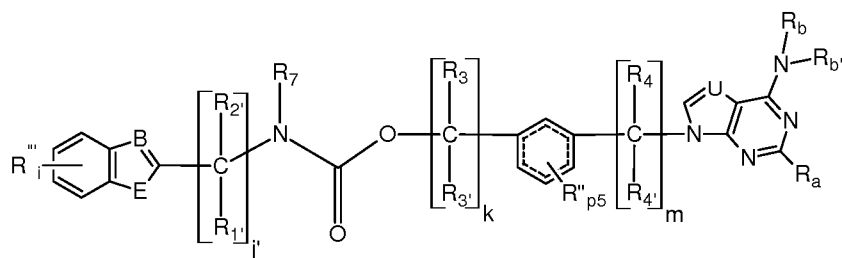
formula (XVII)



formula (XVIII)



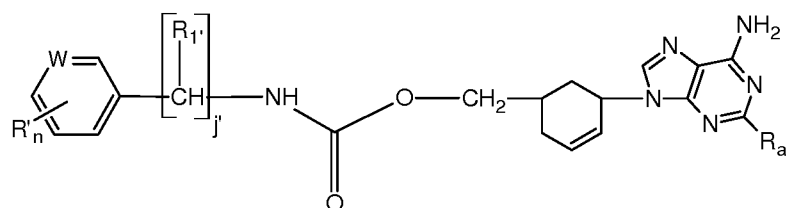
formula (XIX)



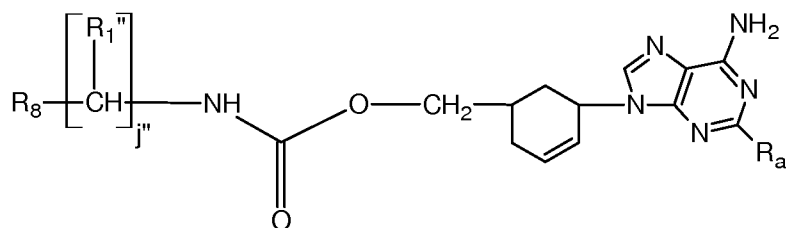
formula (XX)

wherein R' , R''' , R_1' , R_2' , R_1'' , R_2'' , R_3 , R_4 , R_3' , R_4' , R_8 , R_{10} , R_a , R_b , $R_{b'}$, U , W , B , E , j' , j'' , i and n have the same meaning as defined above for formula (II) to (V); wherein R'' has the same meaning as defined above for formula (IX) to (XII); wherein the dash bond represents at least one double bond; wherein k and m are each independently and at each occurrence selected from an integer in the range from 0 to 4, preferably k is 1 and m is 0; wherein p_5 is an integer in the range from 0 to 4; preferably p_5 is an integer in the range from 0 to 2, more preferably p_5 is 0.

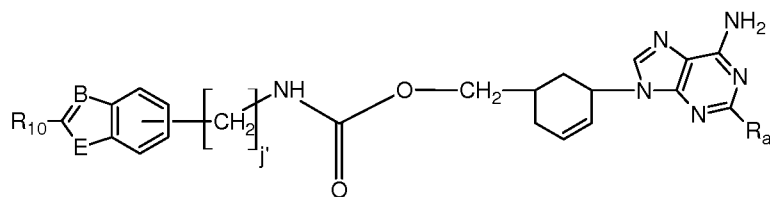
In compounds (C) according to the present invention, preferably, R_1' , R_2' , R_2'' , R_3 , R_4 , R_3' , R_4' , R_7 , R_b and $R_{b'}$ are hydrogen and U is N. Preferred compounds (C) of class (V) are thus selected from those of formula (XVII-a) to (XX-a) herein below:



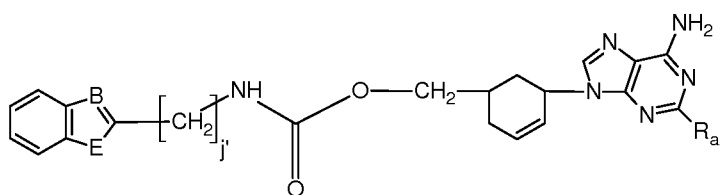
formula (XVII-a)



formula (XVIII-a)



formula (XIX-a)

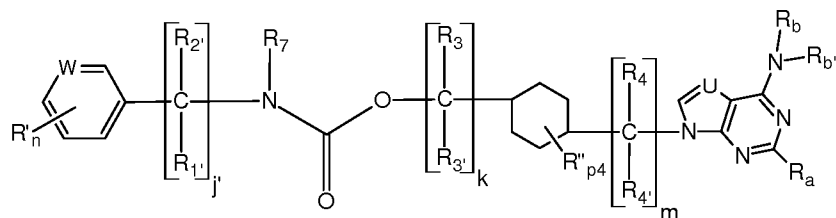


formula (XX-a)

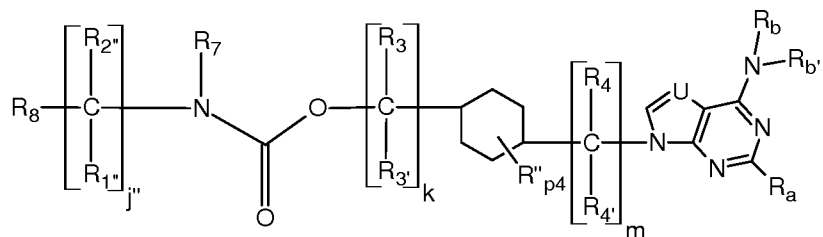
wherein W, B, E, R', R₁', R₁'', R₈, R₁₀, R_a, j', j'' and n have the same meaning as defined above for formula (II-a) to (V-a).

In one embodiment of the present invention, the compounds (C) of class (V) are selected from those of formula (XVII-a) and (XIX-a).

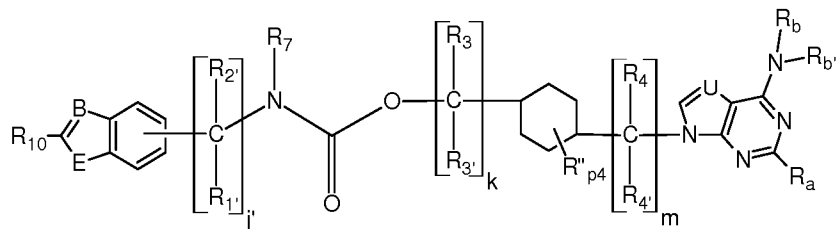
According to one embodiment of the present invention, the compound (C) for use as a kinase inhibitor, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, preferably is a compound chosen among those of formulae (XXI) to (XXIV) [compounds (C) of class (VI), herein after]:



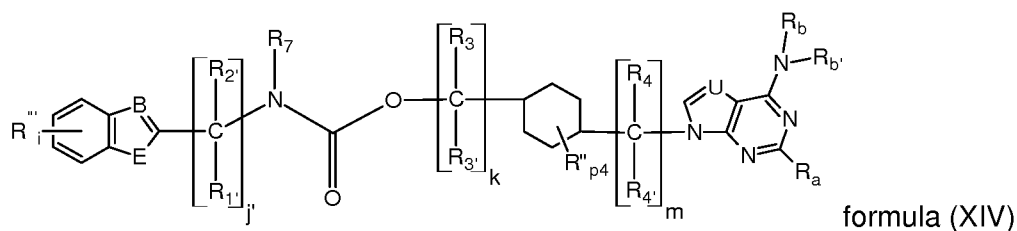
formula (XXI)



formula (XXII)

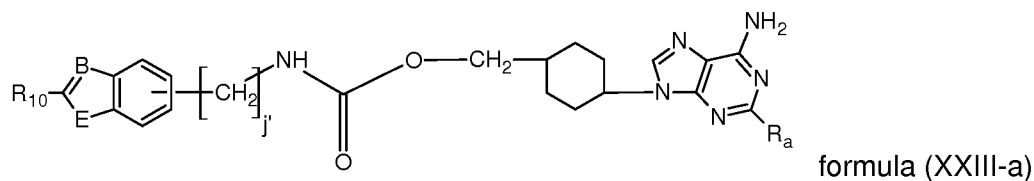
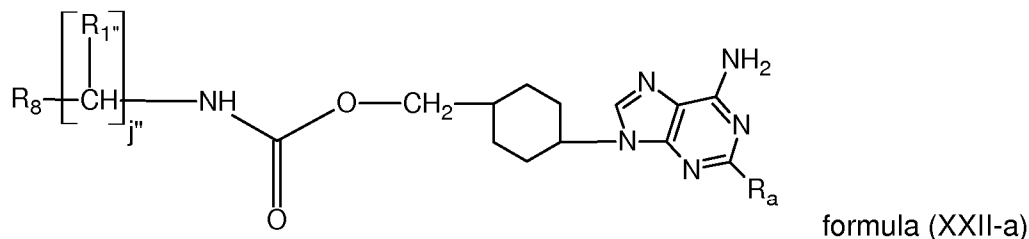
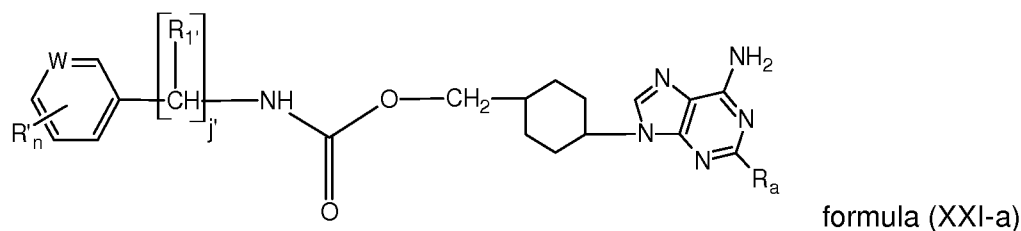


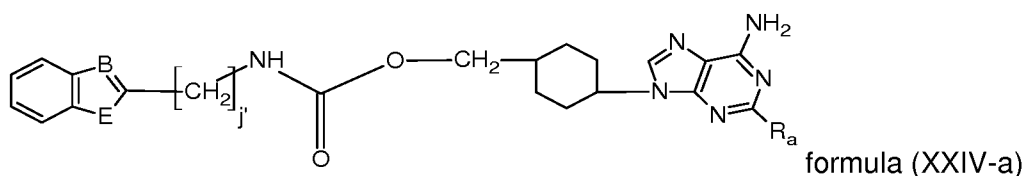
formula (XXIII)



wherein R' , R'' , R_1' , R_2' , R_1'' , R_2'' , R_3 , R_4 , R_3' , R_4' , R_8 , R_{10} , R_a , R_b , $R_{b'}$, U , W , B , E , j' , j'' , i and n have the same meaning as defined above for formula (II) to (V); wherein R'' has the same meaning as defined above for formula (IX) to (XII); wherein k and m are each independently and at each occurrence selected from an integer in the range from 0 to 4, preferably k is 1 and m is 0; wherein p_4 is an integer in the range from 0 to 6; preferably p_4 is an integer in the range from 0 to 3, more preferably p_4 is 0.

In compounds (C) according to the present invention, preferably, R_1'' , R_2' , R_2'' , R_3 , R_4 , R_3' , R_4' , R_7 , R_b and $R_{b'}$ are hydrogen and U is N. Preferred compounds (C) of class (VI) are thus selected from those of formula (XI-a) to (XIII-a) herein below:

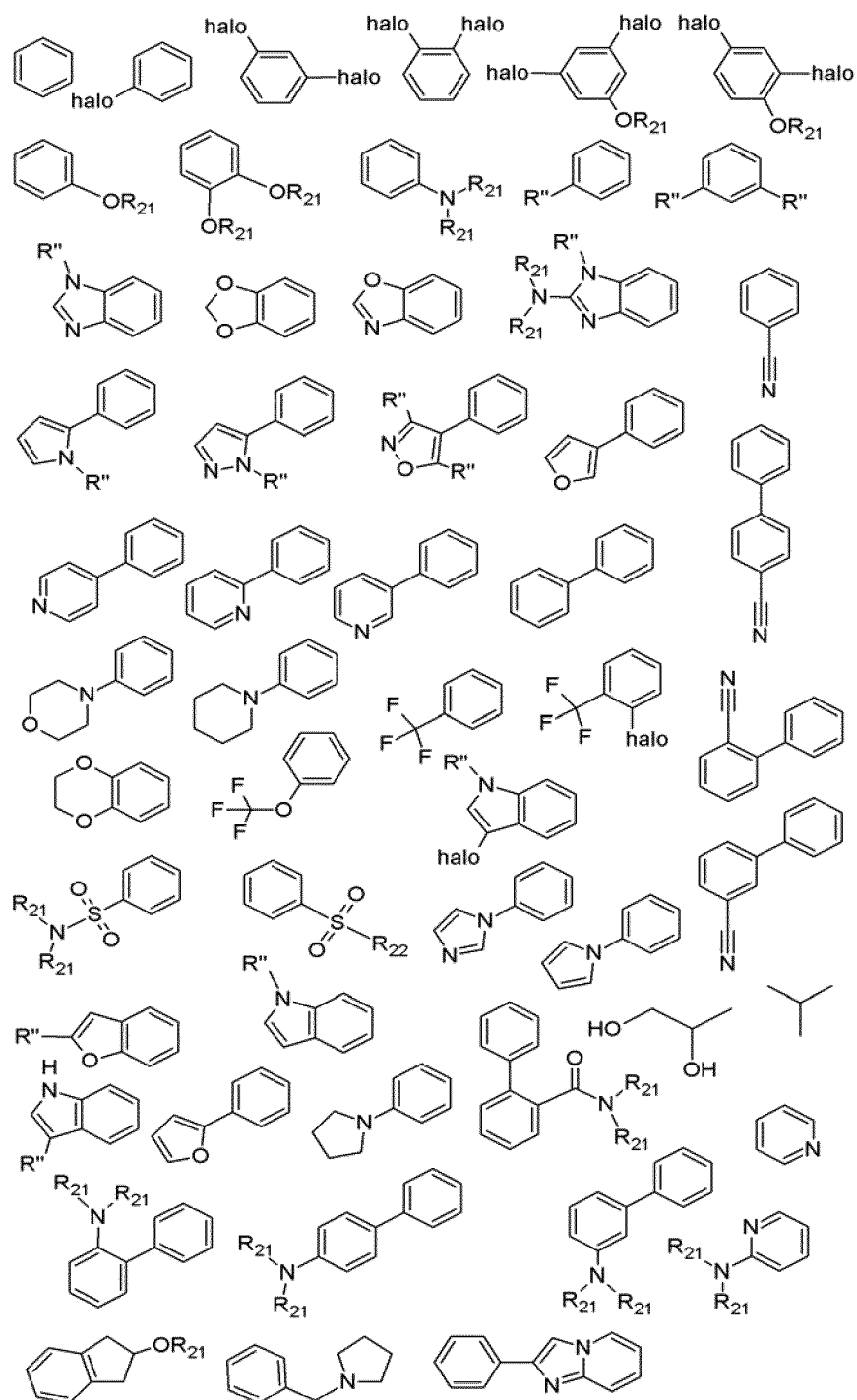




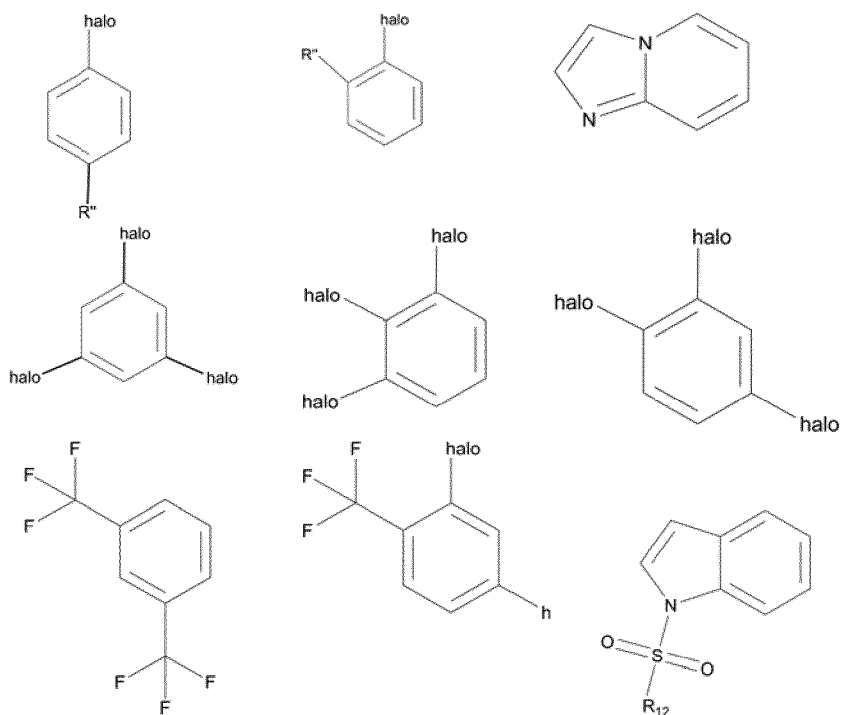
wherein W, B, E, R', R_{1'}, R_{1''}, R₈, R₁₀, R_a, j', j'' and n have the same meaning as defined above for formula (II-a) to (V-a).

In one embodiment of the present invention, the compounds (C) of class (VI) are selected from those of formula (XXI-a) and (XXIII-a).

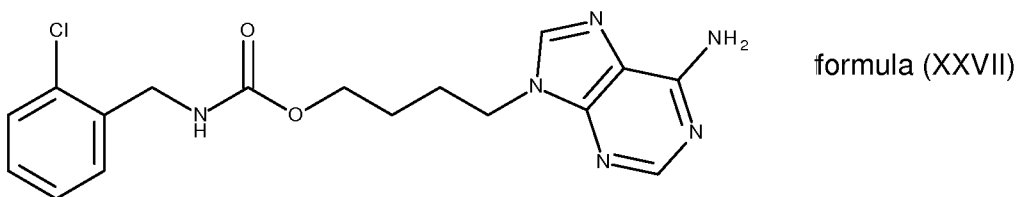
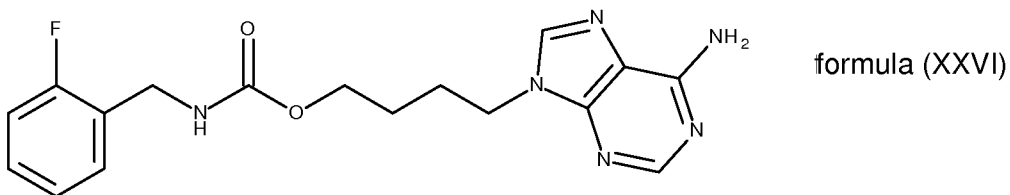
In a preferred embodiment of the compound (C) according to the present invention, A in compound (C) of general formula (I) is independently selected from the following moieties:

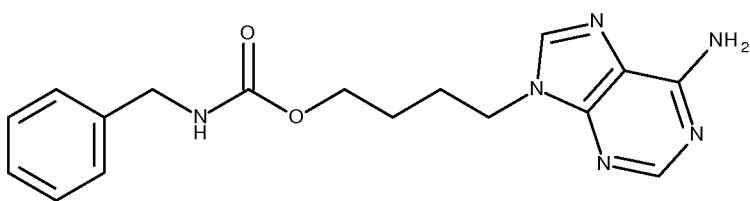


In another preferred embodiment of the compound (C) according to the present invention, A in compound (C) of general formula (I) is independently selected from the following moieties:

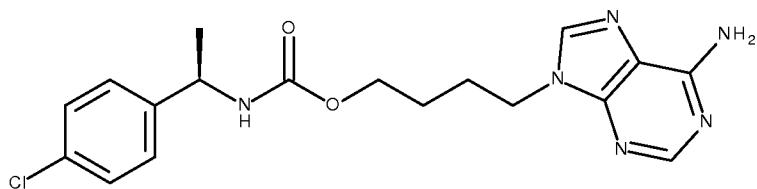


In a preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (II) is a compound chosen among those of formulae (XXVI) to (LIX); (LXIV) to (CXIII) or (CLVIII) to herein below:

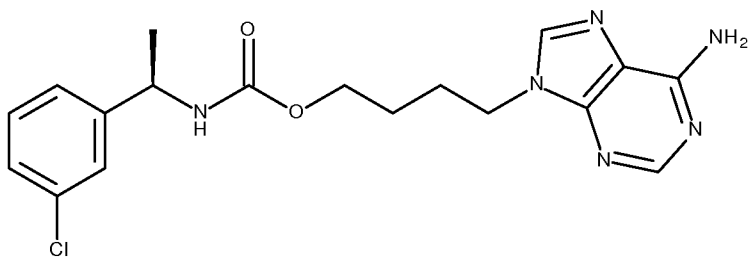




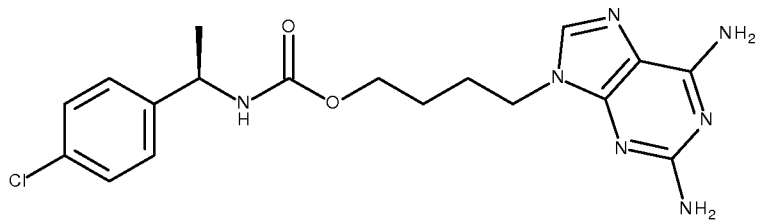
formula (XXVIII)



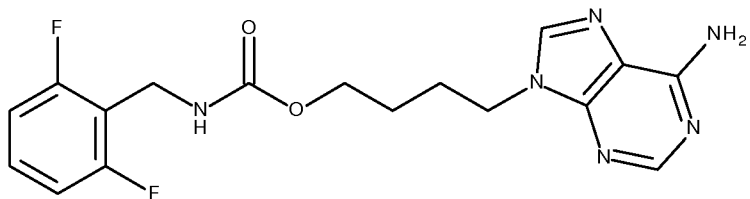
formula (XXIX)



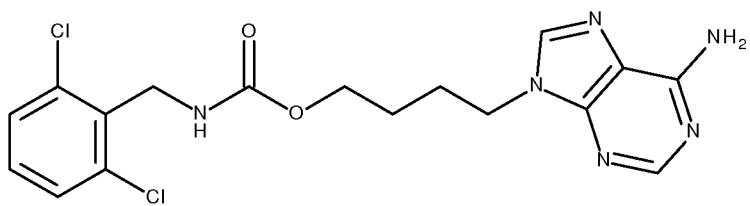
formula (XXX)



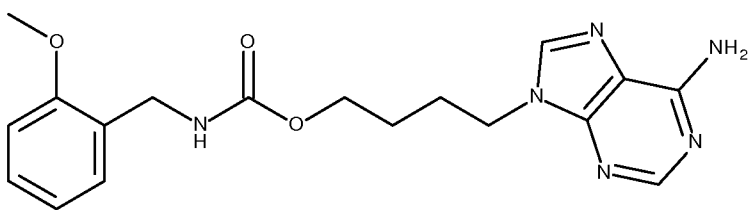
formula (XXXI)



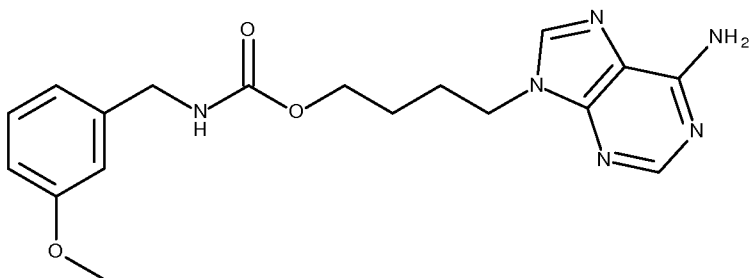
formula (XXXII)



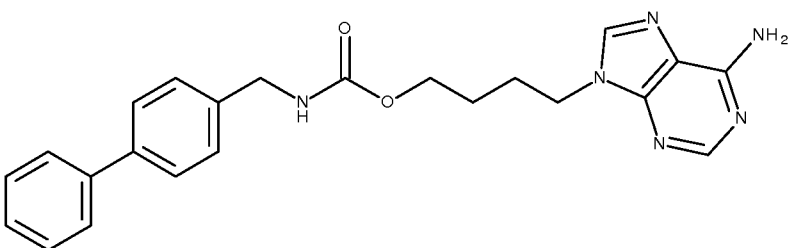
formula (XXXIII)



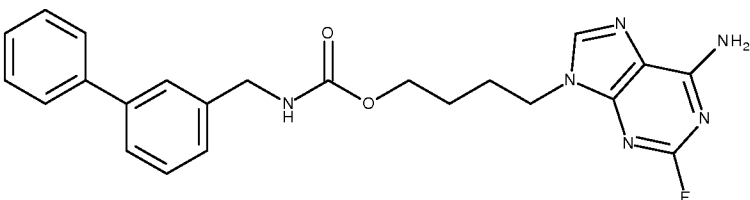
formula (XXXIV)



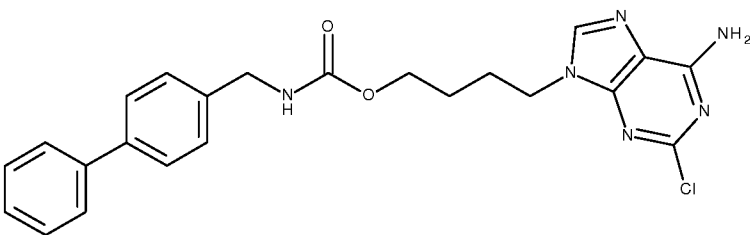
formula (XXXV)



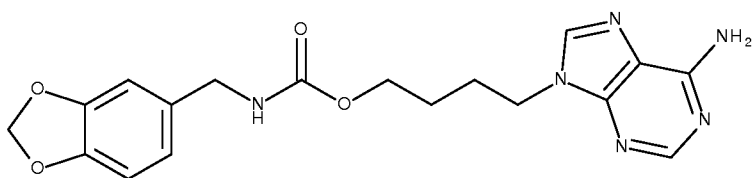
formula (XXXVI)



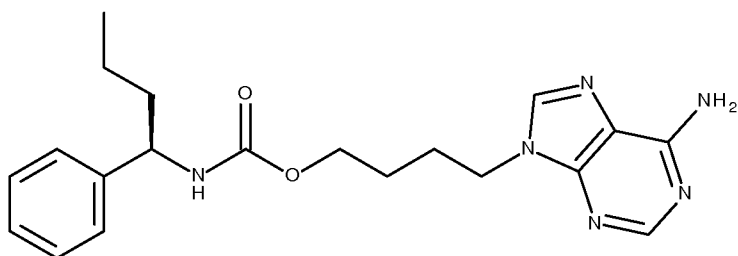
formula (XXXVI - 1)



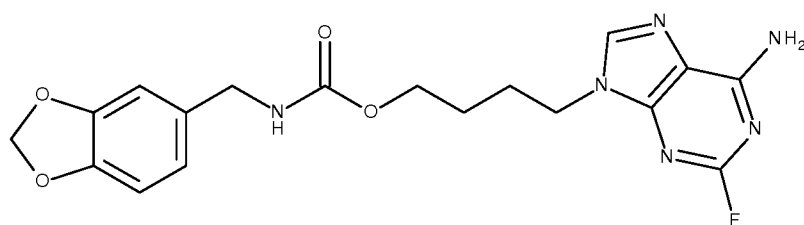
formula (XXXVI - 2)



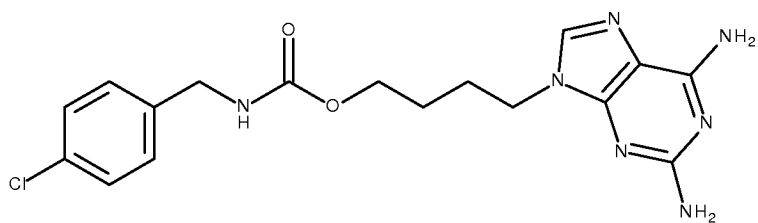
formula (XXXVII)



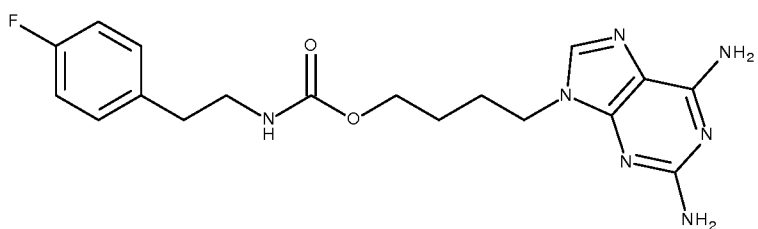
formula (XXXVIII)



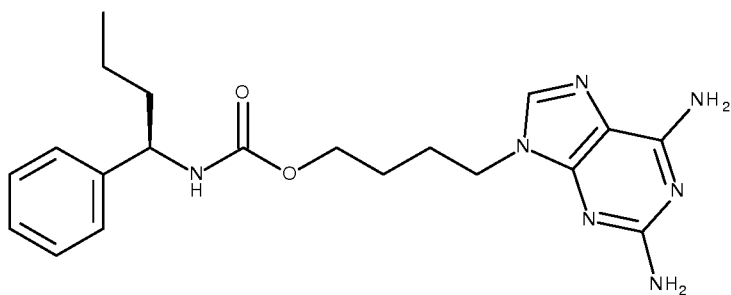
formula (XXXIX)



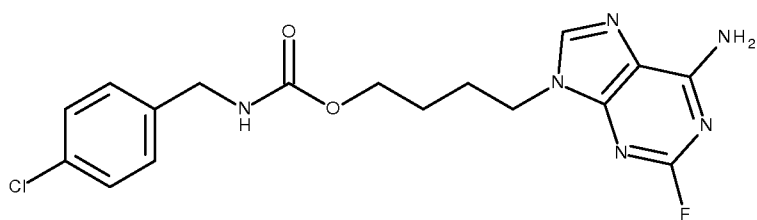
formula (XL)



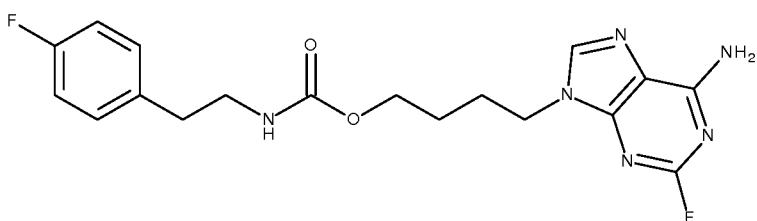
formula (XLI)



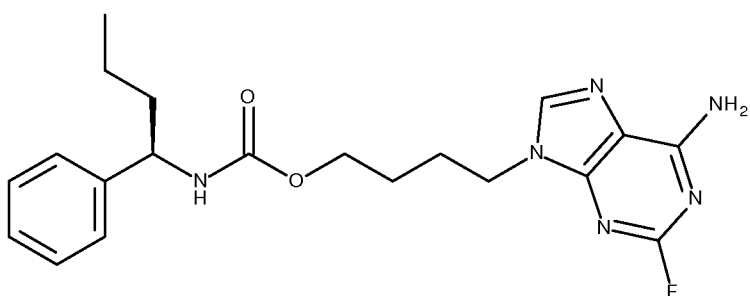
formula (XLII)



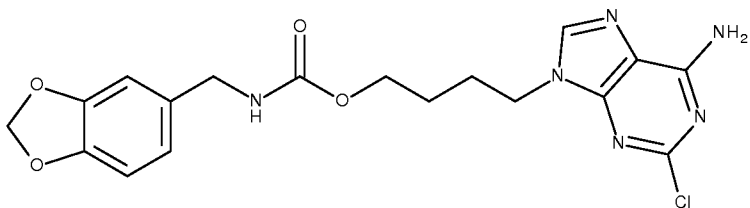
formula (XLIII)



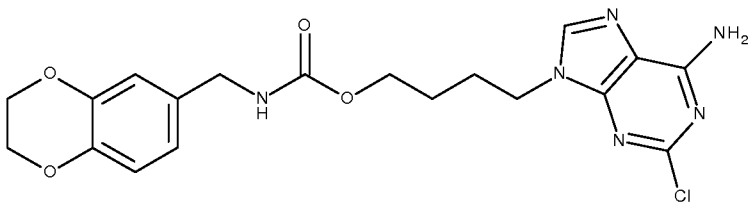
formula (XLIV)



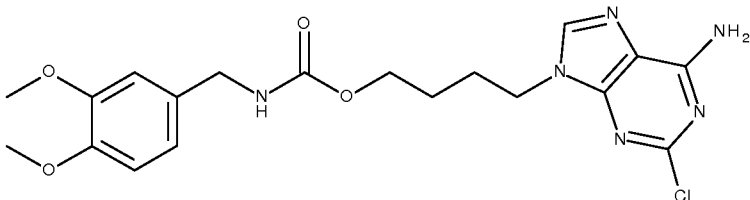
formula (XLV)



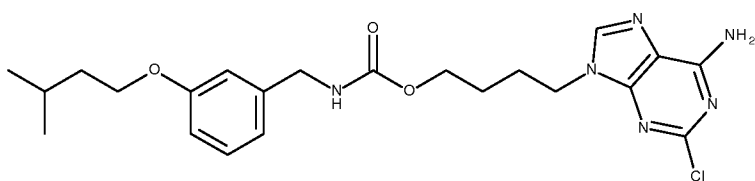
formula (XLVI)



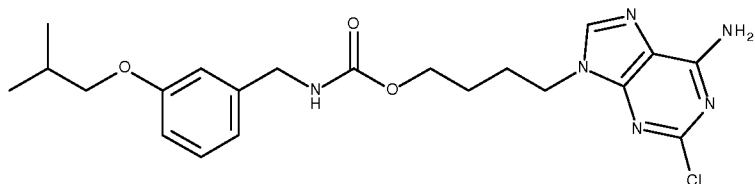
formula (XLVI - 1)



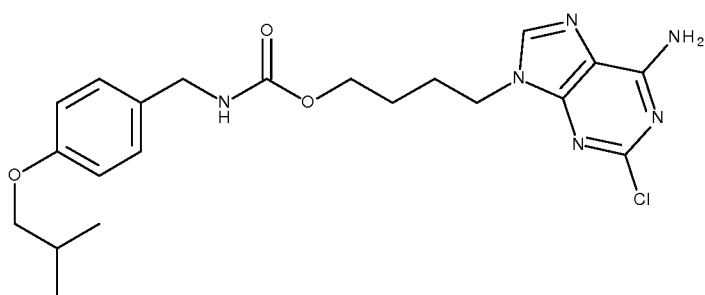
formula (XLVI - 2)



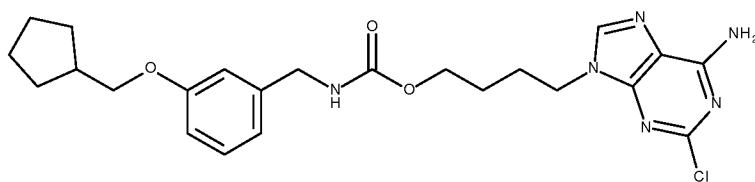
formula (XLVI - 3)



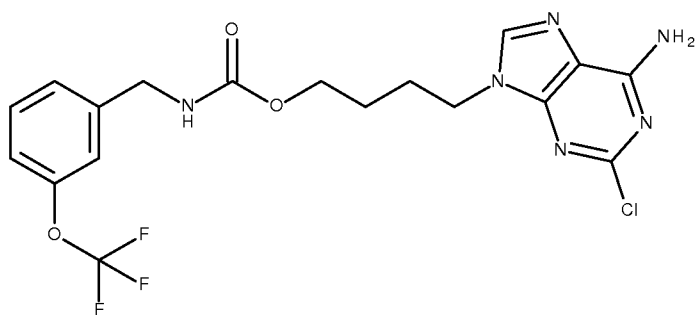
formula (XLVI - 4)



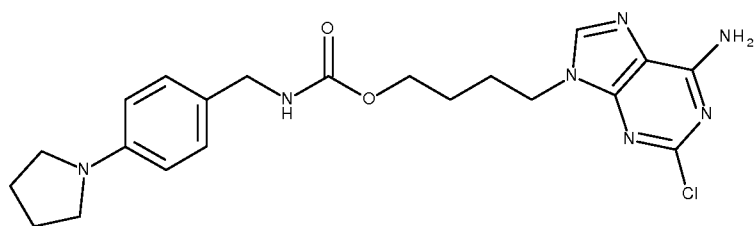
formula (XLVI - 5)



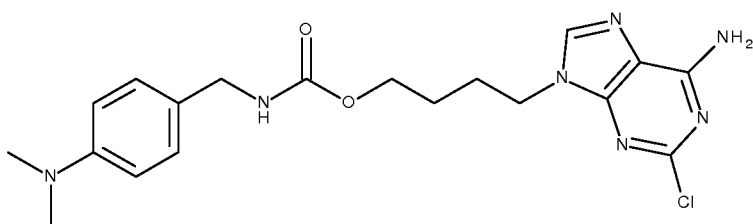
formula (XLVI - 6)



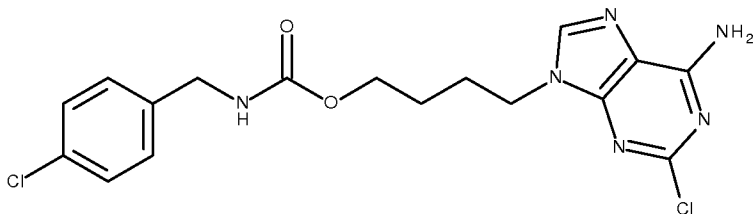
formula (XLVI - 7)



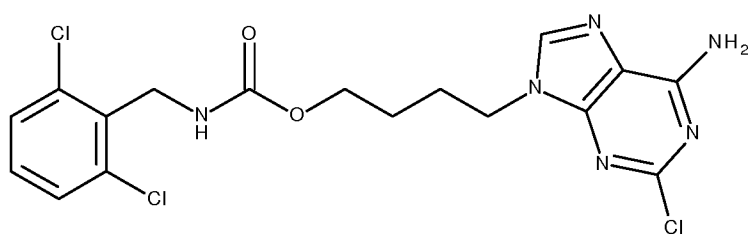
formula (XLVI - 8)



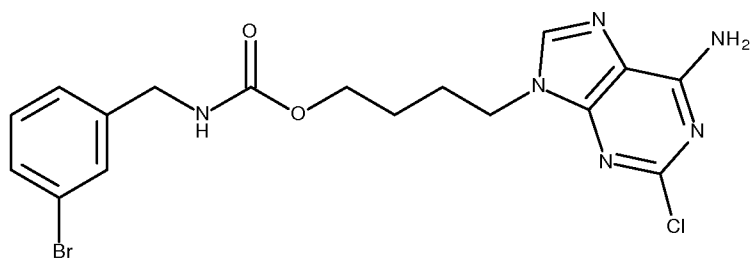
formula (XLVI - 9)



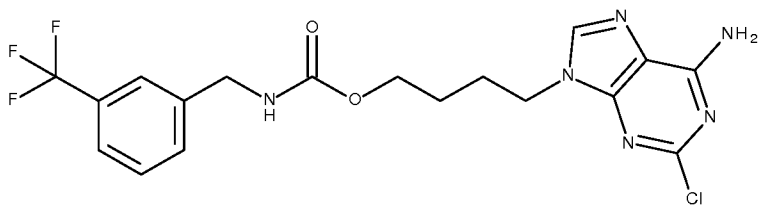
formula (XLVII)



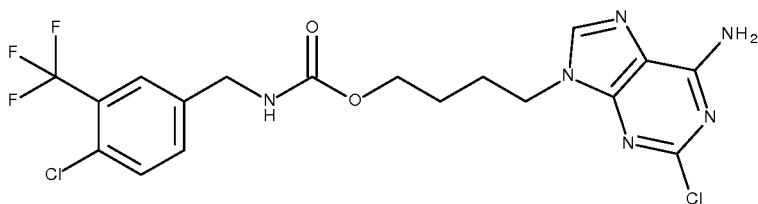
formula (XLVII - 1)



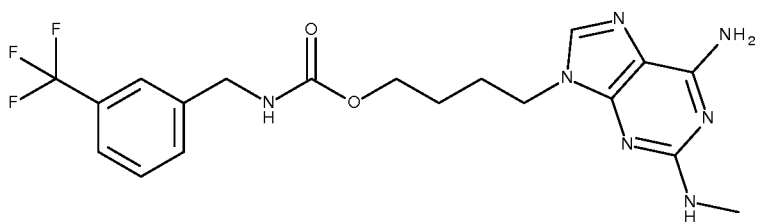
formula (XLVIII)



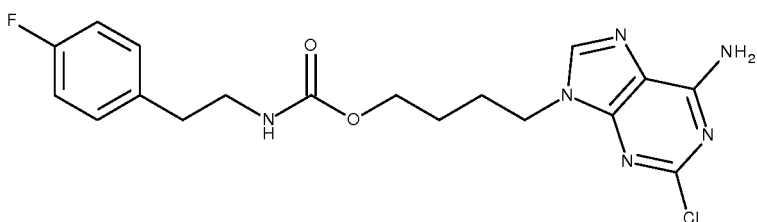
formula (XLIX)



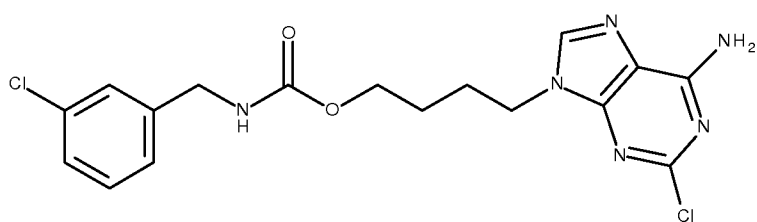
formula (XLIX - 1)



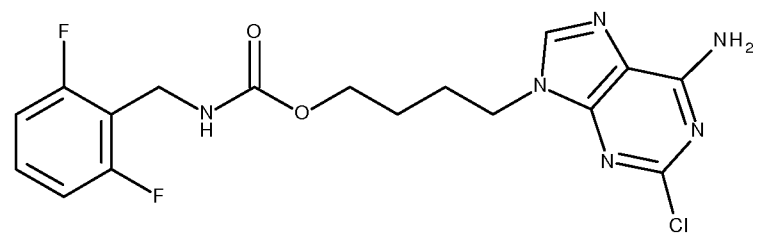
formula (L)



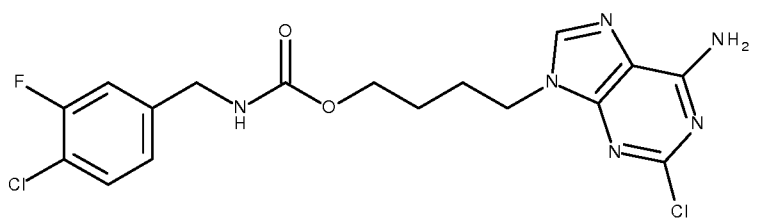
formula (LI)



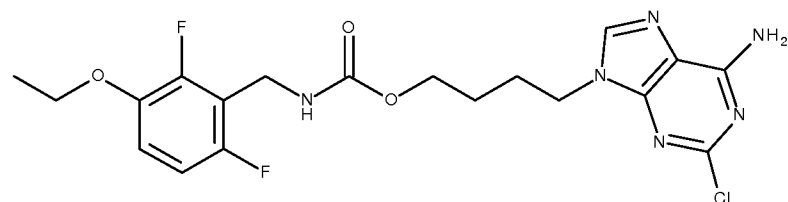
formula (LI - 1)



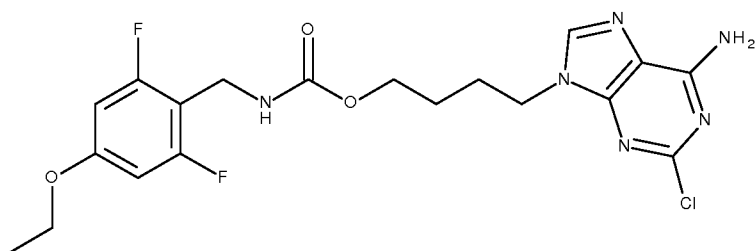
formula (LI - 2)



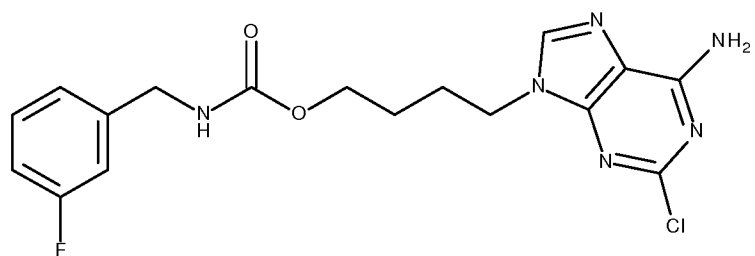
formula (LI - 3)



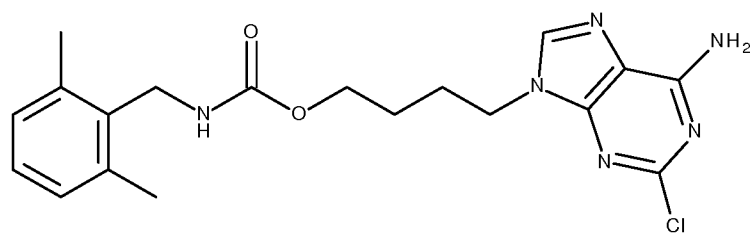
formula (LI - 4)



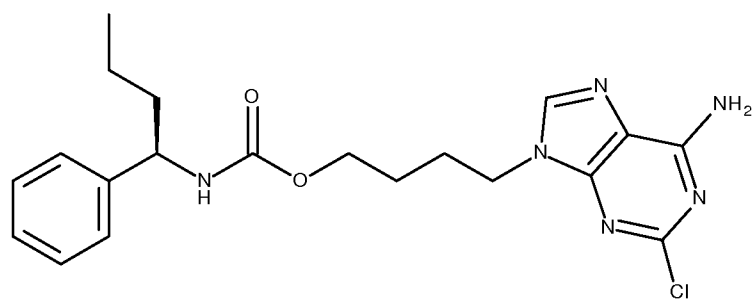
formula (LI - 5)



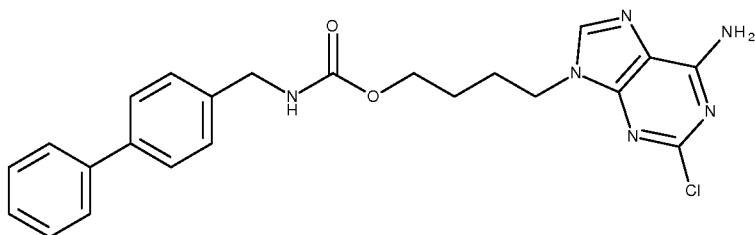
formula (LI - 6)



formula (LI - 7)

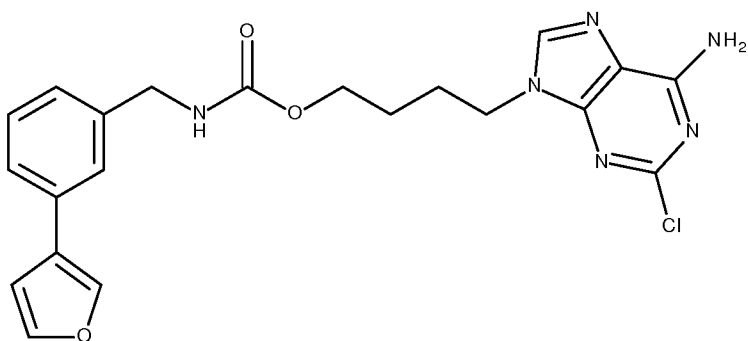


formula (LII)

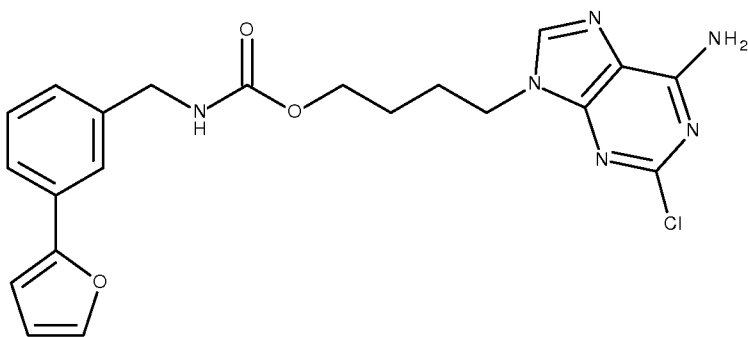


formula (LIII)

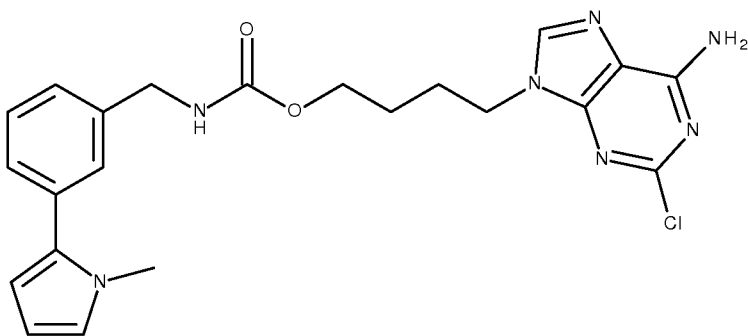
formula (LIII - 1)



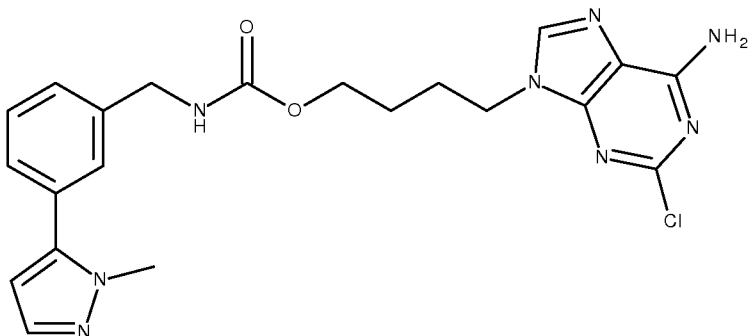
formula (LIII - 2)



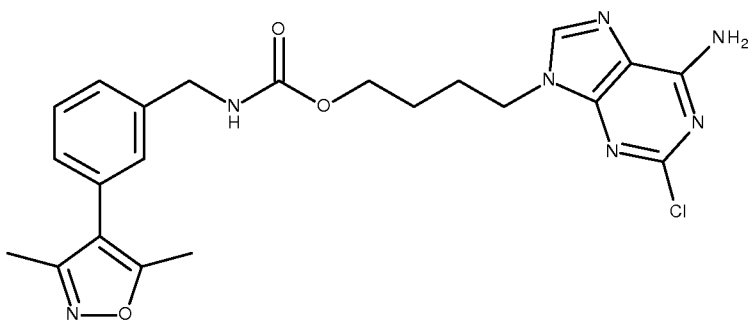
formula (LIII - 3)



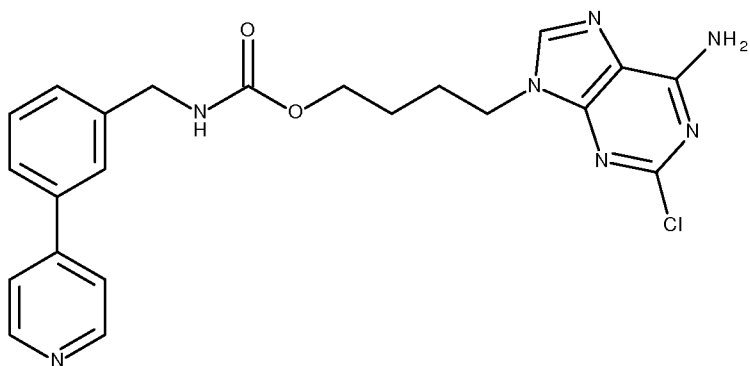
formula (LIII - 4)



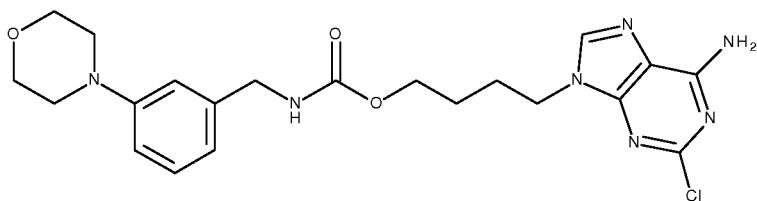
formula (LIII - 5)



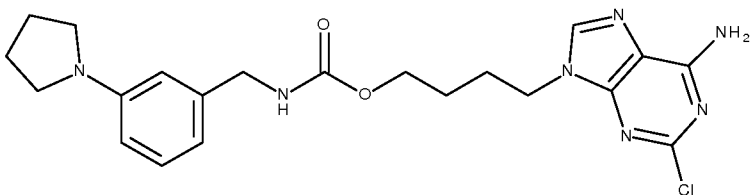
formula (LIII - 6)

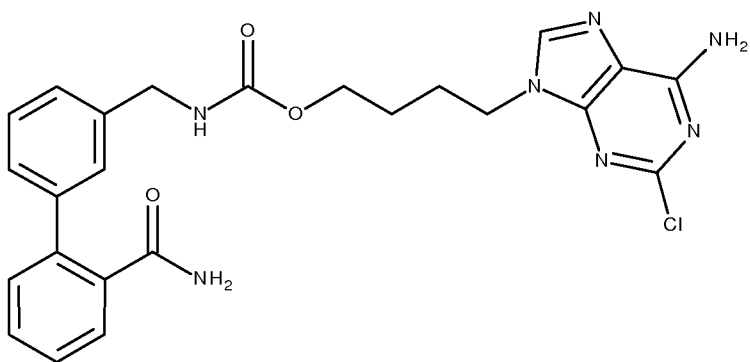


formula (LIII - 7)

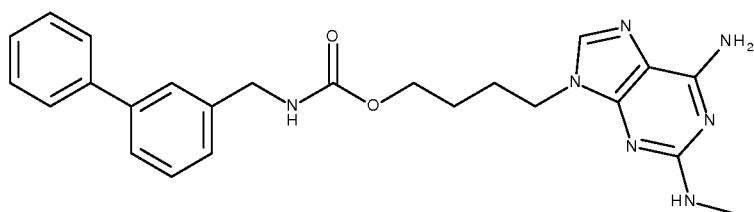


formula (LIII - 8)

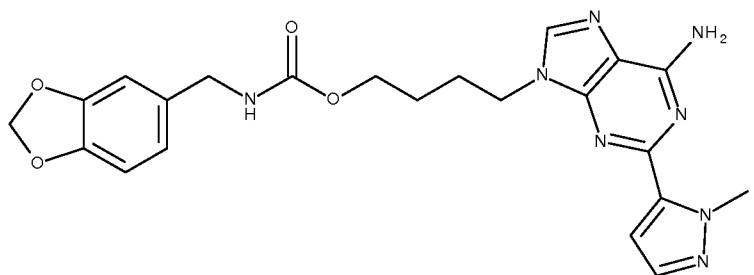




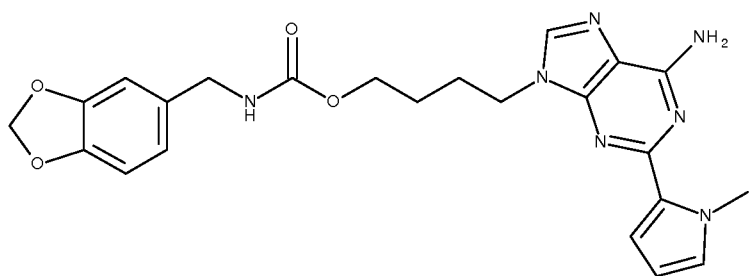
formula (LIII - 9)



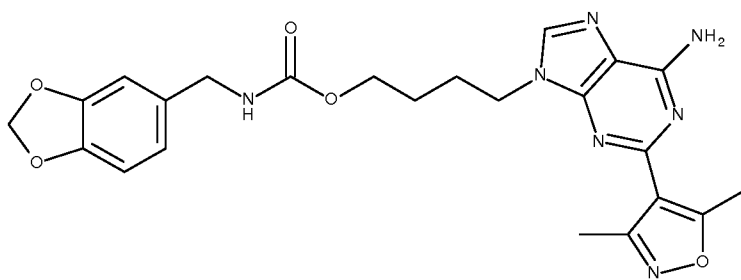
formula (LIV)



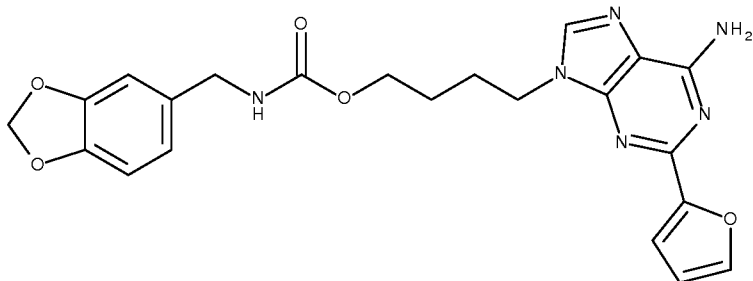
formula (LV)



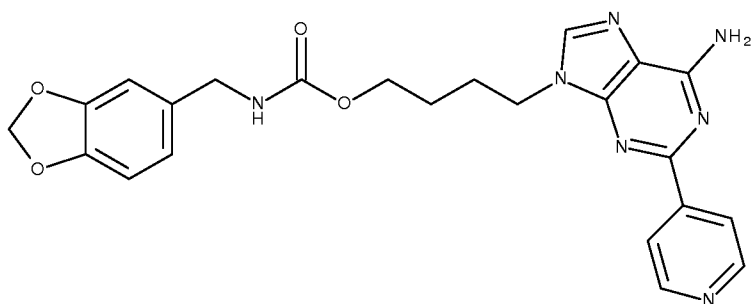
formula (LV-1)



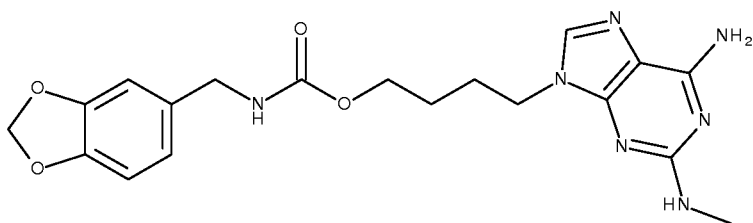
formula (LV-2)



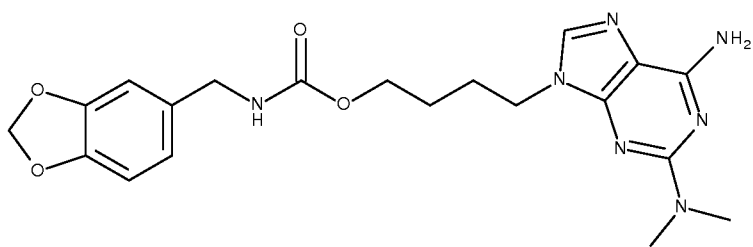
formula (LVI)



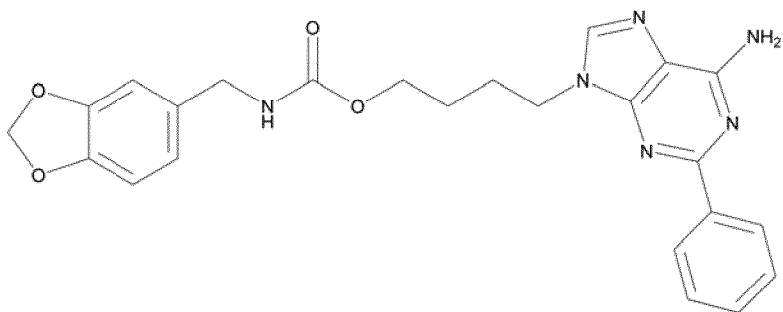
formula (LIX)



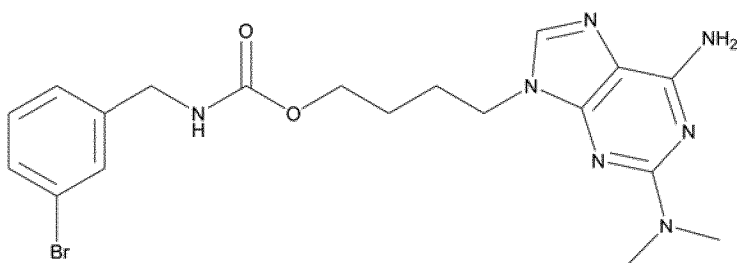
formula (LVIII)



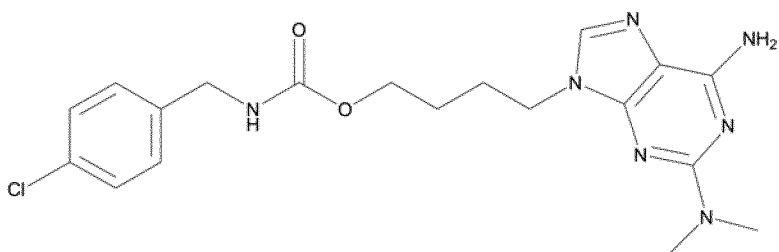
formula (LVIII - 1)



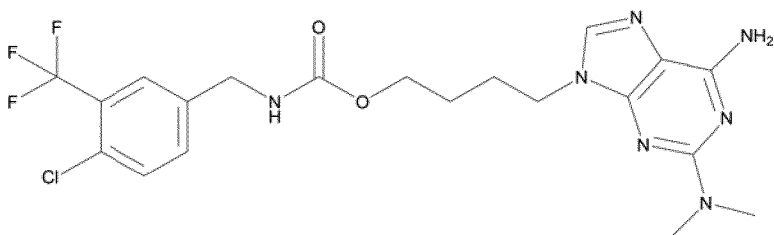
formula (CLVIII)



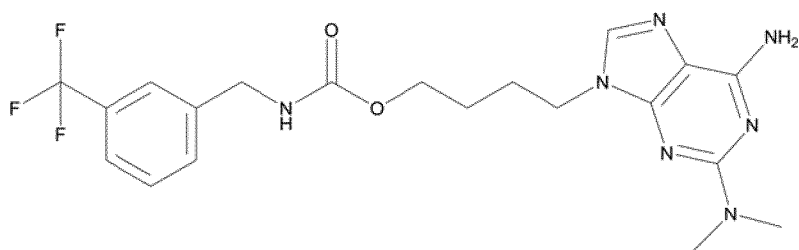
formula (LXIV)



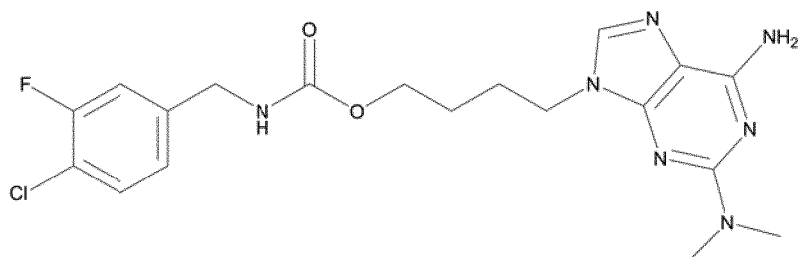
formula (LXV)



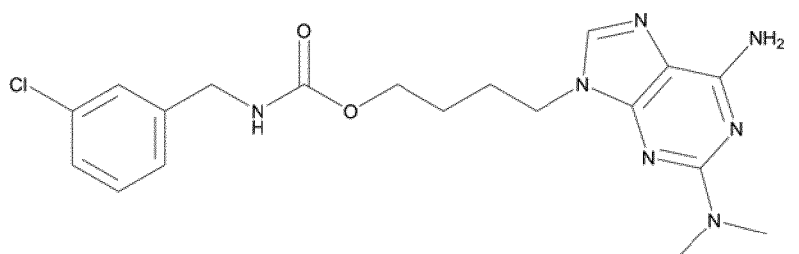
formula (LXVI)



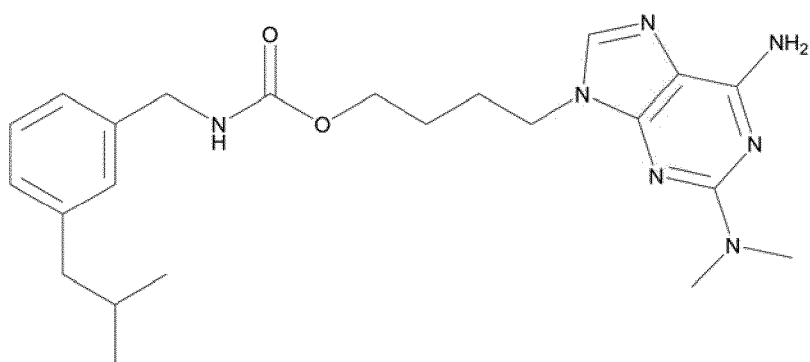
formula (LXVII)



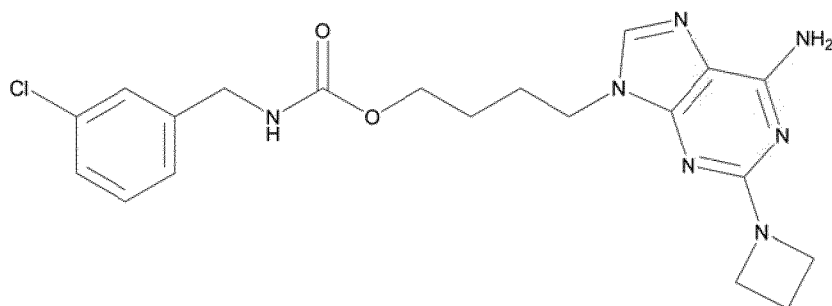
formula (LXVIII)



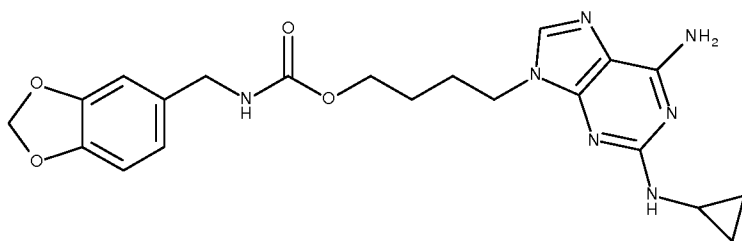
formula (LXIX)



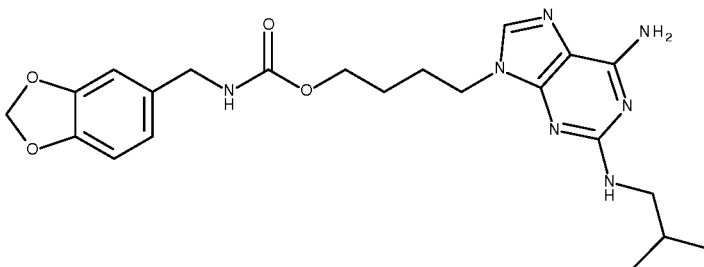
formula (LXX)



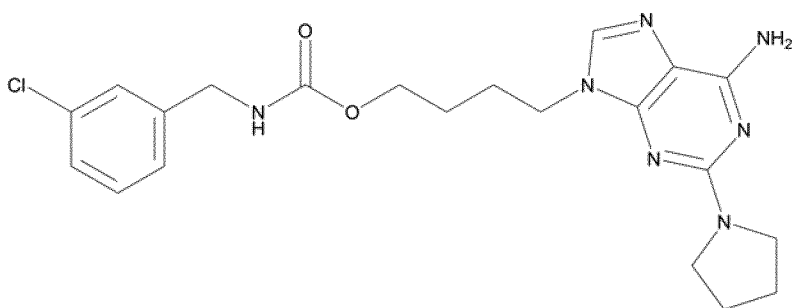
formula (LXXI)



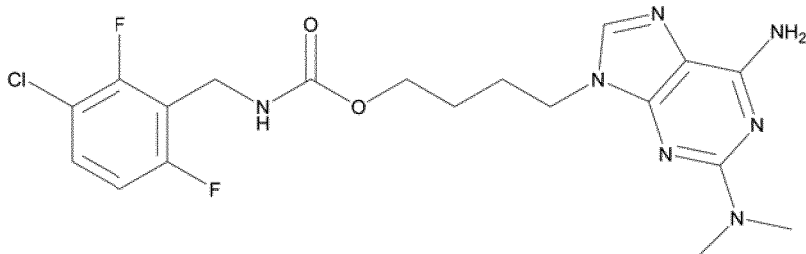
formula (LXXI - 1)



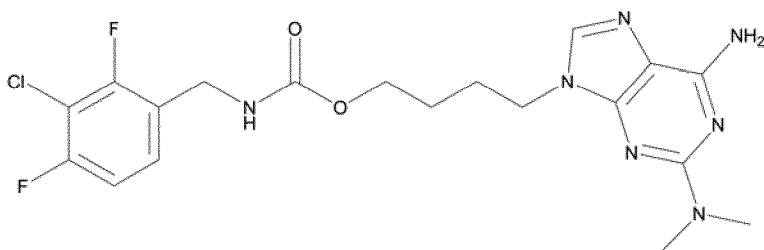
formula (LXXI - 2)



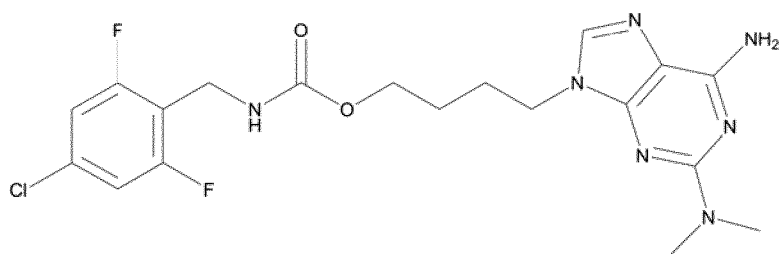
formula (LXXII)



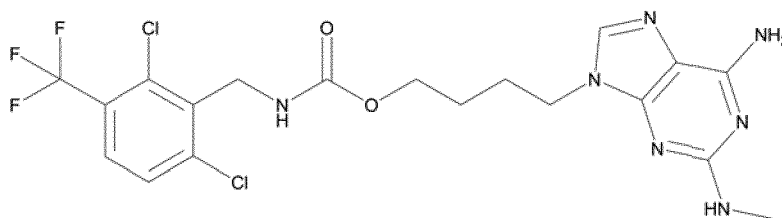
formula (LXXIII)



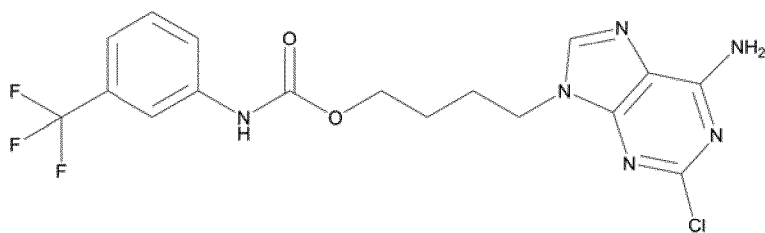
formula (LXXIV)



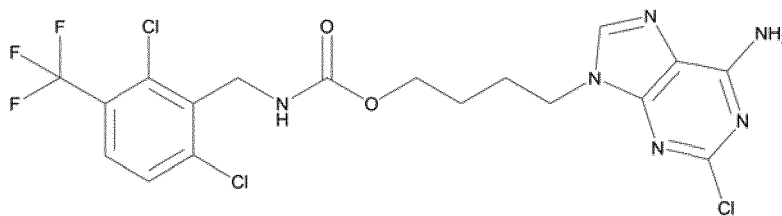
formula (LXXV)



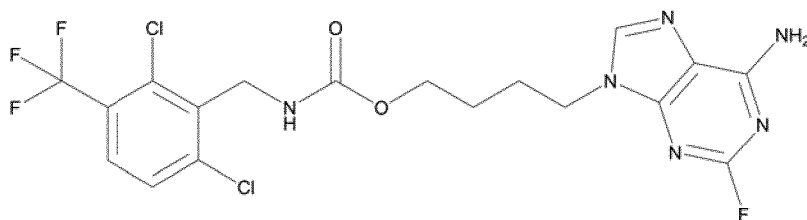
formula (LXXVI)



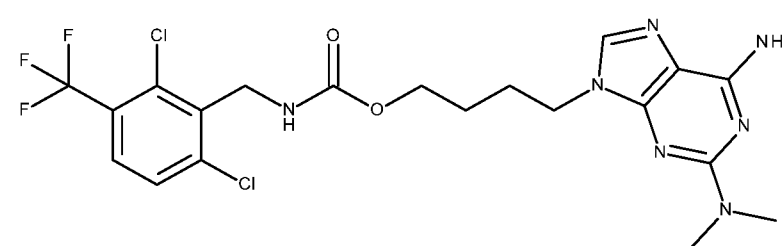
formula (LXXVII)



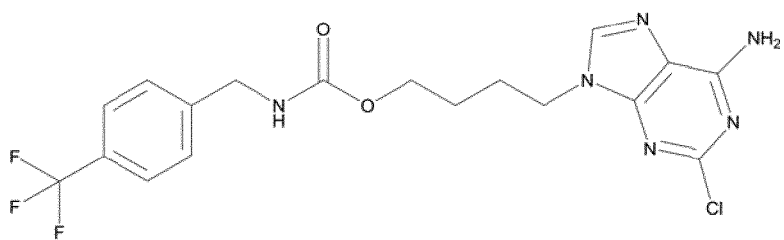
formula (LXXVIII)



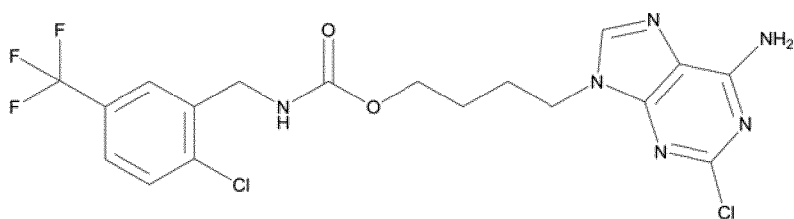
formula (LXXIX)



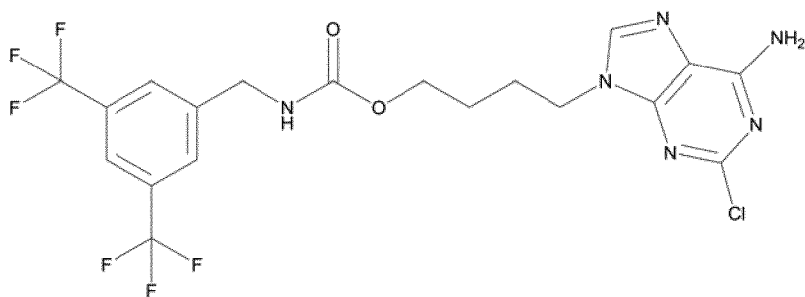
formula (LXXX)



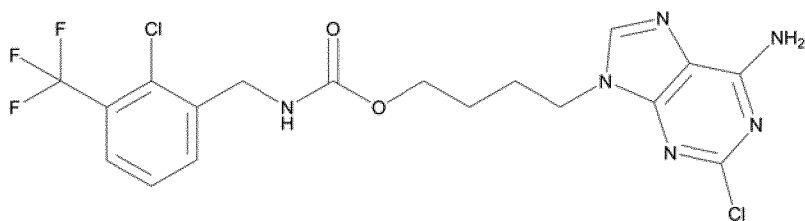
formula (LXXXI)



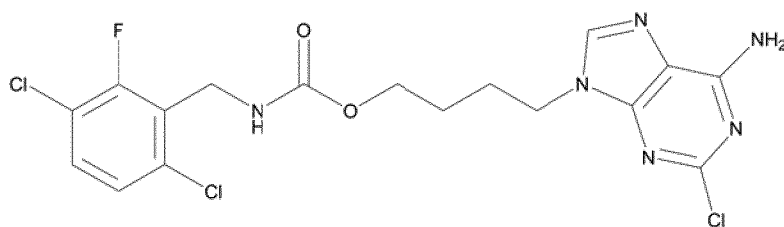
formula (LXXXII)



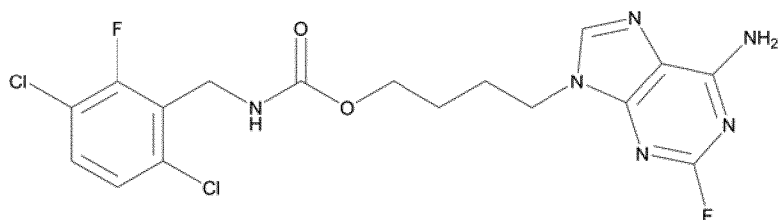
formula (LXXXIII)



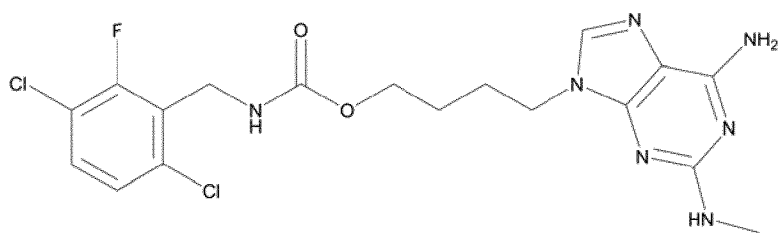
formula (LXXXIV)



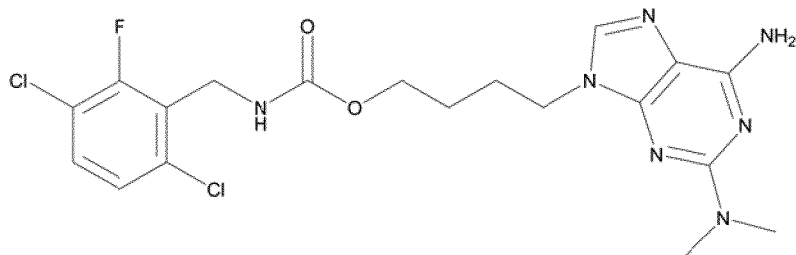
formula (LXXXV)



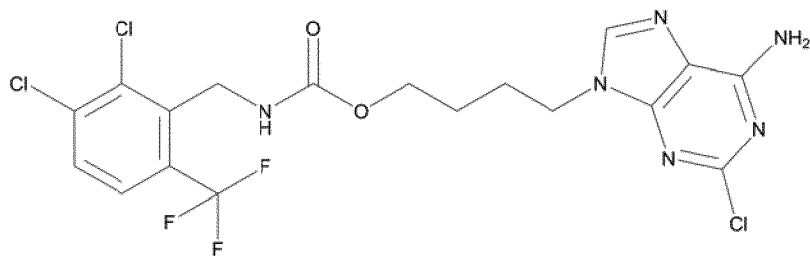
formula (LXXXVI)



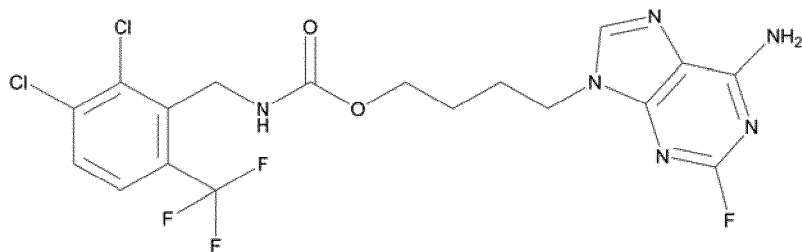
formula (LXXXVII)



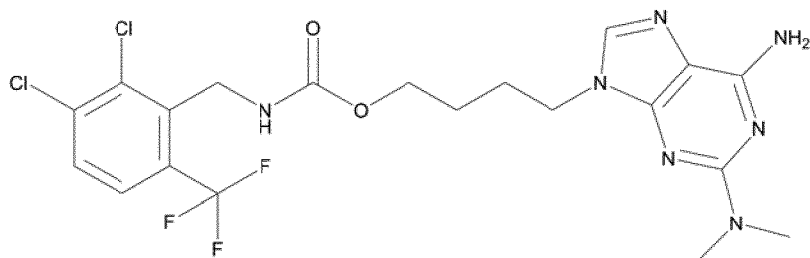
formula (LXXXVIII)



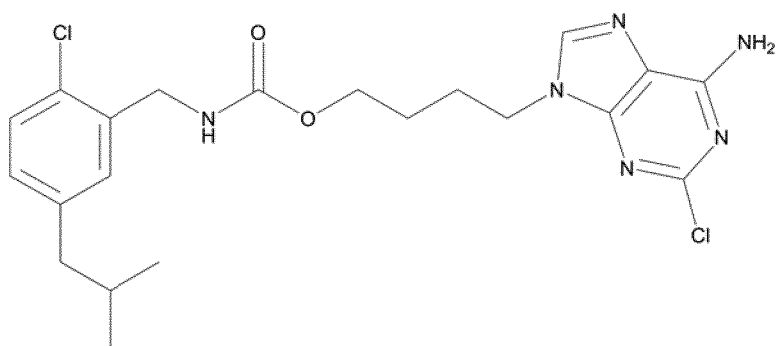
formula (LXXXIX)



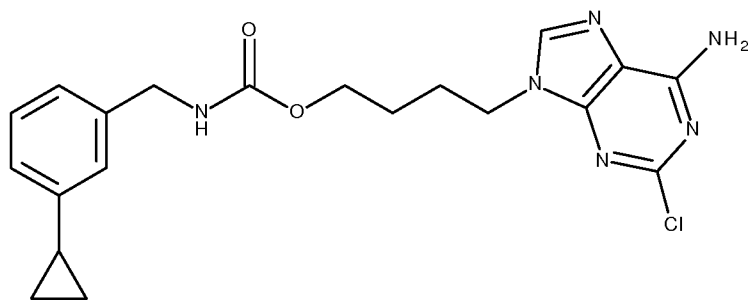
formula (XC)



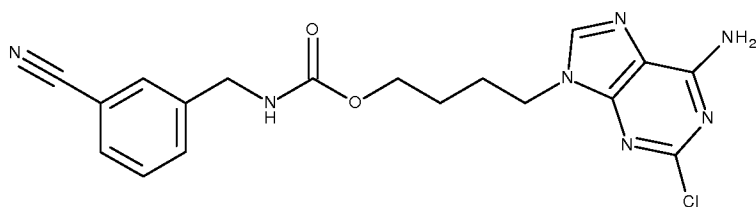
formula (XCI)



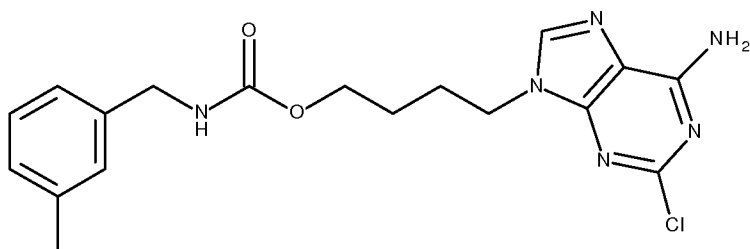
formula (XCII)



formula (XCII -1)

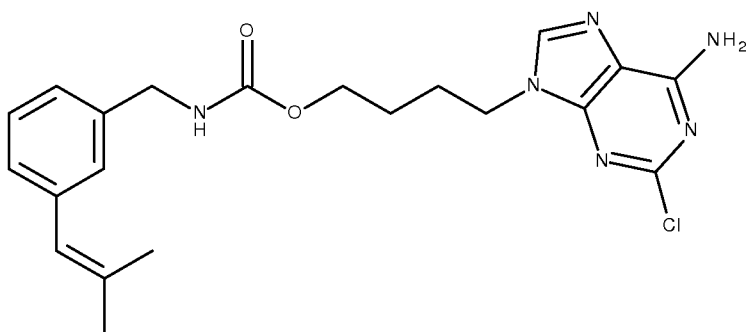


formula (XCII -2)

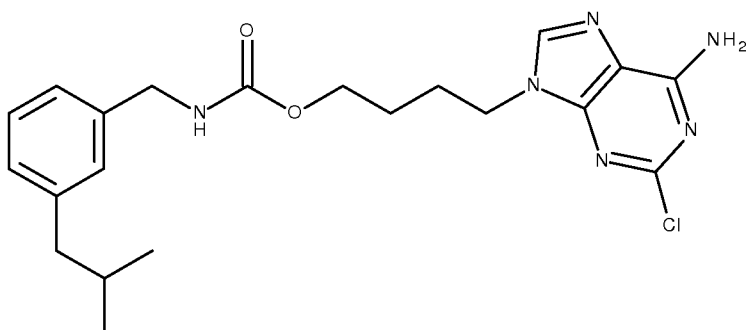


formula (XCII -3)

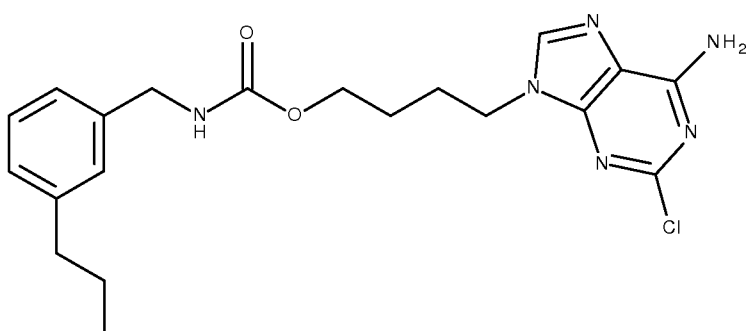
formula (XCII - 4)



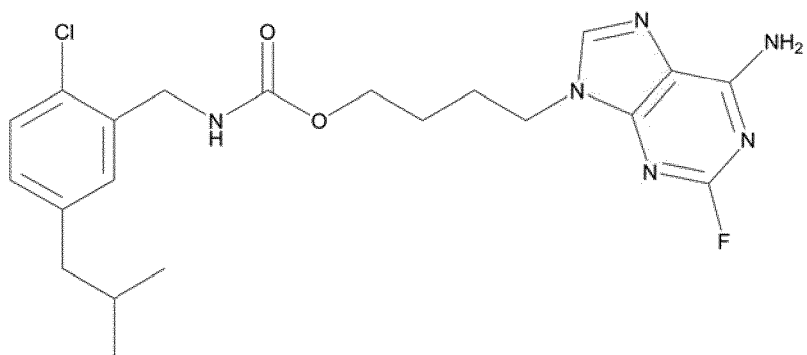
formula (XCII - 5)

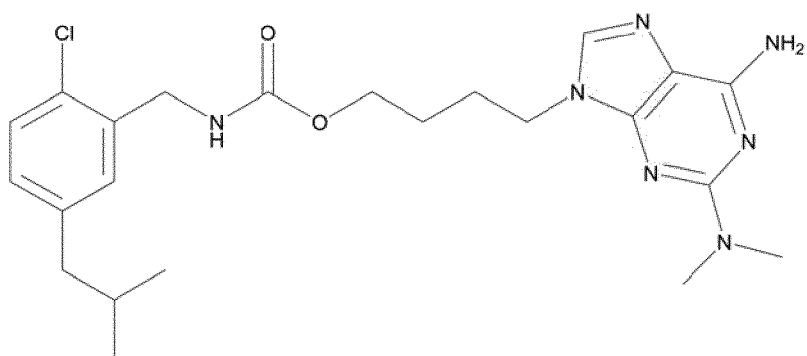


formula (XCII - 6)

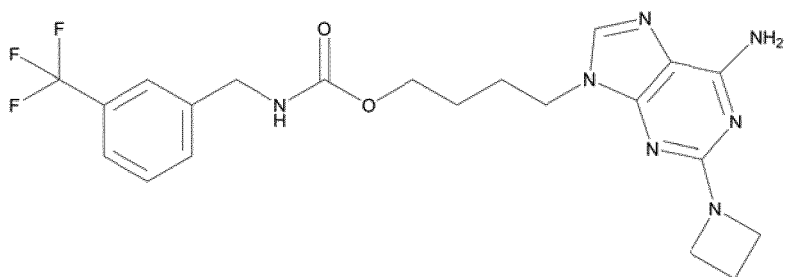


formula (XCII - 7)

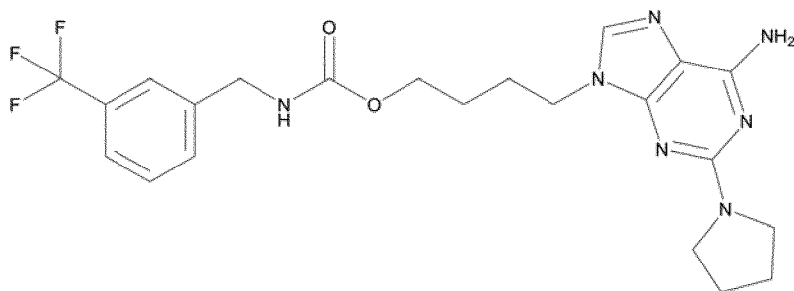




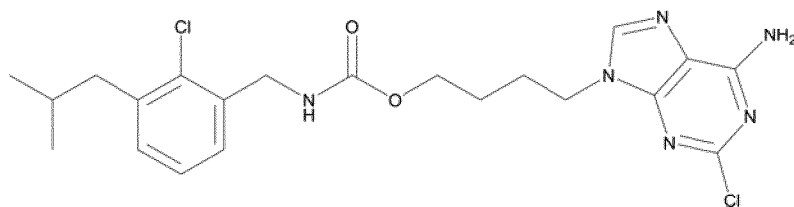
formula (XCIV)



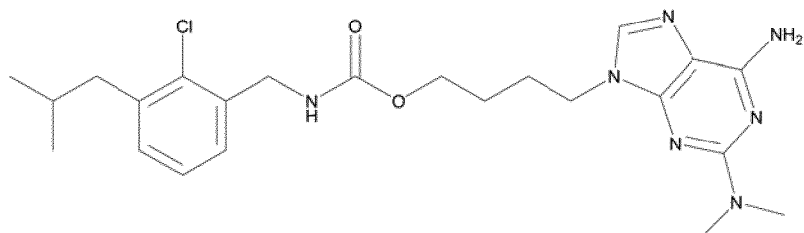
formula (XCV)



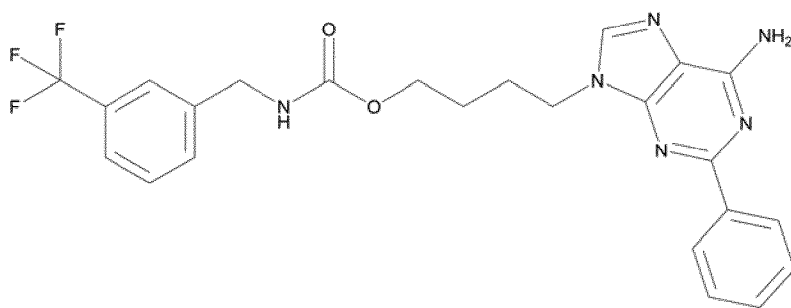
formula (XCVI)



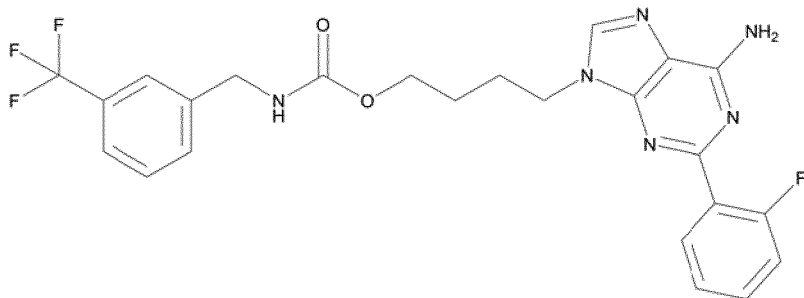
formula (XCVII)



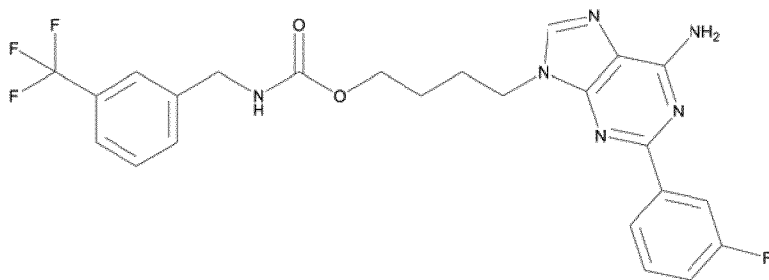
formula (XCVIII)



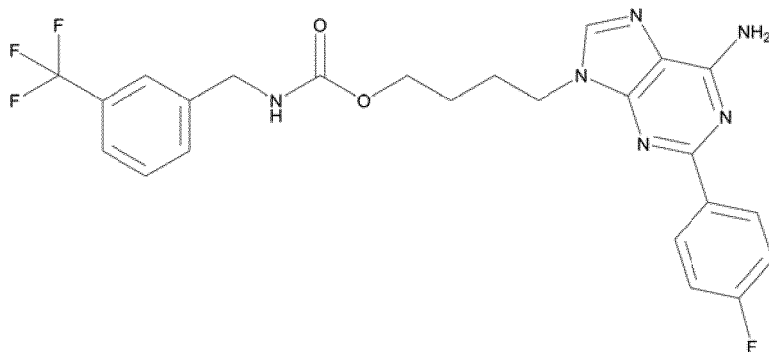
formula (XCIX)



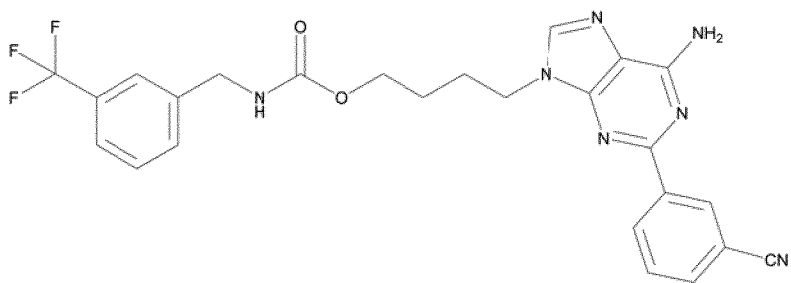
formula (C)



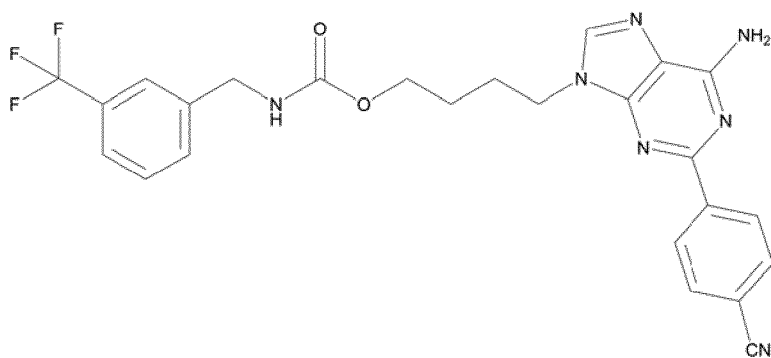
formula (CI)



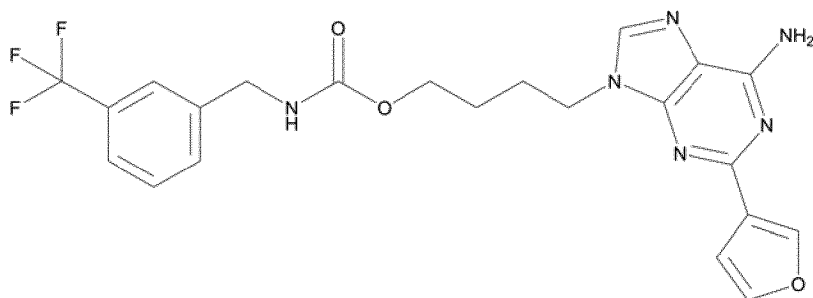
formula (CII)



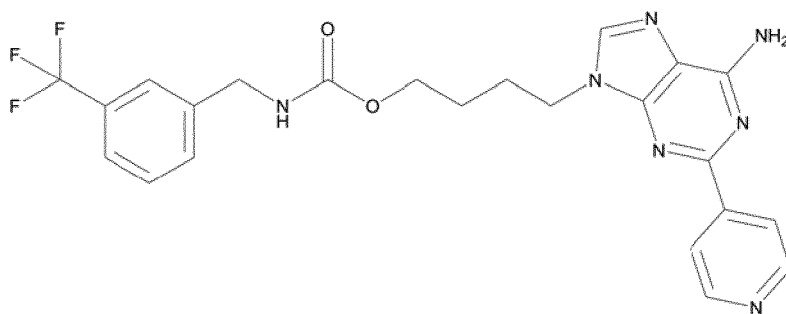
formula (CIII)



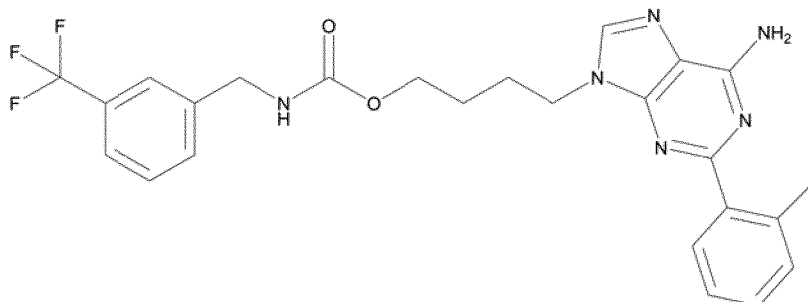
formula (CIV)



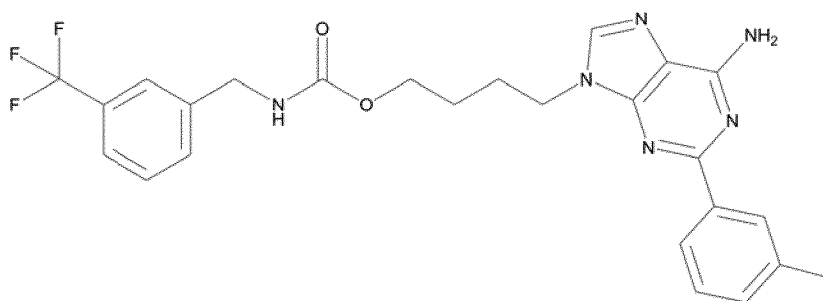
formula (CV)



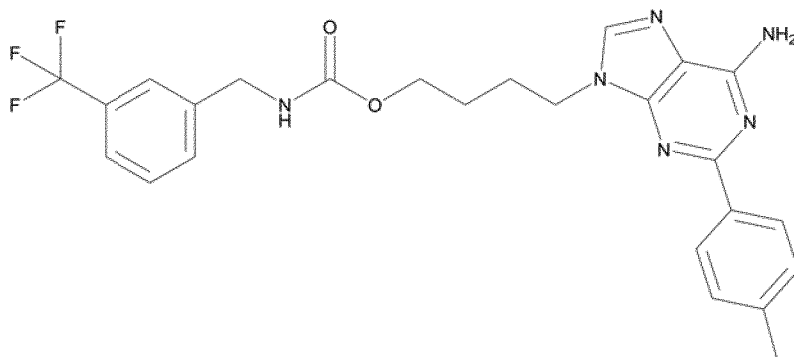
formula (CVI)



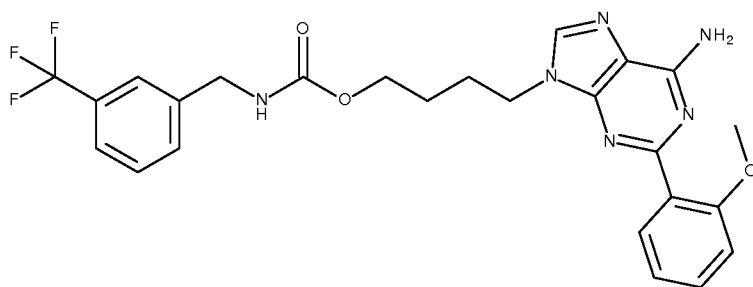
formula (CVII)



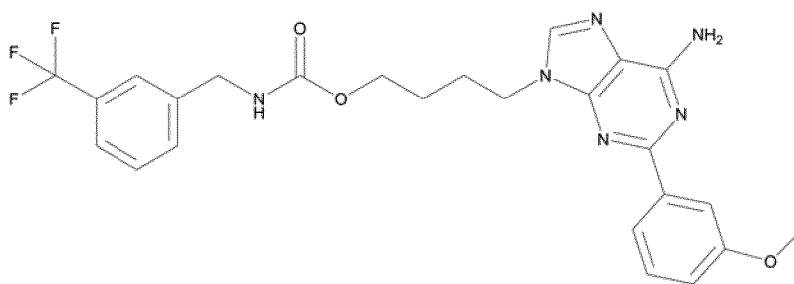
formula (CVIII)



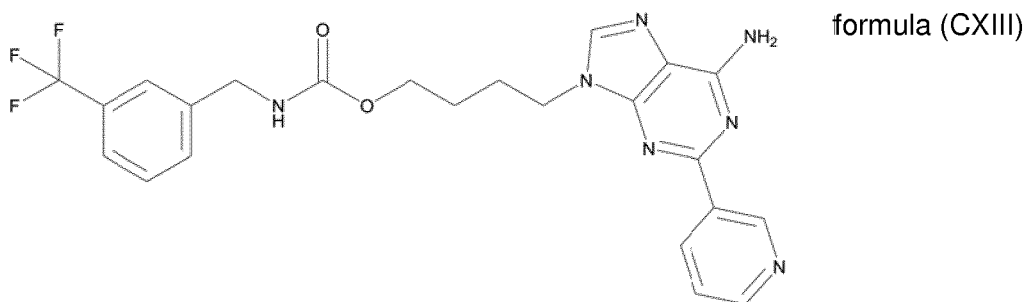
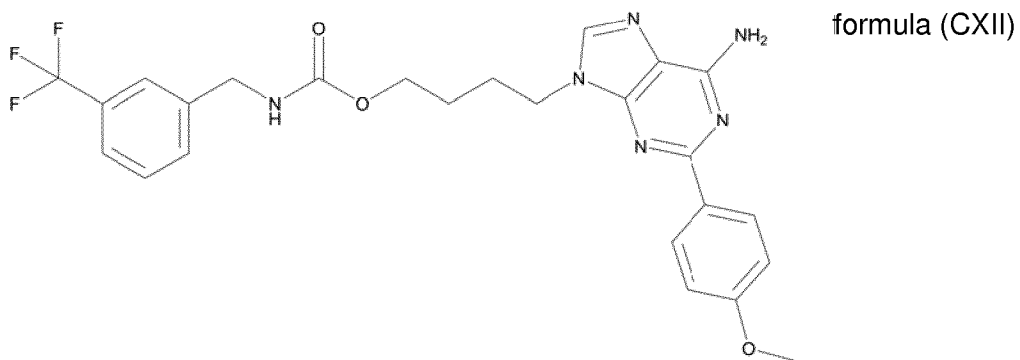
formula (CIX)



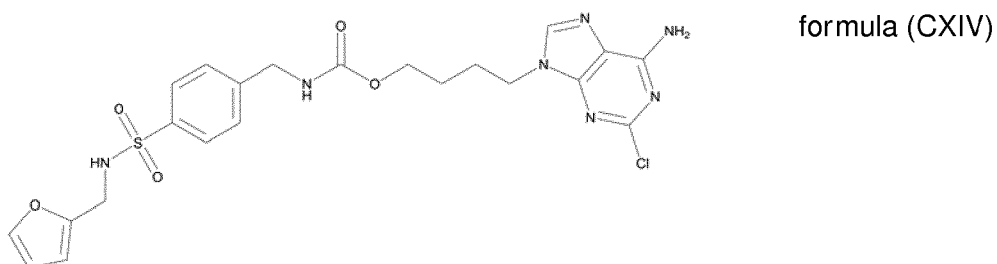
formula (CX)

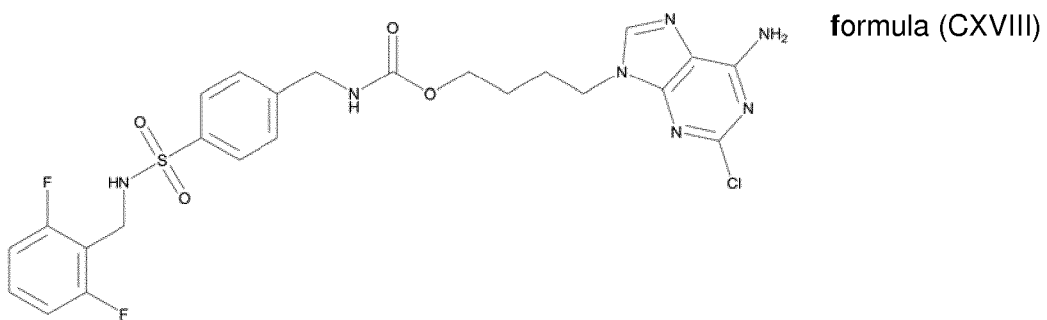
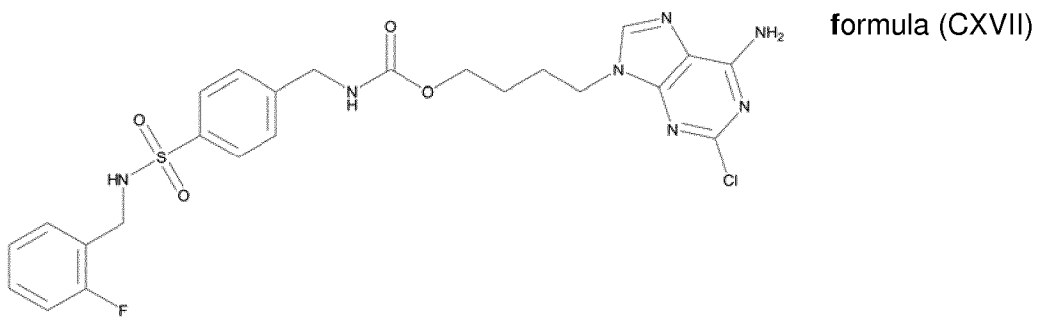
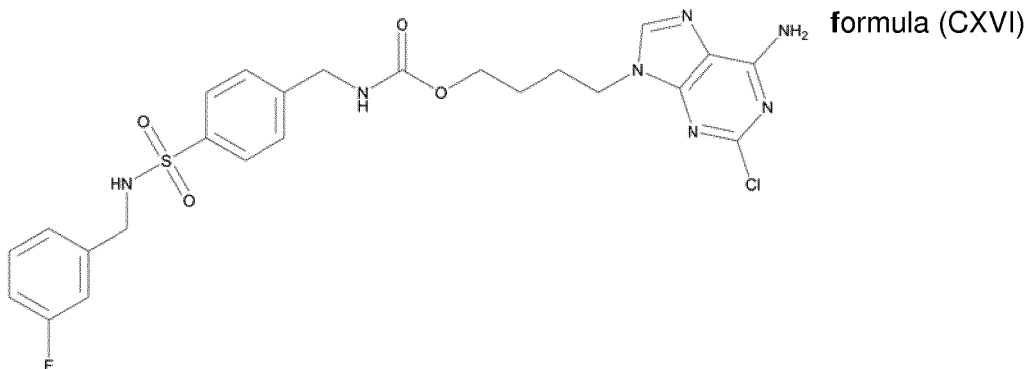
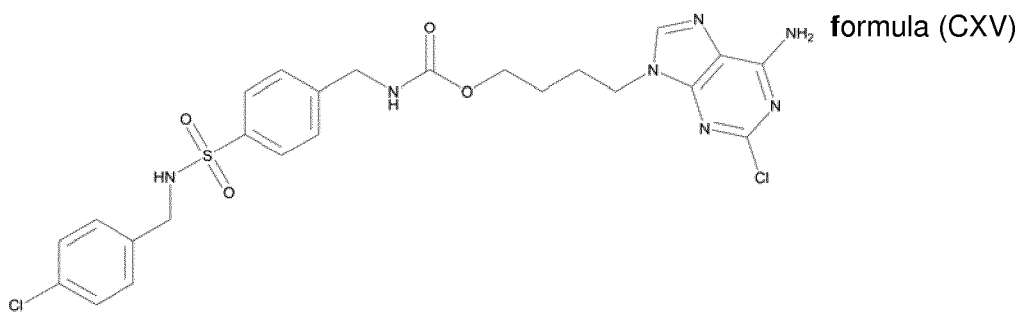


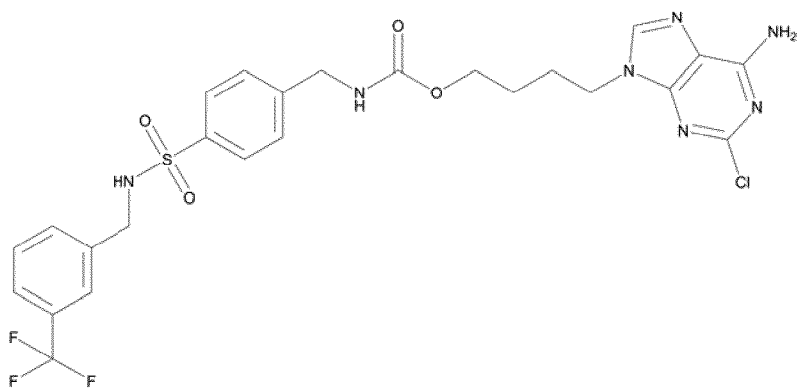
formula (CXI)



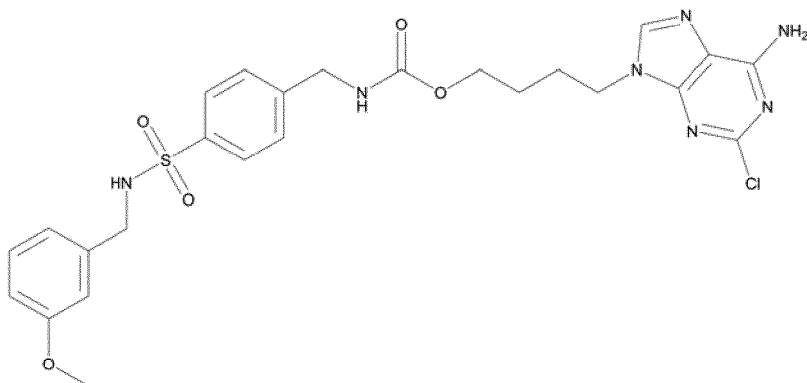
In a preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (II) is a compound chosen among those of formulae (CXIV) to (CXLVII) herein below



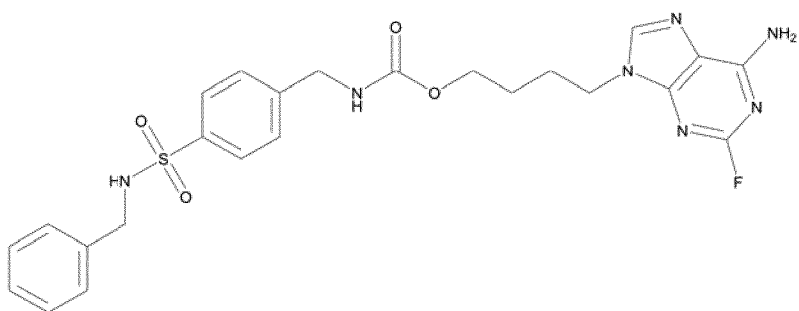




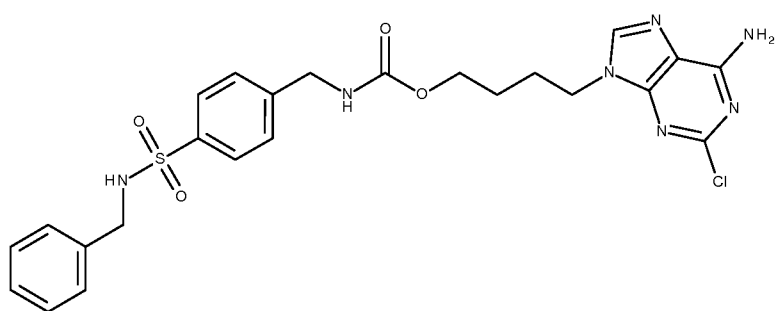
formula (CXIX)



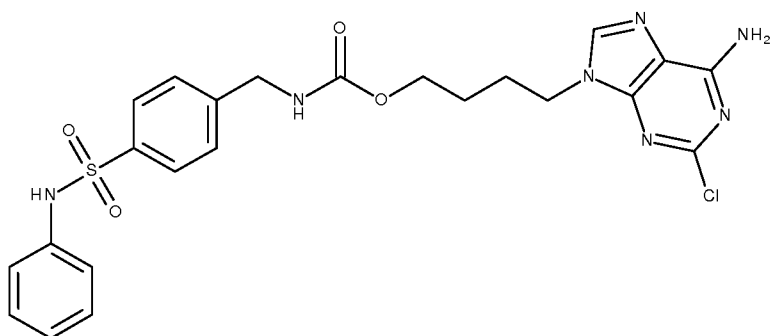
formula (CXX)



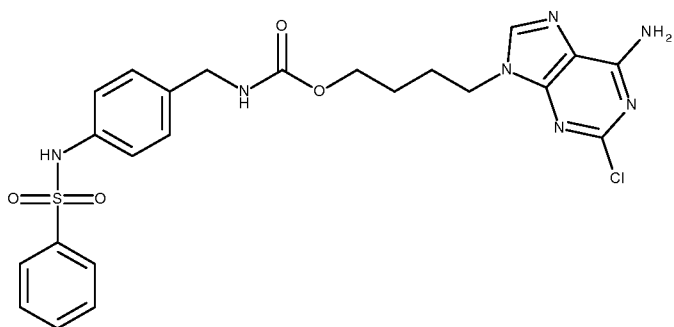
formula (CXXI)



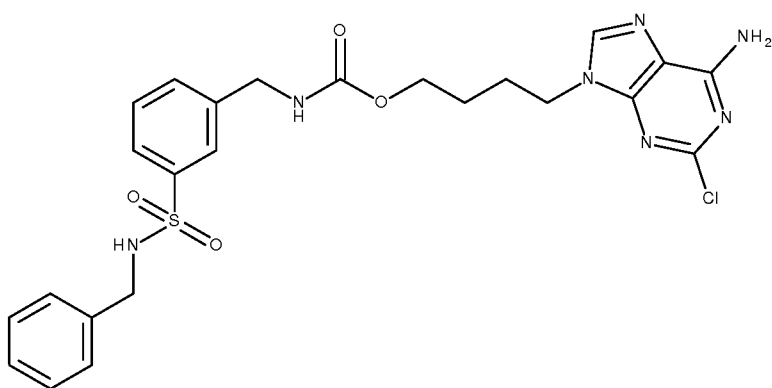
formula (CXXI - 1)



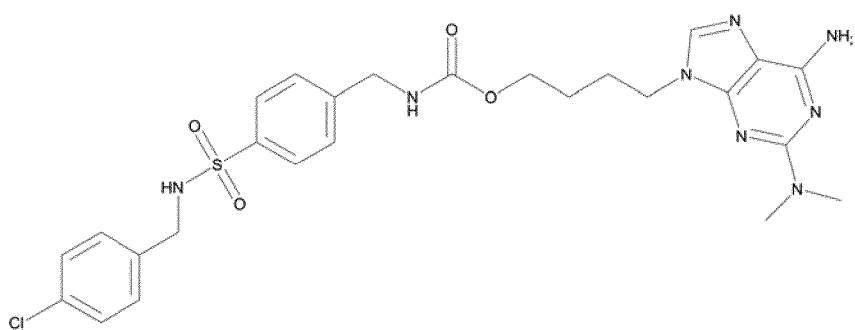
formula (CXXI - 2)



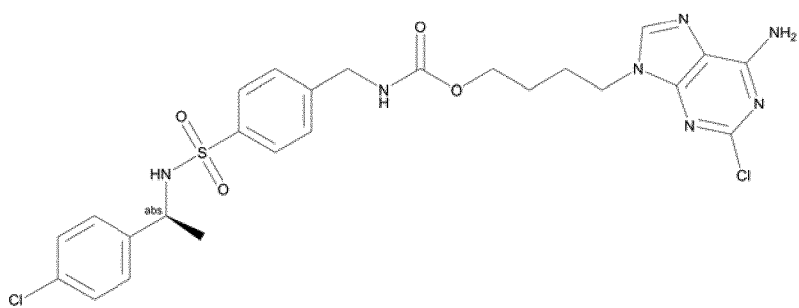
formula (CXXI - 3)



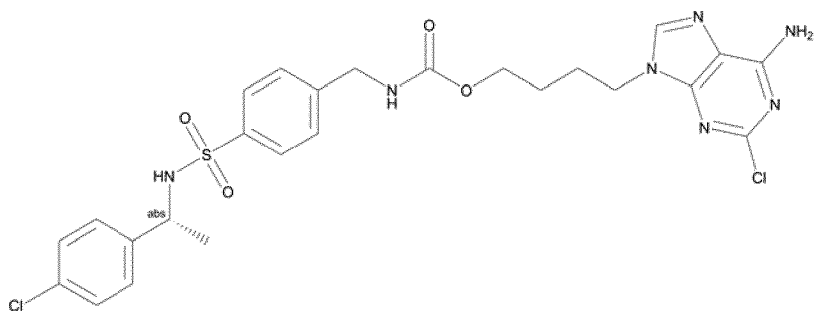
formula (CXXI - 4)



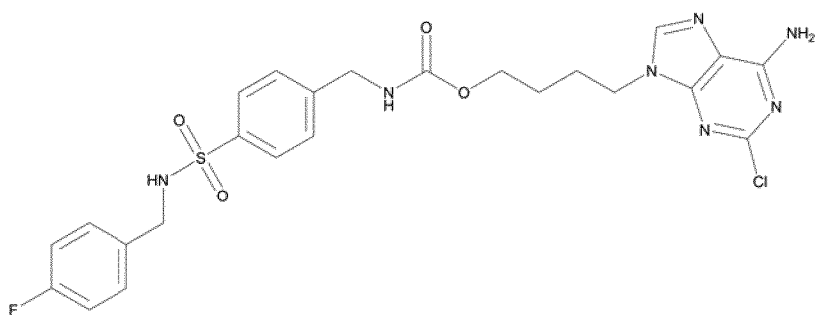
formula (CXXII)



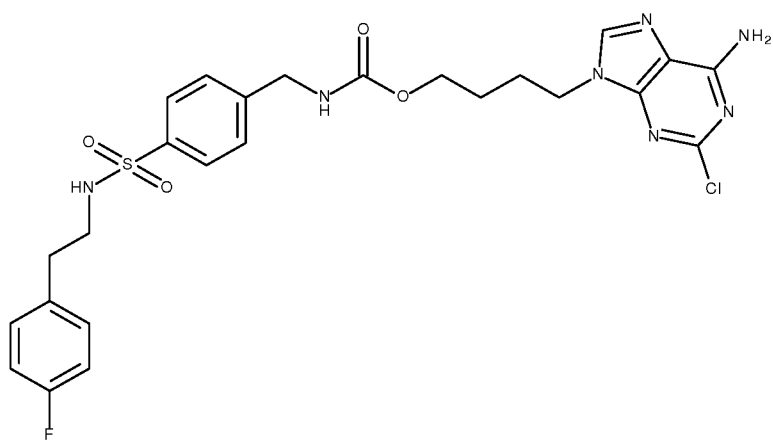
Formula (CXXIII)



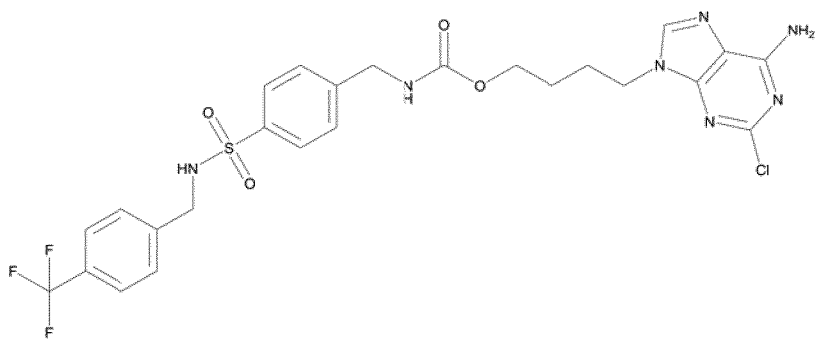
formula (CXXIV)



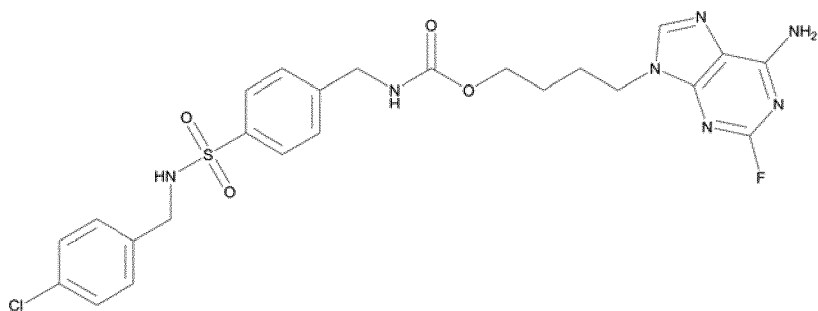
formula (CXXV)



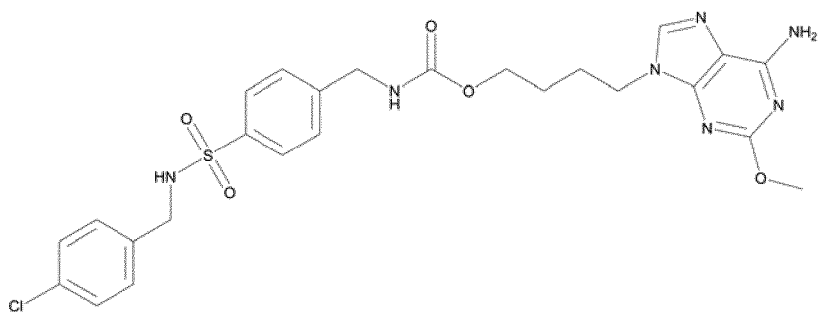
formula (CXXV - 1)



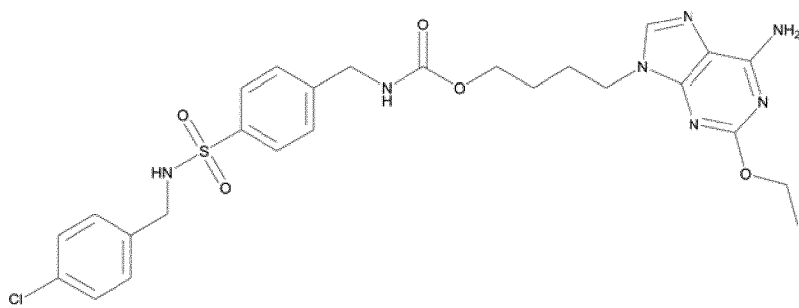
formula (CXXVI)



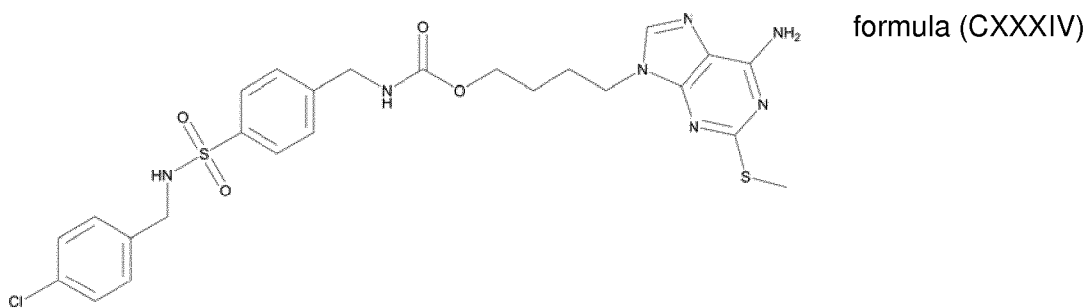
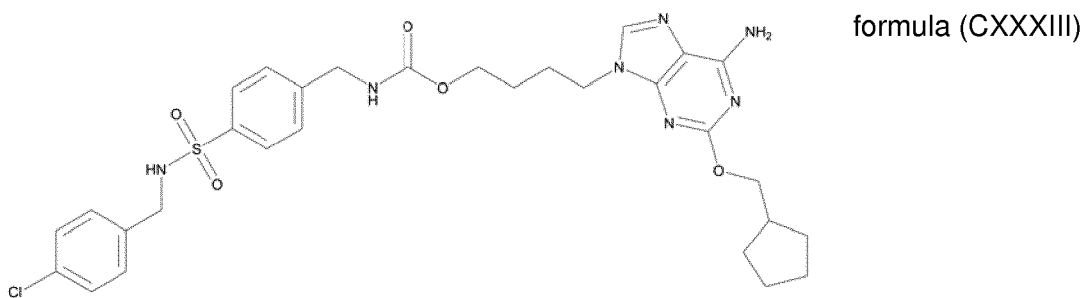
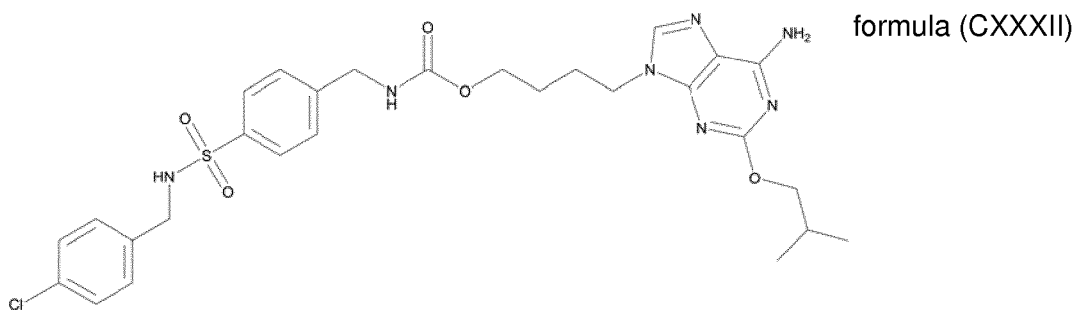
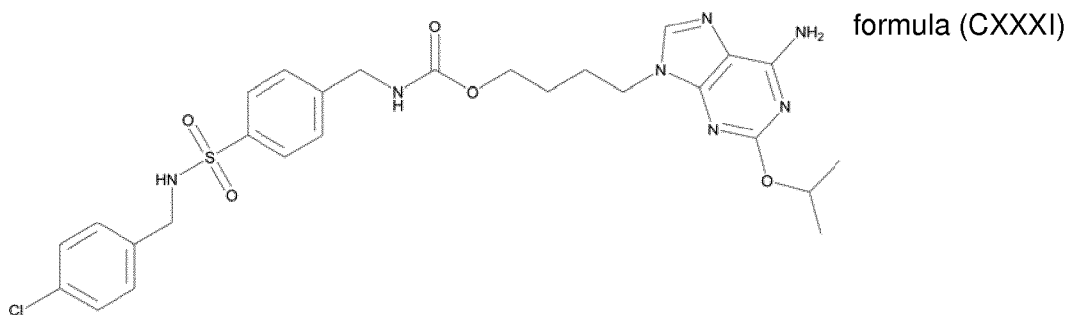
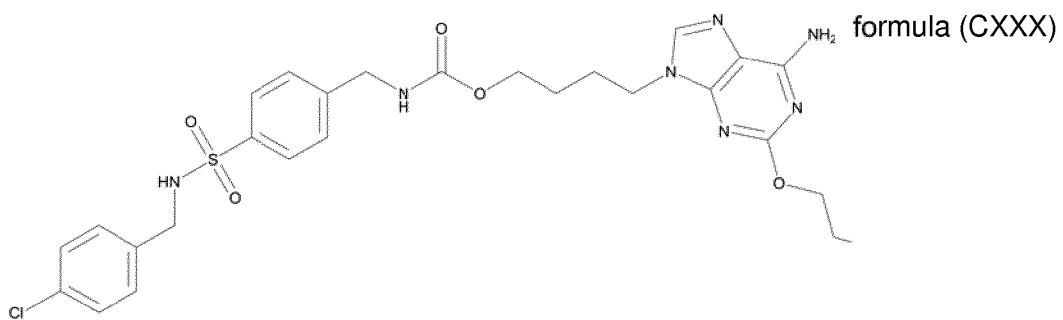
formula (CXXVII)

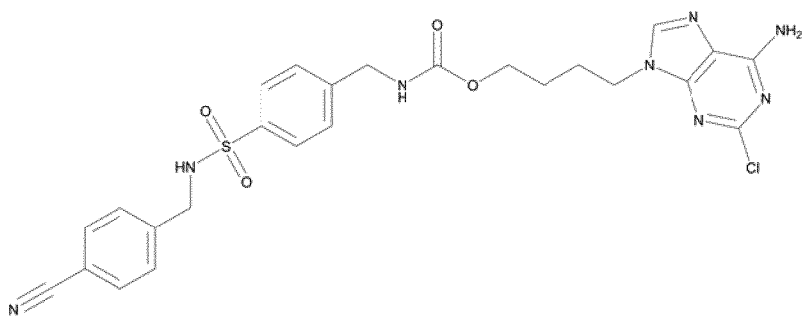


formula (CXXVIII)

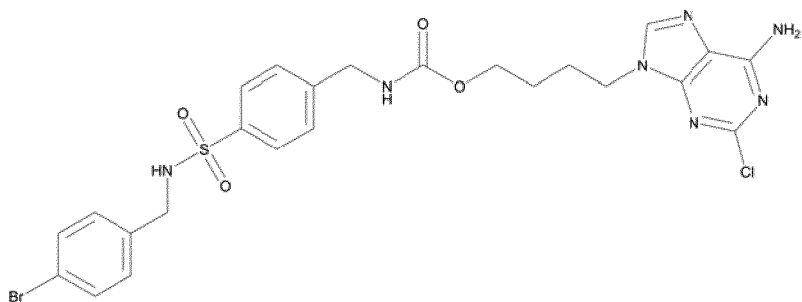


formula (CXXIX)

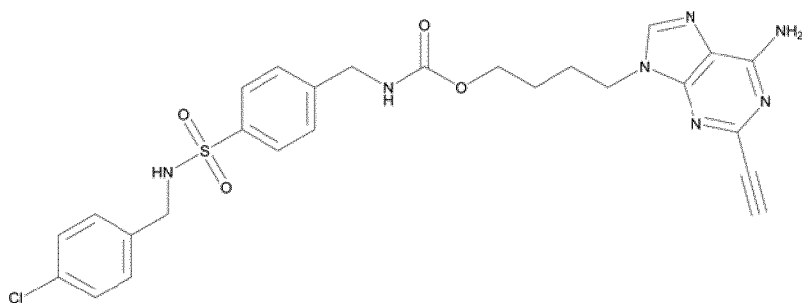




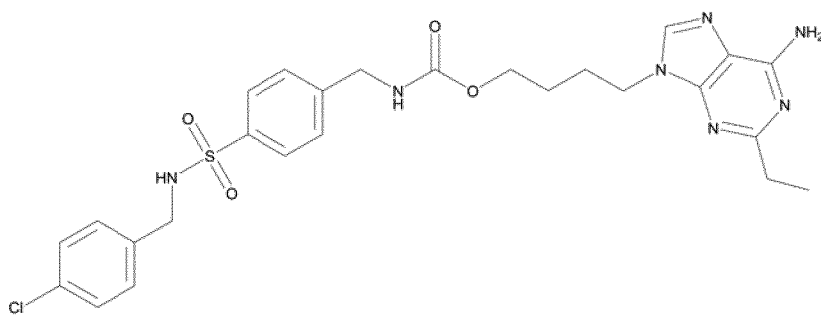
formula (CXXXV)



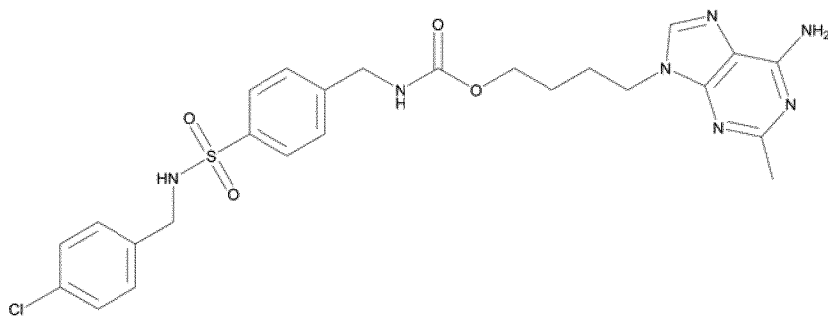
formula (CXXXVI)



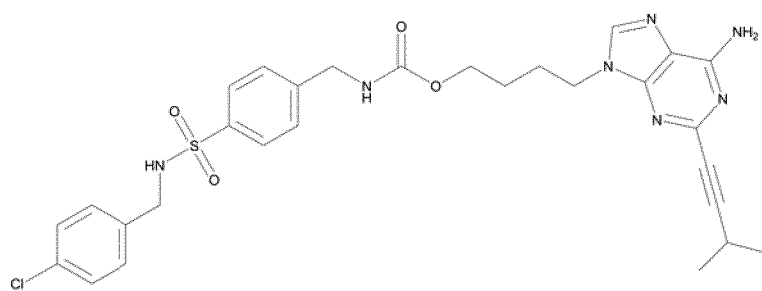
formula (CXXXVII)



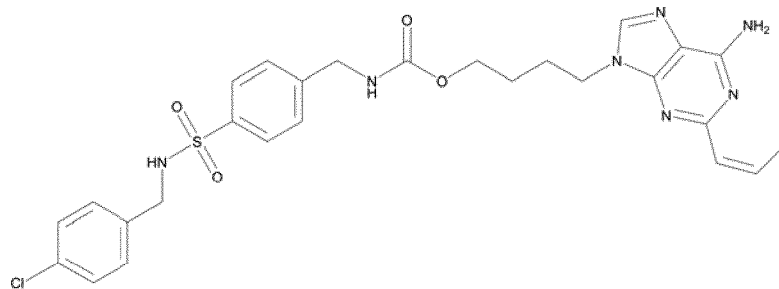
formula (CXXXVIII)



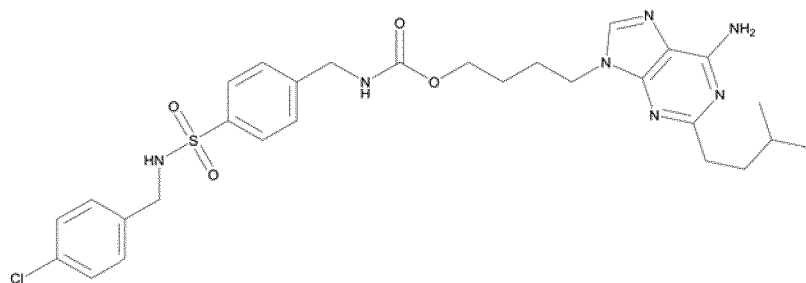
formula (CXXXIX)



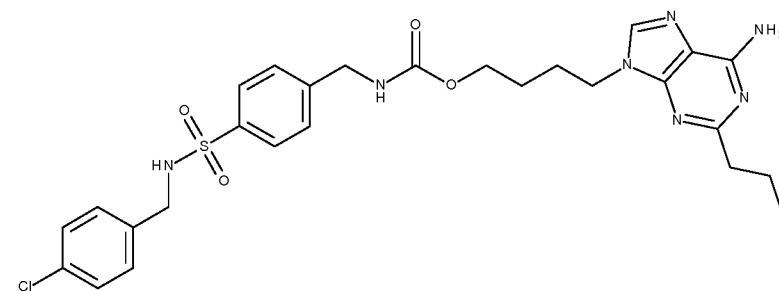
formula (CXL)



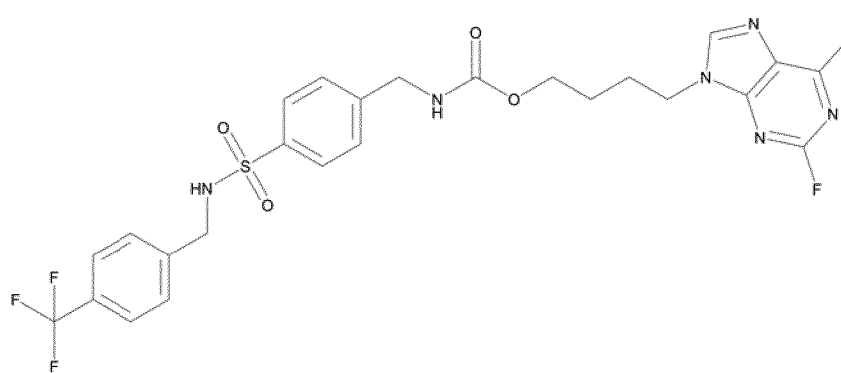
formula (CXLI)



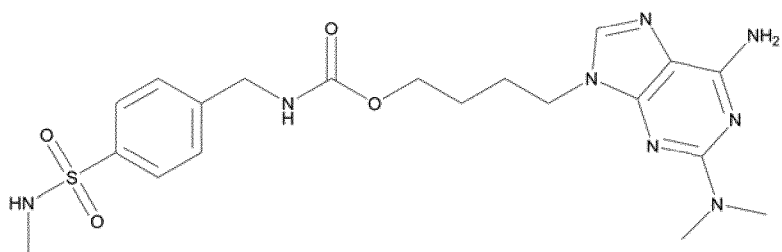
formula (CXLII)



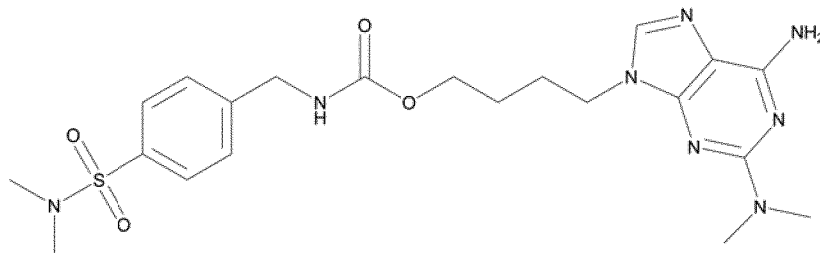
formula (CXLIII)



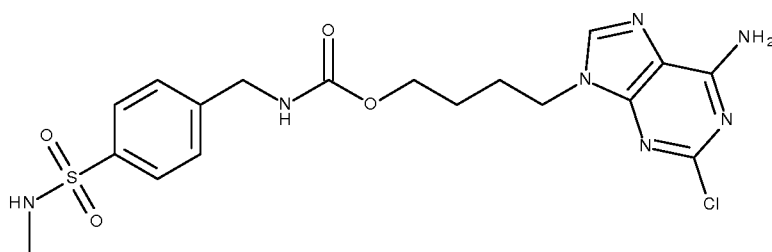
formula (CXLIV)



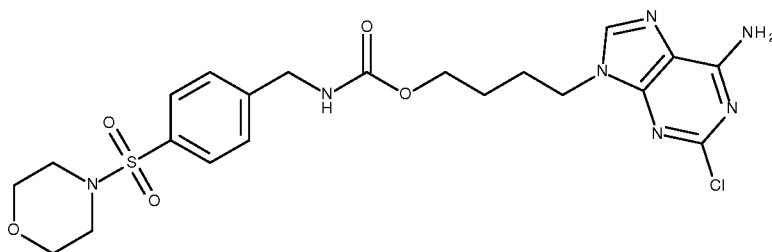
formula (CXLV)



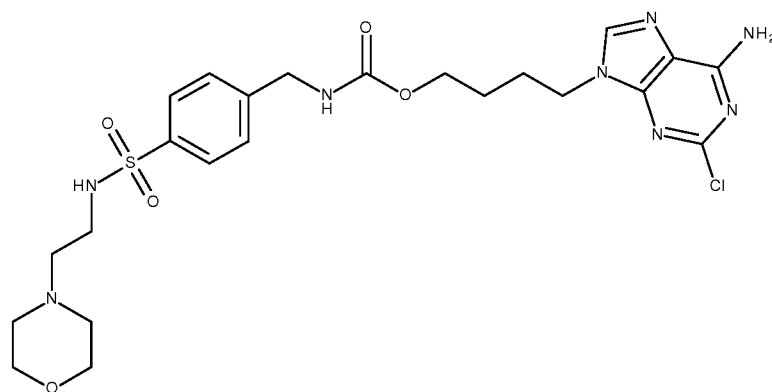
formula (CXLVI)



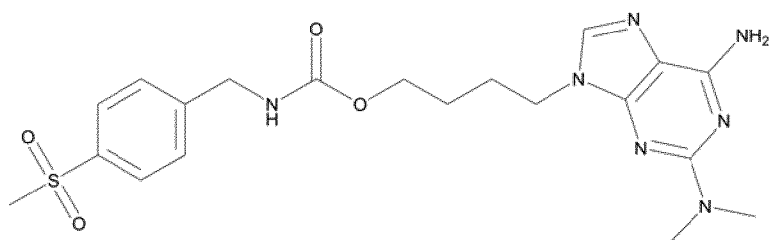
formula (CXLVI - 1)



formula (CXLVI - 2)

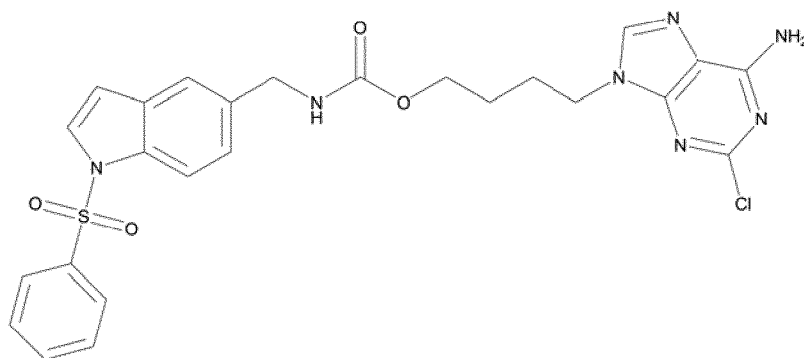


formula (CXLVI - 3)

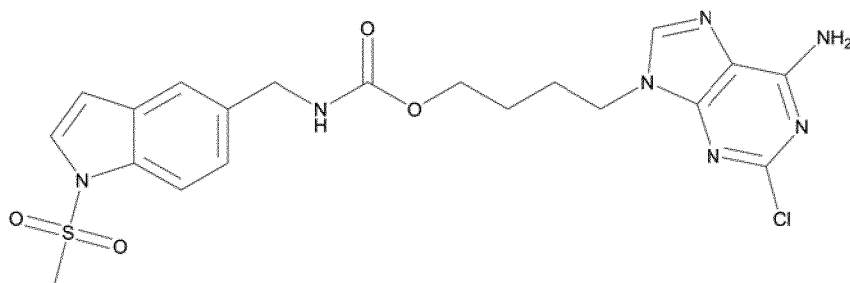


formula (CXLVII)

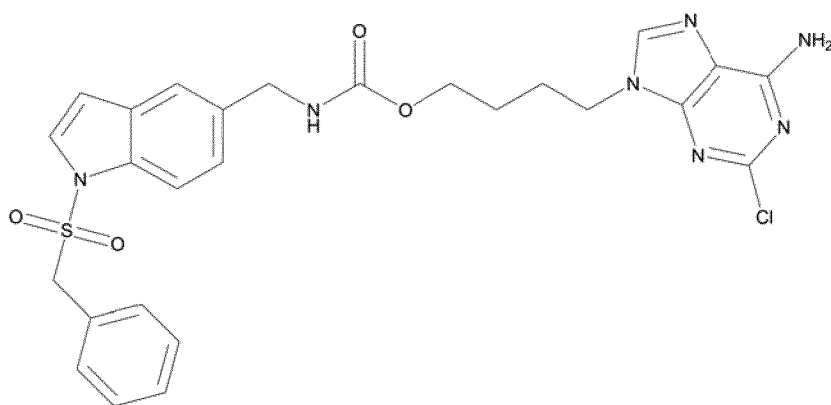
- 5 In a preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (IV) is a compound chosen among those of formulae (CXLVIII) to (CLVII), (CLIX) to (CLXX) or (XXV) to (XXV - 13) herein below:



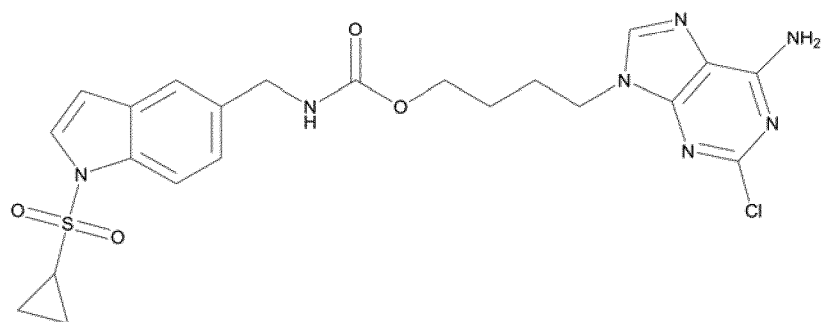
formula (CXLVIII)



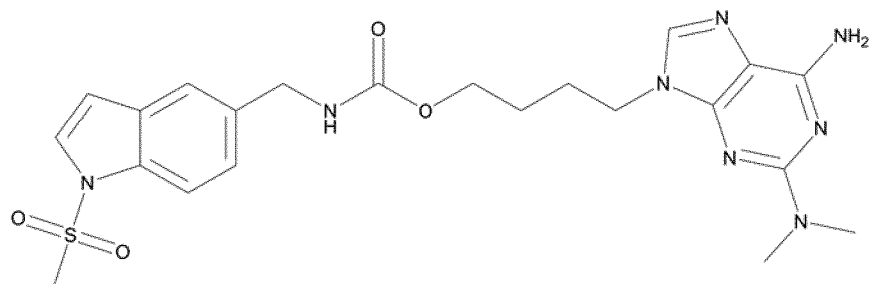
formula (CXLIX)



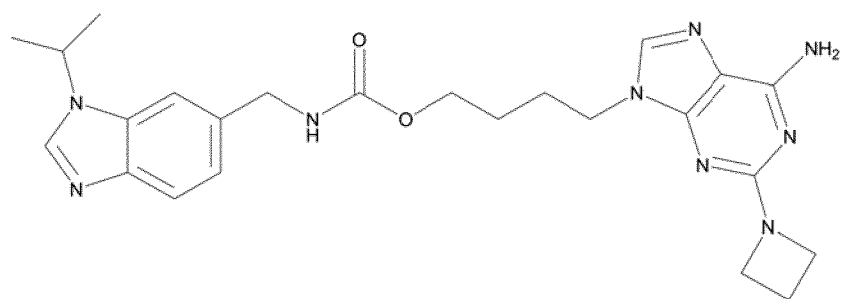
formula (CL)



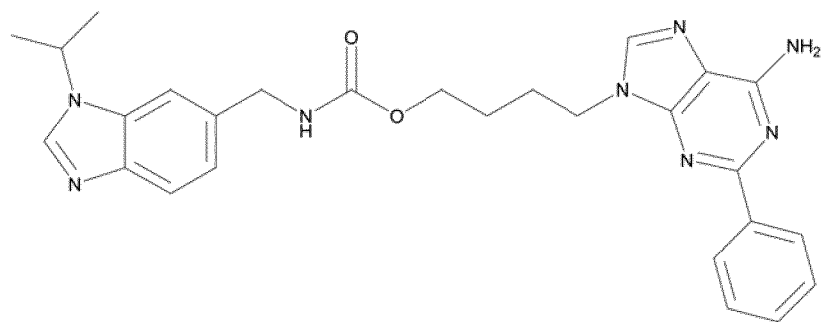
formula (CLI)



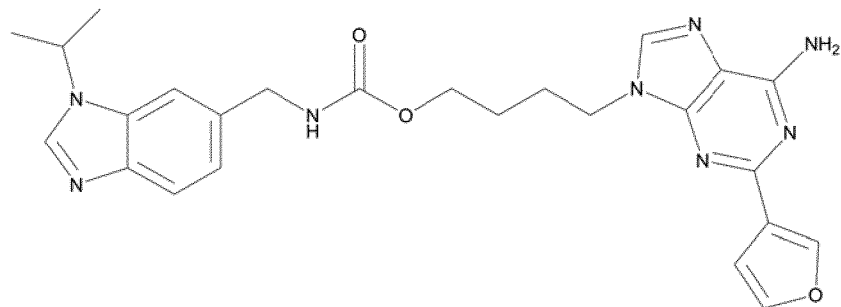
formula (CLII)



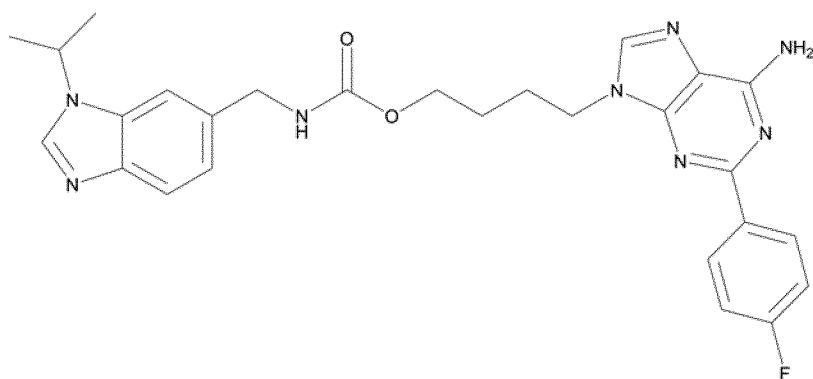
formula (CLIII)



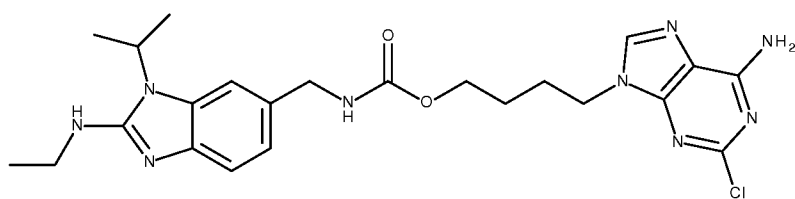
formula (CLIV)



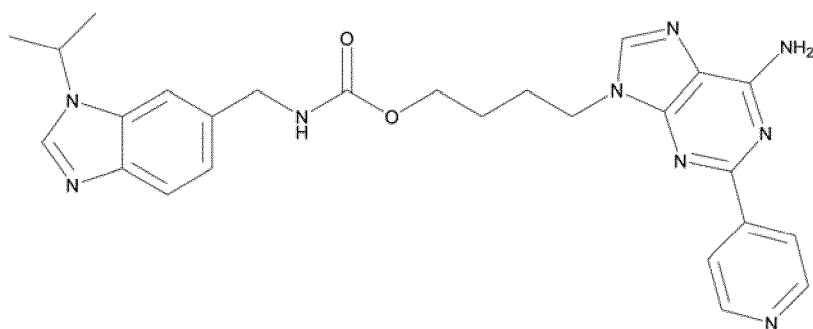
formula (CLV)



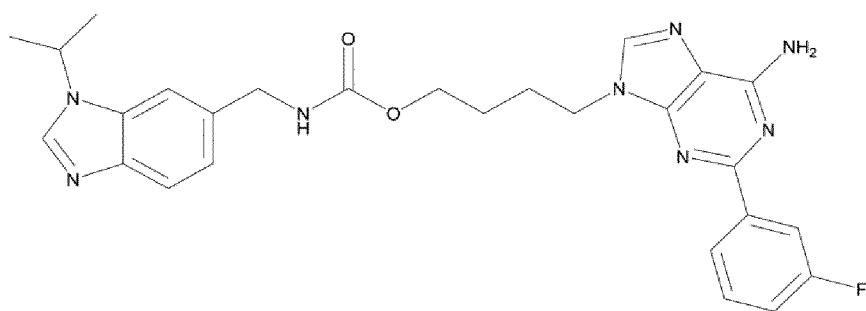
formula (CLVI)



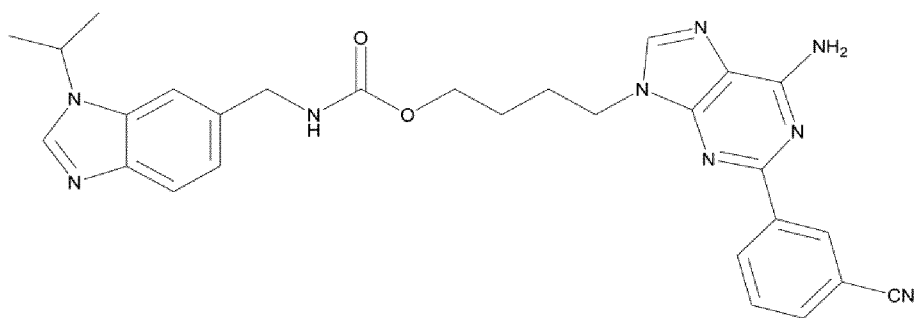
formula (CLVI - 1)



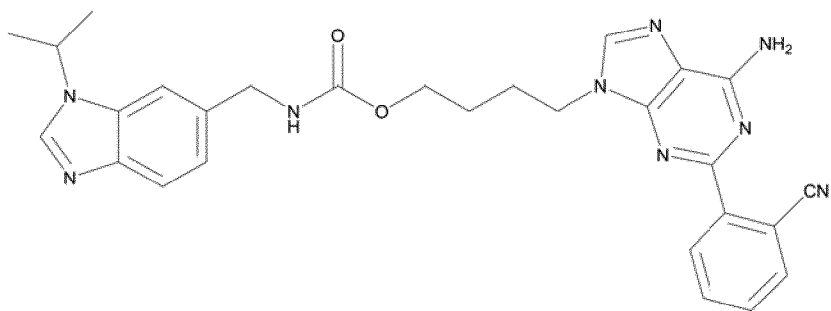
formula (CLVII)



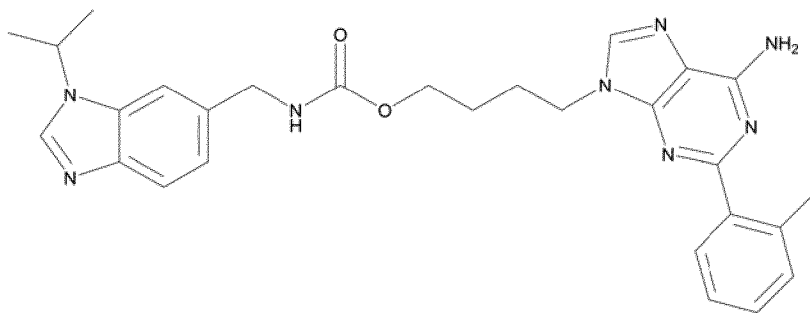
formula (CLIX)



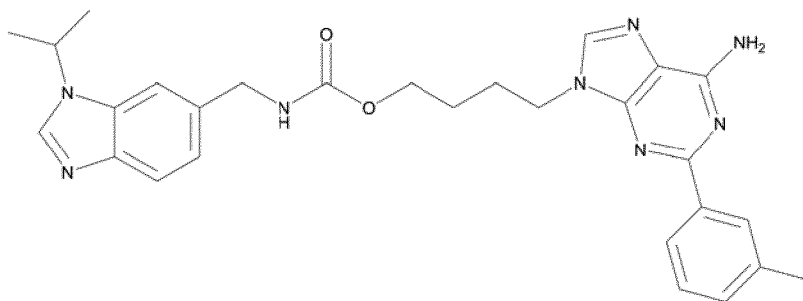
formula (CLX)



formula (CLXII)



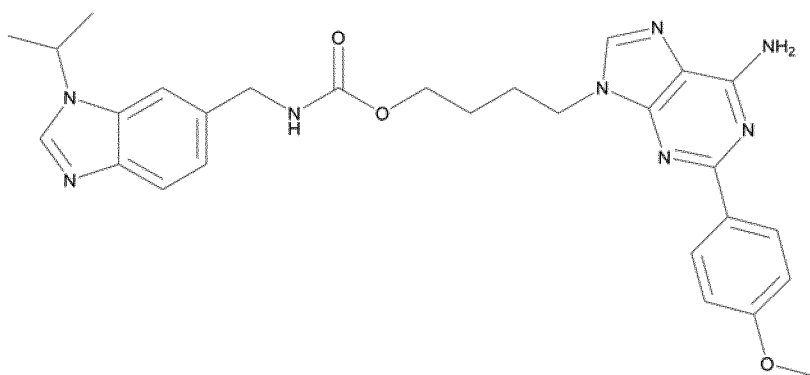
formula (CLXIII)



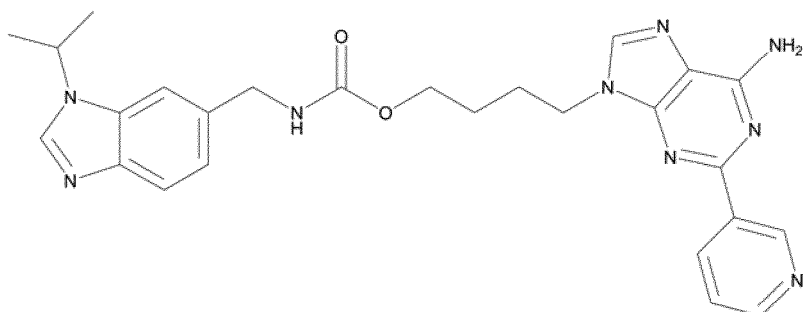
formula (CLXIV)

CC1=CNC2=CC=CC=C2N1CCNC(=O)OCCCCN3C4=NC=CC=C5C4=NC(=C3)N=C(C5)c6ccccc6FCC1=CN2C(=N1)c3ccc(cc3CN(C)C)CCNC(=O)OCCCCN4C5=NC6=C(N)N=CN=C5C7=CC=C(C=C7)OC(C)C4CC1=C(C)N2C=CC=C3C=C2C(=C1)CCN3C(=O)OCCCCCN4C5=NC6=CC=C(OC)C=C6N=C5N=C4N

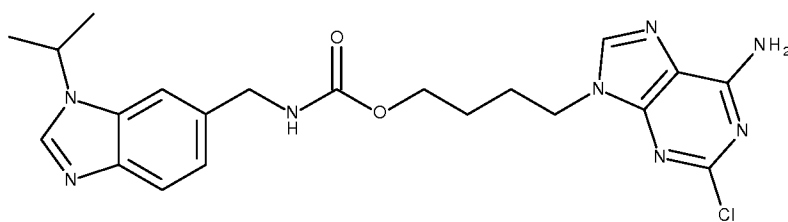
formula (CLXVIII)



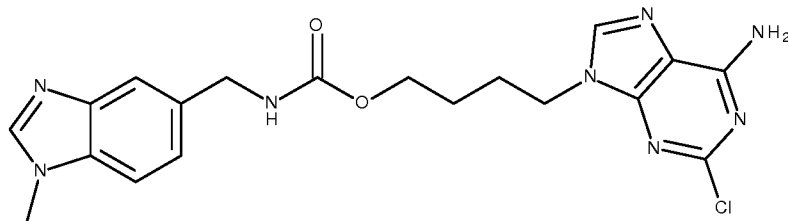
formula (CLXIX)



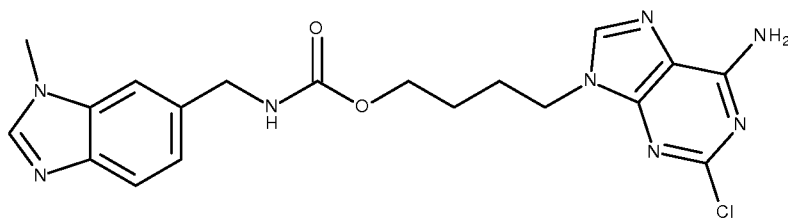
formula (CLXX)



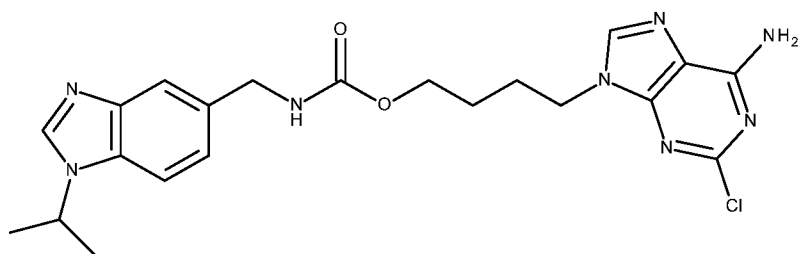
formula (XXV)



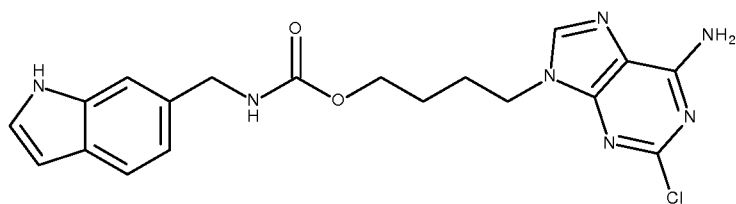
formula (XXV - 1)



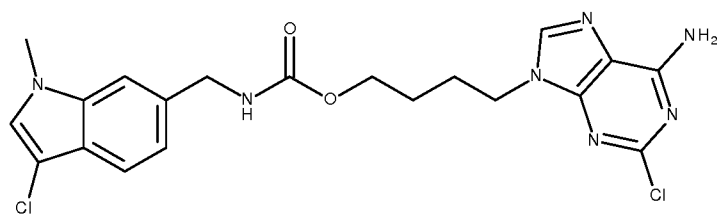
formula (XXV - 2)



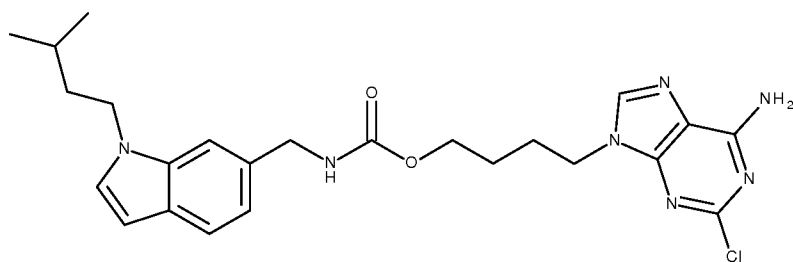
formula (XXV - 3)



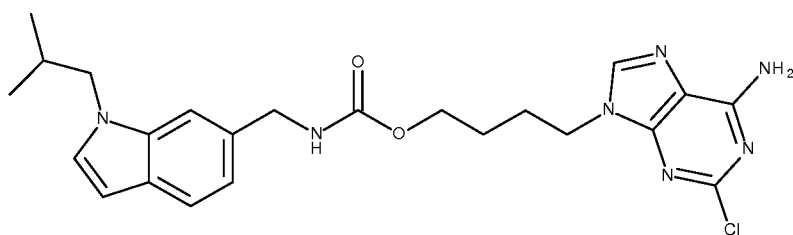
formula (XXV - 4)



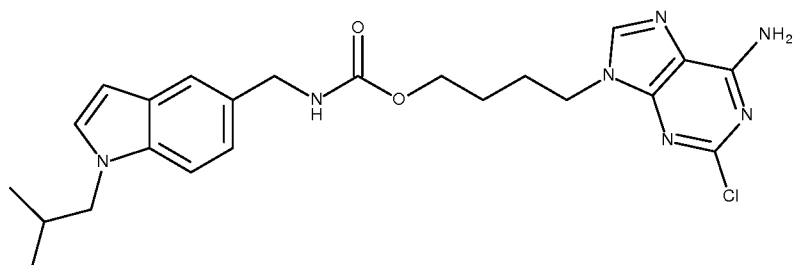
formula (XXV - 5)



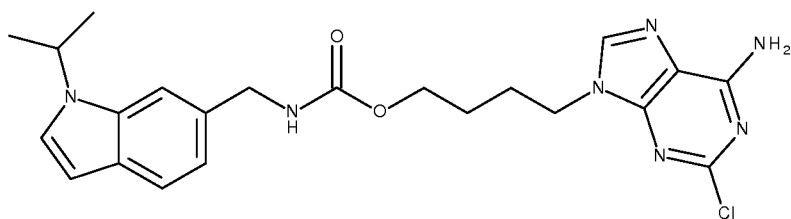
formula (XXV - 6)



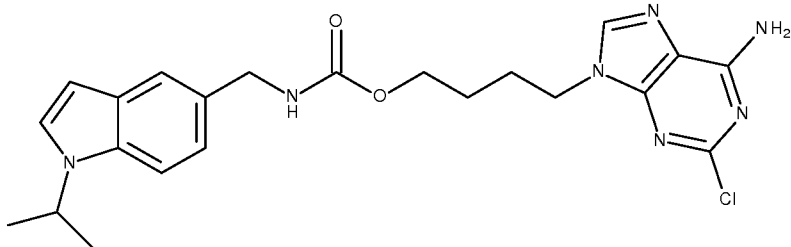
formula (XXV - 7)



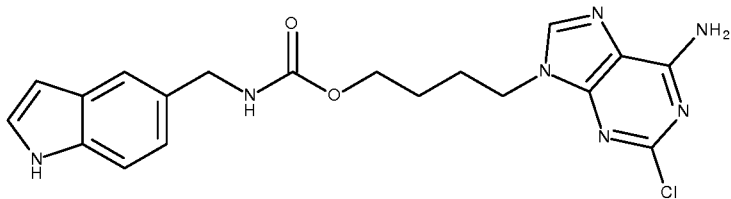
formula (XXV - 8)



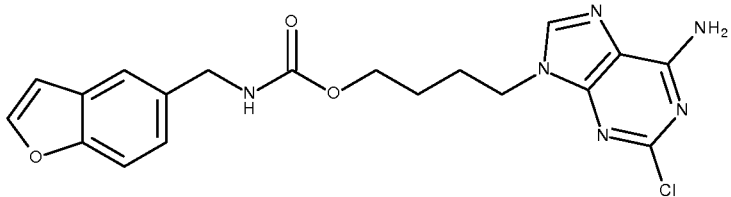
formula (XXV - 9)



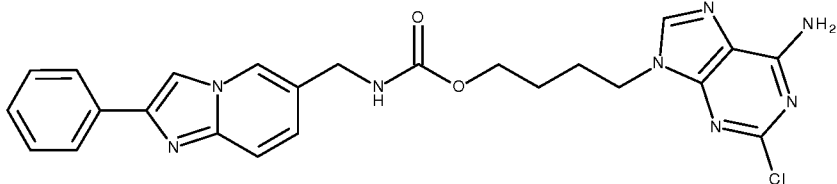
formula (XXV - 10)



formula (XXV - 11)

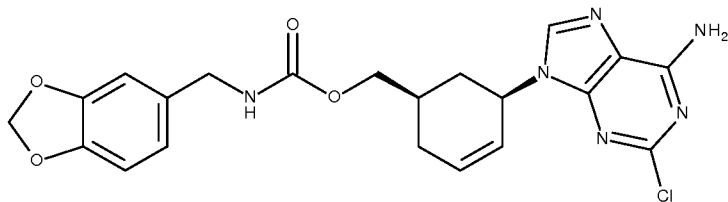


formula (XXV - 12)



formula (XXV - 13)

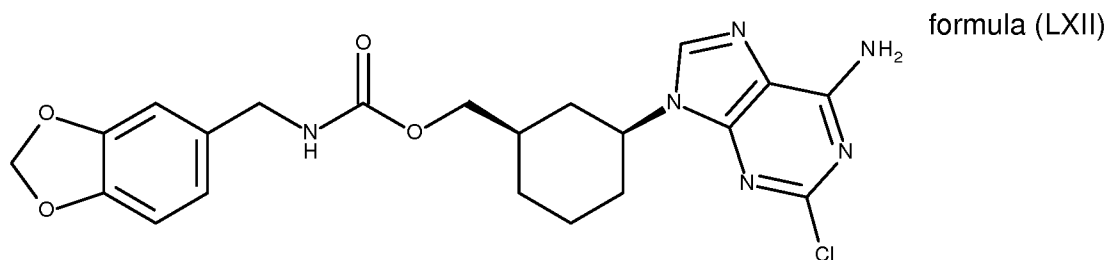
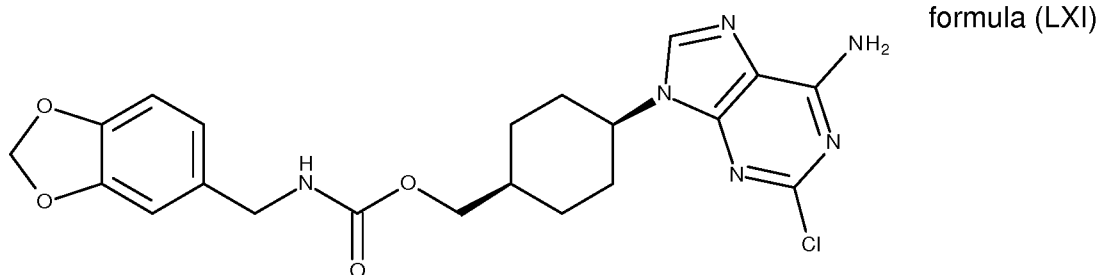
In a preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (XVII) is a compound of formula (LX)



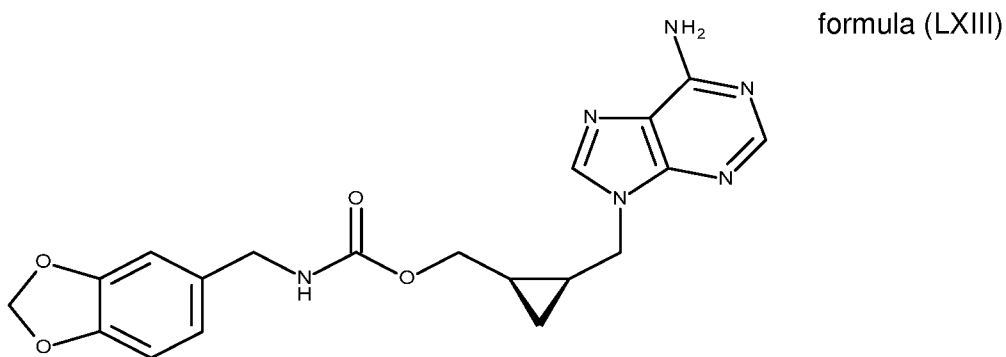
formula (LX)

In a preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (XIII) is chosen among those of formula (LXI) or (LXII) herein below:

5



In a preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (IX') is a compound according to formula (LXIII) herein below

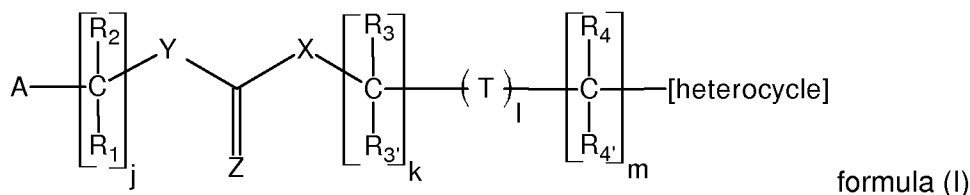


In a more preferred embodiment of the present invention, the compound (C), according to the present invention, for use as a kinase inhibitor according to general formula (I), or the N-oxide, pharmaceutically acceptable

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salt, pharmaceutically acceptable solvate, or stereoisomer thereof, is a compound of formula (XXV), as defined above.

The present invention further relates to an *in vitro* method of inhibiting protein kinase activity which comprises contacting a protein kinase with a compound of formula (I) [compound (C), herein after], as defined above, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof,

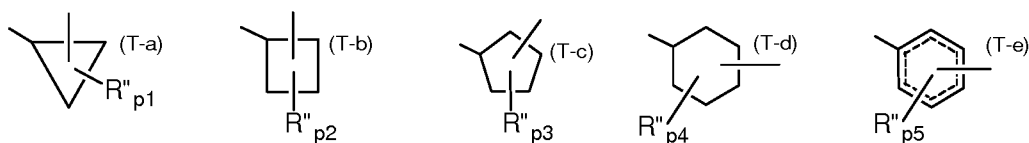


wherein:

- each of A is independently selected from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl, wherein said alkyl, alkenyl, alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl, are optionally substituted with one or more substituents independently selected from the group consisting of halo, NO₂, alkyl, alkenyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, CF₃, CN, OR₁₁, SR₁₁, N(R₁₁)₂, OC(R₁₁)₂O, OC(R₁₁)₂C(R₁₁)₂O, S(O)R₁₂, SO₂R₁₂, SO₂N(R₁₁)₂, S(O)₃R₁₁, P(O)(OR₁₁)₂, SO₂NR₁₁COR₁₂, SO₂NR₁₁CO₂R₁₂, SO₂NR₁₁CON(R₁₁)₂, NR₁₁COR₁₂, NR₁₁CO₂R₁₂, NR₁₁CON(R₁₁)₂, NR₁₁C(NR₁₁)NHR₁₁, COR₁₁, CON(R₁₁)₂, CONR₁₁SO₂R₁₂, NR₁₁SO₂R₁₂, SO₂NR₁₁CO₂R₁₂, OCONR₁₁SO₂R₁₂, OC(O)R₁₁, C(O)OCH₂OC(O)R₁₁, and OCON(R₁₁)₂ and each optional alkyl, alkenyl, cycloalkyl, aryl, heterocyclyl, heteroaryl substituent is further optionally substituted with halo, NO₂, alkyl, cycloalkyl, aryl, CF₃, N(R₁₁)₂, alkyl or aryl or heteroaryl amide, NR₁₁COR₁₂, NR₁₁SO₂R₁₂, COR₁₁, CON(R₁₁)₂, NR₁₁CON(R₁₁)₂, OC(O)R₁₁, OC(O)N(R₁₁)₂, S(O)₃R₁₁, P(O)(OR₁₁)₂, SR₁₁, S(O)R₁₂, SO₂R₁₂, SO₂N(R₁₁)₂, CN, or OR₁₁; and wherein each of R₁₁ and R₁₂, independently from each other and at each occurrence, are selected from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, aralkyl and CF₃, wherein said alkyl, alkenyl, alkynyl,

cycloalkyl, heterocyclyl, aryl, heteroaryl, and aralkyl substituents are optionally substituted with halo, alkyl, cycloalkyl, heterocyclyl, mono- or dialkylamino, alkyl or aryl or heteroaryl amide, CN, O—C₁₋₆alkyl, CF₃, aryl, or heteroaryl;

- 5 - each of X and Y, independently from each other and at each occurrence, are selected from O, C, S, NR₇; and wherein R₇ is selected from hydrogen, C₁₋₁₂ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group;
- 10 - each of Z is O, S, N—CN, N—OR₈; and wherein R₈ is selected from hydrogen, an C₁₋₁₂ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group;
- 15 - each of R₁ and R₂, independently from each other and at each occurrence, are selected from the group consisting of hydrogen; C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl and C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group; OR₁₃, SR₁₃ or N(R₁₃)₂ wherein each of R₁₃, independent from each other, is selected from hydrogen or C₁₋₁₂ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group, and j is an integer in the range from 0 to 7; with the proviso that when j = 0 and Y = NR₇, then A and R₇ may form together a saturated or unsaturated cyclic moiety;
- 20 - each of R₃, R_{3'}, R₄ and R_{4'}, independently from each other and at each occurrence, are selected from the group consisting of hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl and C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group;
- 25 - each of T is selected from the group consisting of O, S, NR₉, or a divalent moiety of formula (T-a) to (T-e) wherein the second point of attachment can be at any carbon atom of the cyclic system, wherein the dash bond represents an optional double bond;
- 30



and wherein R_9 is selected from hydrogen or a C_{1-12} alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group;

- each of R'' is selected independently and at each occurrence, from the group consisting of hydrogen, C_{1-15} alkyl, C_{2-15} alkenyl and C_{2-15} alkynyl, wherein said C_{1-15} alkyl, C_{2-15} alkenyl, C_{2-15} alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group; and each of p_1 is an integer in the range from 0 to 4; each of p_2 is an integer in the range from 0 to 6; each of p_3 is an integer in the range from 0 to 8; each of p_4 is an integer in the range from 0 to 10; each of p_5 is an integer in the range from 0 to 8;
- each of k is an integer in the range from 0 to 7; each of l is an integer in the range from 0 to 1; and each of m is an integer in the range from 0 to 7 and with the proviso that the sum of k and m is equal to or greater than 1.

It is further understood that all definitions and preferences as described for compound (C) above equally apply for this embodiment and all further embodiments, as described below.

As used in the foregoing and hereinafter, the following definitions apply unless otherwise noted.

The term halo - alone or in combination means all halogens, that is, chloro (Cl), bromo (Br), fluoro (F), iodo (I).

The term alkyl - alone or in combination means an alkane-derived radical containing from 1 to 20, preferably 1 to 15 carbon atoms, unless otherwise specified, for example C_{F-G} alkyl defines a straight or branched alkyl radical having from F to G carbon atoms, e.g. C_{1-4} alkyl defines a straight or branched alkyl radical having from 1 to 4 carbon atoms such as for example methyl, ethyl, 1-propyl, 2-propyl, 1-butyl, 2-butyl, 2-methyl-1-propyl. An alkyl group may be a straight chain alkyl or branched alkyl. Preferably, straight or branched alkyl groups containing from 1-15, more preferably 1 to 8, even

more preferably 1-6 and most preferably 1-4, carbon atoms, such as methyl, ethyl, propyl, isopropyl, butyl, t-butyl and the like. Alkyl also includes a straight chain or branched alkyl group that contains or is interrupted by a cycloalkyl portion. The straight chain or branched alkyl group is attached at any available point to produce a stable compound. Examples of this include, but are not limited to, 4-(isopropyl)-cyclohexylethyl or 2-methyl-cyclopropylpentyl.

The term alkenyl - alone or in combination means a straight or branched hydrocarbon containing 2-20, preferably 2-17, more preferably 2-10, even more preferably 2-8, most preferably 2-4, carbon atoms, unless otherwise specified and at least one, preferably 1-3, more preferably 1-2, most preferably one, carbon to carbon double bond. Examples of alkenyl groups include ethenyl, propenyl, isopropenyl, butenyl, cyclohexenyl, cyclohexenylalkyl and the like. Alkenyl also includes a straight chain or branched alkenyl group that contains or is interrupted by a cycloalkyl portion. Carbon to carbon double bonds may be either contained within a cycloalkyl portion, with the exception of cyclopropyl, or within a straight chain or branched portion.

The term alkynyl - alone or in combination means a straight or branched hydrocarbon containing 2-20, preferably 2-17, more preferably 2-10, even more preferably 2-8, most preferably 2-4, carbon atoms containing at least one, preferably one, carbon to carbon triple bond. Examples of alkynyl groups include ethynyl, propynyl, butynyl and the like.

The term aryl - alone or in combination means phenyl, naphthyl or anthracenyl optionally carbocyclic fused with a cycloalkyl or heterocyclyl of preferably 5-7, more preferably 5-6, ring members and/or optionally substituted with 1 to 5 groups or substituent. An aryl may be optionally substituted whereby the substituent is attached at one point to the aryl or whereby the the substituent is attached at two points to the aryl to form a bicyclic system e.g. benzodioxole, benzodioxan, benzimidazole.

The term heteroaryl - alone or in combination means a monocyclic aromatic ring structure containing 5 or 6 ring atoms, or a bicyclic aromatic group having 8 to 10 atoms, containing one or more, preferably 1-4, more

preferably 1-3, heteroatoms independently selected from the group O, S, and N, and optionally substituted with 1 to 5 groups or substituents. Heteroaryl is also intended to include oxidized S or N, such as sulfinyl, sulfonyl and N-oxide of a tertiary ring nitrogen. A carbon or nitrogen atom is the point of attachment of the heteroaryl ring structure such that a stable aromatic ring is retained. More specifically the term heteroaryl includes, but is not limited to, pyridyl, furanyl, thiophenyl, thiazolyl, isothiazolyl, triazolyl, imidazolyl, isoxazolyl, pyrrolyl, pyrazolyl, pyrimidinyl, benzofuranyl, isobenzofuranyl, benzothiazolyl, benzoisothiazolyl, benzotriazolyl, indolyl, isoindolyl, benzoxazolyl, quinolyl, isoquinolyl, benzimidazolyl, benzisoxazolyl, benzothiophenyl, dibenzofuran, and benzodiazepin-2-one-5-yl, and the like.

The term heterocyclyl - alone or in combination is intended to denote a saturated, partially unsaturated or completely unsaturated monocycle, bicycle, or tricycle having 3 to 12 carbon atoms and containing 1, 2, 3, or 4 heteroatoms each independently selected from O, S, P or N, and are optionally benzo fused or fused heteroaryl of 5-6 ring members and/or are optionally substituted as in the case of cycloalkyl. Heterocyclyl is also intended to include oxidized S or N, such as sulfinyl, sulfonyl and N-oxide of a tertiary ring nitrogen. The point of attachment is at a carbon or nitrogen atom. In each case the heterocyclyl may be condensed with an aryl to form a bicyclic ring system.

The term cycloalkyl refers to a cyclic or polycyclic alkyl group containing 3 to 15 carbon atoms. Preferably, cycloalkyl groups are monocyclic, bicyclic or tricyclic ring systems of 3-8, more preferably 3-6, ring members per ring, such as cyclopropyl, cyclopentyl, cyclohexyl, adamantyl and the like.

The term aralkyl refers to organic compounds containing an aromatic nucleus to which an alkyl radical is bonded. These alkyl radicals include methyl, ethyl, propyl, butyl, octyl, etc. radicals. The term aralkyl is thus seen to include aralkyl hydrocarbons such as the alkyl benzenes, and the various alkyl naphthalenes. From this definition of the term aralkyl compound it is seen that the term includes compounds such as benzyl, the three isomeric xyllys, the two isomeric trimethyl benzenes, ethyl benzene, p-methyl biphenyl, a-methyl naphthalene, etc.

The present invention further relates to a pharmaceutical composition comprising a carrier, and as active ingredient an effective amount of a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified
5 herein, and as defined in any one of the embodiments presented herein.

The present invention relates to a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, and as defined in any one of the embodiments presented herein, for use as a medicament.

10 The present invention relates to a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, and as defined in any one of the embodiments presented herein, for use in the treatment of a disease selected from cancer, inflammatory disorders, cardiovascular diseases, viral
15 induced diseases, circulatory diseases, fibro-proliferative diseases and pain sensitization disorders.

The present invention further relates to a method of inhibiting protein kinase activity in a warm-blooded animal said method comprising the administration to an animal in need thereof, of a kinase-inhibitory effective
20 amount of a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, and according to any one of the embodiments presented herein.

25 The present invention further relates to a method of inhibiting protein kinase activity in a warm-blooded animal said method comprising the administration to an animal in need thereof, of a kinase-inhibitory effective amount of a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, and according to any one of the embodiments presented
30 herein, wherein the protein kinase is selected from the group consisting of ABL1, ACVR1B (ALK4), AKT1 (PKB alpha), AMPK A1/B1/G1, AURKA (Aurora A), BTK, CDK1/cyclin B, CHEK1 (CHK1), CSNK1G2 (CK1 gamma 2),

CSNK2A1 (CK2 alpha 1), DYRK3, EGFR (ErbB1), EPHA2, ERBB2 (HER2), FGFR1, FLT3, FRAP1 (mTOR), GSK3B (GSK3 beta), IGF1R, IKBKB (IKK beta), INSR, IRAK4, JAK3, KDR (VEGFR2), KIT, LCK, MAP2K1 (MEK1), MAP4K4 (HGK), MAPK1 (ERK2), MAPK14 (p38 alpha), MAPK3 (ERK1),
5 MAPK8 (JNK1), MARK2, MET (cMet), NEK1, PAK4, PDGFRB (PDGFR beta), PHKG2, PIM1, PLK1, PRKACA (PKA), PRKCB1 (PKC beta I), ROCK1, RPS6KA3 (RSK2), RPS6KB1 (p70S6K), SRC, SYK, and TEK (Tie2).

The present invention further relates to a method of treating a disease selected from cancer, inflammatory disorders, cardiovascular diseases, viral
10 induced diseases, circulatory diseases, fibro-proliferative diseases and the treatment of pain sensitization, in a warm-blooded animal said method comprising the administration to an animal in need thereof of an effective amount of a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as
15 specified herein, and according to any one of the embodiments presented herein.

It should be noted that the radical positions on any molecular moiety used in the definitions may be anywhere on such moiety as long as it is chemically stable.

20 Radicals used in the definitions of the variables include all possible isomers unless otherwise indicated. For instance pyridyl includes 2-pyridyl, 3-pyridyl and 4-pyridyl; pentyl includes 1-pentyl, 2-pentyl and 3-pentyl.

When any variable occurs more than one time in any constituent, each definition is independent. Whenever used hereinafter, the term "compounds
25 (C) of formula (I)", or "the present compounds" or similar terms, it is meant to include all the compounds (C) of formula (I), N-oxides, addition salts, and stereochemically isomeric forms. One embodiment comprises the compounds (C) of formula (I) or any subgroup of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) specified herein, as well as the N-oxides, salts, as the possible
30 stereoisomeric forms thereof. Another embodiment comprises the compounds (C) of formula (I) or any subgroup of compounds of formula (II)-(LXIII) and (I-

a)-(XXIV-a) specified herein, as well as the salts as the possible stereoisomeric forms thereof.

5 The compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, have several centers of chirality and exist as stereochemically isomeric forms. The term "stereochemically isomeric forms" as used herein defines all the possible compounds made up of the same atoms bonded by the same sequence of bonds but having different three-dimensional structures which are not interchangeable, which the compound (C) of formula (I) as
10 specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, may possess.

Unless otherwise mentioned or indicated, the chemical designation of a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified
15 herein, encompasses the mixture of all possible stereochemically isomeric forms, which said compound may possess. Said mixture may contain all diastereomers and/or enantiomers of the basic molecular structure of said compound. All stereochemically isomeric forms of the compounds of the present invention both in pure form or mixed with each other are intended to be
20 embraced within the scope of the present invention.

Pure stereoisomeric forms of the compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, and intermediates as mentioned herein are defined as isomers substantially free of other
25 enantiomeric or diastereomeric forms of the same basic molecular structure of said compounds or intermediates. In particular, the term "stereoisomerically pure" concerns compounds or intermediates having a stereoisomeric excess of at least 80% (i.e. minimum 90% of one isomer and maximum 10% of the other possible isomers) up to a stereoisomeric excess of 100% (i.e. 100% of one
30 isomer and none of the other), more in particular, compounds or intermediates having a stereoisomeric excess of 90% up to 100%, even more in particular having a stereoisomeric excess of 94% up to 100% and most in particular

having a stereoisomeric excess of 97% up to 100%. The terms “enantiomerically pure” and “diastereomerically pure” should be understood in a similar way, but then having regard to the enantiomeric excess, and the diastereomeric excess, respectively, of the mixture in question.

5 Pure stereoisomeric forms of the compounds and intermediates of this invention may be obtained by the application procedures known in the art. For instance, enantiomers may be separated from each other by the selective crystallization of their diastereomeric salts with optically active acids or bases. Examples thereof are tartaric acid, dibenzoyltartaric acid, ditoluoyltartaric acid
10 and camphorsulfonic acid. Alternatively, enantiomers may be separated by chromatographic techniques using chiral stationary phases. Said pure stereochemically isomeric forms may also be derived from the corresponding pure stereochemically isomeric forms of the appropriate starting materials, provided that the reaction occurs stereospecifically. Preferably, if a specific
15 stereoisomer is desired, said compound will be synthesized by stereospecific methods of preparation. These methods will advantageously employ enantiomerically pure starting materials.

The diastereomeric racemates of the compounds (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of
20 formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, can be obtained separately by conventional methods. Appropriate physical separation methods that may advantageously be employed are, for example, selective crystallization and chromatography, e.g. column chromatography.

For some of the compound (C) of formula (I) as specified herein, or a
25 compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein,, N-oxides, salts, solvates, and the intermediates used in the preparation thereof, the absolute stereochemical configuration was not experimentally determined.

A person skilled in the art is able to determine the absolute
30 configuration of such compounds using art-known methods such as, for example, X-ray diffraction.

The present invention is also intended to include all isotopes of atoms occurring on the present compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein. Isotopes include those atoms having the same atomic number but different mass numbers. By way of general example and without limitation, isotopes of hydrogen include tritium and deuterium. Isotopes of carbon include C-13 and C-14.

For therapeutic use, salts of the compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, are those wherein the counter-ion is pharmaceutically acceptable, which salts can be referred to as pharmaceutically acceptable acid and base addition salts. However, salts of acids and bases that are non-pharmaceutically acceptable may also find use, for example, in the preparation or purification of a pharmaceutically acceptable compound. All salts, whether pharmaceutically acceptable or not, are included within the ambit of the present invention.

The pharmaceutically acceptable acid and base addition salts as mentioned hereinabove are meant to comprise the therapeutically active non-toxic acid and base addition salt forms that the compounds (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, are able to form. The pharmaceutically acceptable acid addition salts can conveniently be obtained by treating the base form with such appropriate acid in an anion form. Appropriate anions comprise, for example, trifluoroacetate, acetate, benzenesulfonate, benzoate, bicarbonate, bitartrate, bromide, calcium edetate, camsylate, carbonate, chloride, citrate, dihydrochloride, edetate, edisylate, estolate, esylate, fumarate, gluceptate, gluconate, glutamate, glycolylarsanilate, hexylresorcinate, hydrabamine, hydrobromide, hydrochloride, hydroxynaphthoate, iodide, isethionate, lactate, lactobionate, malate, maleate, mandelate, mesylate, methylbromide, methylnitrate, methylsulfate, mucate, napsylate, nitrate, pamoate (embonate), pantothenate, phosphate/diphosphate, polygalacturonate, salicylate, stearate, subacetate,

succinate, sulfate, tannate, tartrate, teoclote, triethiodide, and the like. The counterion of choice can be introduced using ion exchange resins. Conversely said salt forms can be converted by treatment with an appropriate base into the free base form.

5 The compounds (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, containing an acidic proton may also be converted into their nontoxic metal or amine addition salt forms by treatment with appropriate organic and inorganic bases in a cation form. Appropriate basic salts comprise
10 those formed with organic cations such as benzathine, chloroprocaine, choline, diethanolamine, ethylenediamine, meglumine, procaine, and the like; and those formed with metallic cations such as aluminum, calcium, lithium, magnesium, potassium, sodium, zinc, and the like. Conversely said salt forms can be converted by treatment with an appropriate acid into the free form.

15 The term addition salt as used hereinabove also comprises the solvates which the compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, as well as the salts thereof, are able to form. Such solvates are for example hydrates, alcoholates and the like.

20 The N-oxide forms of the present compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, are meant to comprise the compounds of formula (I) wherein one or several nitrogen atoms are oxidized to the so-called N-oxide.

25 It will be appreciated that the compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, may have metal binding, chelating, complex forming properties and therefore may exist as metal complexes or metal chelates. Such metalated derivatives of the compound (C)
30 of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, are intended to be included within the scope of the present invention.

Some of the compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, may also exist in their tautomeric form. Such forms although not explicitly indicated in the above formula are intended to be included within the scope of the present invention.

In a further aspect, the present invention concerns a pharmaceutical composition comprising a therapeutically effective amount of a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, and a pharmaceutically acceptable carrier. A therapeutically effective amount in this context is an amount sufficient to prophylactically act against, to stabilize or reduce illnesses mediated by protein kinases in ill subjects or subjects being at risk of being ill, in particular a protein kinase selected from the group consisting of ABL1, ACVR1B (ALK4), AKT1 (PKB alpha), AMPK A1/B1/G1, AURKA (Aurora A), BTK, CDK1/cyclin B, CHEK1 (CHK1), CSNK1G2 (CK1 gamma 2), CSNK2A1 (CK2 alpha 1), DYRK3, EGFR (ErbB1), EPHA2, ERBB2 (HER2), FGFR1, FLT3, FRAP1 (mTOR), GSK3B (GSK3 beta), IGF1R, IKBKB (IKK beta), INSR, IRAK4, JAK3, KDR (VEGFR2), KIT, LCK, MAP2K1 (MEK1), MAP4K4 (HGK), MAPK1 (ERK2), MAPK14 (p38 alpha), MAPK3 (ERK1), MAPK8 (JNK1), MARK2, MET (cMet), NEK1, PAK4, PDGFRB (PDGFR beta), PHKG2, PIM1, PLK1, PRKACA (PKA), PRKCB1 (PKC beta I), ROCK1, RPS6KA3 (RSK2), RPS6KB1 (p70S6K), SRC, SYK, and TEK (Tie2). Examples of illnesses mediated by protein kinases include in particular cancer, inflammatory disorders, cardiovascular diseases, viral induced diseases, circulatory diseases, fibro-proliferative diseases and pain sensitization disorders.

In still a further aspect, this invention relates to a process of preparing a pharmaceutical composition as specified herein, which comprises intimately mixing a pharmaceutically acceptable carrier with a therapeutically effective amount of a compound (C) of formula (I), as specified herein, or of a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein.

Therefore, the compounds (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, may be formulated into various pharmaceutical forms for administration purposes. As appropriate compositions there may be cited all compositions usually employed for systemically administering drugs. To prepare the pharmaceutical compositions of this invention, an effective amount of the particular compound, optionally in addition salt form or metal complex, as the active ingredient is combined in intimate admixture with a pharmaceutically acceptable carrier, which carrier may take a wide variety of forms depending on the form of preparation desired for administration. These pharmaceutical compositions are desirable in unitary dosage form suitable, particularly, for administration orally, rectally, percutaneously, or by parenteral injection. For example, in preparing the compositions in oral dosage form, any of the usual pharmaceutical media may be employed such as, for example, water, glycols, oils, alcohols and the like in the case of oral liquid preparations such as suspensions, syrups, elixirs, emulsions and solutions; or solid carriers such as starches, sugars, kaolin, lubricants, binders, disintegrating agents and the like in the case of powders, pills, capsules, and tablets.

Because of their ease in administration, tablets and capsules represent the most advantageous oral dosage unit forms, in which case solid pharmaceutical carriers are obviously employed. For parenteral compositions, the carrier will usually comprise sterile water, at least in large part, though other ingredients, for example, to aid solubility, may be included. Injectable solutions, for example, may be prepared in which the carrier comprises saline solution, glucose solution or a mixture of saline and glucose solution. Injectable suspensions may also be prepared in which case appropriate liquid carriers, suspending agents and the like may be employed. Also included are solid form preparations, which are intended to be converted, shortly before use, to liquid form preparations. In the compositions suitable for percutaneous administration, the carrier optionally comprises a penetration enhancing agent and/or a suitable wetting agent, optionally combined with suitable additives of

any nature in minor proportions, which additives do not introduce a significant deleterious effect on the skin.

The compounds (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, of the present invention may also be administered via oral inhalation or insufflation by means of methods and formulations employed in the art for administration via this way. Thus, in general the compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, may be administered to the lungs in the form of a solution, a suspension or a dry powder, a solution being preferred. Any system developed for the delivery of solutions, suspensions or dry powders via oral inhalation or insufflation are suitable for the administration of the present compounds.

Thus, the present invention also provides a pharmaceutical composition adapted for administration by inhalation or insufflation through the mouth comprising a compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, and a pharmaceutically acceptable carrier. Preferably, the compounds of the present invention are administered via inhalation of a solution in nebulized or aerosolized doses.

It is especially advantageous to formulate the aforementioned pharmaceutical compositions in unit dosage form for ease of administration and uniformity of dosage. Unit dosage form as used herein refers to physically discrete units suitable as unitary dosages, each unit containing a predetermined quantity of active ingredient calculated to produce the desired therapeutic effect in association with the required pharmaceutical carrier. Examples of such unit dosage forms are tablets (including scored or coated tablets), capsules, pills, suppositories, powder packets, wafers, injectable solutions or suspensions and the like, and segregated multiples thereof.

The compound (C) of formula (I) as specified herein, or a compound of any of the subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, show kinase inhibition properties. Illnesses and diseases

5 treatable using the compounds and methods of the present invention include protein kinase mediated diseases like cancer, inflammatory disorders, cardiovascular diseases, viral induced diseases, circulatory diseases, fibro-proliferative diseases and pain sensitization disorders. Many of the compounds of this invention may show a favourable pharmacokinetic profile and have attractive properties in terms of bioavailability, including an acceptable half-life, AUC (area under the curve) and peak values and lacking unfavourable phenomena such as insufficient quick onset and tissue retention.

10 The combinations of the present invention may be used as medicaments. Said use as a medicine or method of treatment comprises the systemic administration to ill subjects of an amount effective to combat the conditions associated with the illnesses. Consequently, the combinations of the present invention can be used in the manufacture of a medicament useful for treating, preventing or combating illness or disease associated with protein
15 kinases including cancer, inflammatory disorders, cardiovascular diseases, viral induced diseases, circulatory diseases, fibro-proliferative diseases and pain sensitization disorders.

20 The term "therapeutically effective amount" as used herein means that amount of active compound or component or pharmaceutical agent that elicits the biological or medicinal response in a tissue, system, animal or human that is being sought, in the light of the present invention, by a researcher, veterinarian, medical doctor or other clinician, which includes alleviation of the symptoms of the disease being treated.

25 In general it is contemplated that an antiviral effective daily amount would be from 0.01 mg to 1500 mg daily, more preferably from 0.1 mg to 50 mg daily. It may be appropriate to administer the required dose as one, two, three, four or more (sub-)doses at appropriate intervals throughout the day. Said (sub-)doses may be formulated as unit dosage forms, for example, containing 1 to 1000 mg, and in particular 5 to 200 mg of active ingredient per
30 unit dosage form.

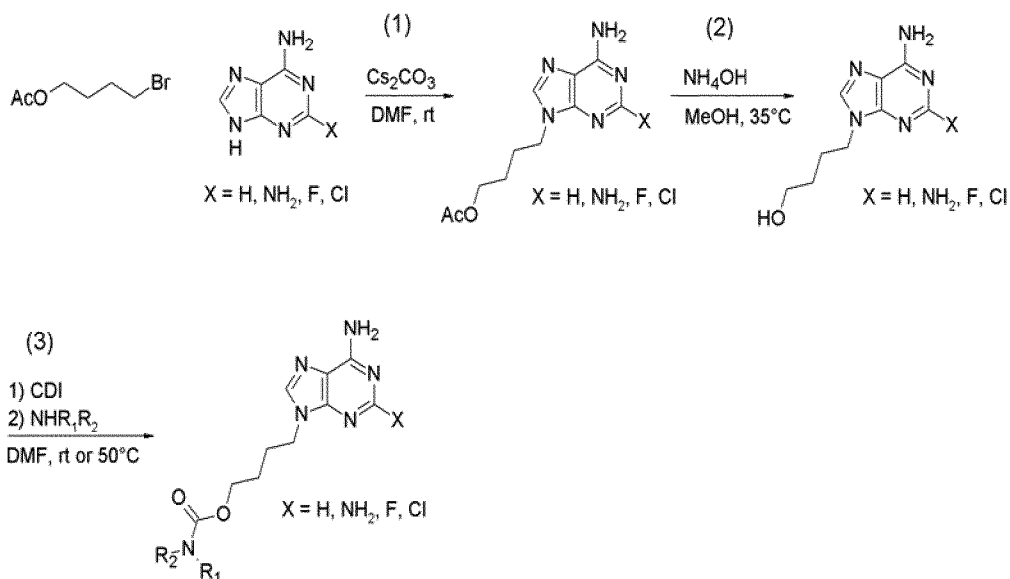
 The exact dosage and frequency of administration depends on the particular compound (C) of formula (I), or the particular compound of any of the

subgroups of compounds of formula (II)-(LXIII) and (I-a)-(XXIV-a) as specified herein, used, the particular condition being treated, the severity of the condition being treated, the age, weight, sex, extent of disorder and general physical condition of the particular patient as well as other medication the individual may be taking, as is well known to those skilled in the art. Furthermore, it is evident that said effective daily amount may be lowered or increased depending on the response of the treated subject and/or depending on the evaluation of the physician prescribing the compounds of the instant invention. The effective daily amount ranges mentioned hereinabove are therefore only guidelines.

Examples

Example 1: General procedure for the synthesis of carbamate acyclic purine nucleoside analogues

The following procedure illustrates the preparation of several carbamate acyclic purine nucleoside analogues, the synthetic scheme is outlined below. The synthesis starts with alkylation of the purine with an appropriate haloalkyl-acetate on the N⁹ position of the adenine ring in step (1), in step (2) the acetate group is removed. In step (3), the final step, the preparation of the carbamate acyclic nucleoside from the corresponding alcohol via activation by carbonyldiimidazole (CDI) followed by reaction with the appropriate amine (3). The synthesis of various amine intermediates, as used in step (3), is illustrated in example 6 below. Examples of the structures of the final compounds can be found in Table 1 below.



Step (1): To a stirred mixture of a suitable purine (1 equiv.) and cesium carbonate (1.2 equiv.) in dry DMF (1.5 mL/mmol), 4-bromobutylacetate (1.2 equiv.) was added dropwise under azote atmosphere. The reaction mixture was left at room temperature overnight. The solvent was then evaporated under reduced pressure and the residue was partitioned between DCM and water. The organic layer was extracted twice with DCM. The combined organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude was then purified by flash column chromatography (0-10% MeOH in DCM) to afford the expected compound.

The following compounds are examples illustrating step (1):

4-(6-aminopurin-9-yl)butyl acetate was prepared from adenine (1.35 g, 10 mmol). Yield: 2.12 g (85%) of the title compound as a white powder. ¹H NMR (300 MHz, CDCl₃) δ 8.36 (s, 1H), 7.80 (s, 1H), 5.71 (bs, 2H), 4.24 (t, *J* = 7.2 Hz, 2H), 4.10 (t, *J* = 6.4 Hz, 2H), 2.04 (s, 3H), 2.00-1.94 (m, 2H), 1.72-1.65 (m, 2H).

4-(6-amino-2-chloro-purin-9-yl)butyl acetate was prepared from 2-chloroadenine (2.5 g, 15 mmol). Yield: 3.55 g (83%) of the title compound as a white powder. ¹H NMR (300 MHz, CDCl₃) δ 7.77 (s, 1H), 6.15 (bs, 2H), 4.21 (t, *J* = 7.2 Hz, 2H), 4.11 (t, *J* = 6.4 Hz, 2H), 2.05 (s, 3H), 2.02-1.93 (m, 2H), 1.73-1.63 (m, 2H).

4-(6-amino-2-fluoro-purin-9-yl)butyl acetate was prepared from 2-fluoroadenine (530 mg, 1.98 mmol) following the general procedure except that no extraction was performed. Yield: 384 mg (86%) of the title compound as a white powder. ¹H NMR (300 MHz, CDCl₃) δ 7.75 (s, 1H), 5.72 (bs, 2H), 4.18 (t, *J* = 7.1 Hz, 2H), 4.11 (t, *J* = 6.4 Hz, 2H), 2.05 (s, 3H), 1.99-1.91 (m, 2H), 1.72-1.65 (m, 2H).

4-(6-amino-2-amino-purin-9-yl)butyl acetate was prepared from 2-aminoadenine (300 mg, 2.00 mmol) following the general procedure except that no extraction was performed. Yield: 345 mg (65%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 7.70 (s, 1H), 6.62 (bs, 2H), 5.76 (bs, 2H), 4.02-3.94 (m, 4H), 1.99 (s, 3H), 1.83-1.73 (m, 2H), 1.57-1.48 (m, 2H).

Step (2): An aqueous ammonia solution (28%, 2.5 mL/mmol) was added to a stirred suspension of the protected compound in MeOH (2.5 mL/mmol). The reaction mixture was heated to 35°C and stirred overnight. Concentration of the reaction mixture under vacuum followed by a purification by flash column chromatography (0-20% MeOH in DCM) provided the deprotected compound.

The following compounds are examples illustrating step (2):

4-(6-aminopurin-9-yl)butan-1-ol was prepared from 4-(6-aminopurin-9-yl)butyl acetate (2.07 g, 8.3 mmol). Yield: 1.51 g (87%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.14 (s, 1H), 8.13 (s, 1H), 7.17 (bs, 2H), 4.44 (t, *J* = 4.7 Hz, 1H), 4.15 (t, *J* = 7.1 Hz, 2H), 3.43-3.37 (m, 2H), 1.88-1.78 (m, 2H), 1.42-1.33 (m, 2H).

4-(6-amino-2-chloro-purin-9-yl)butan-1-ol was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl acetate (2.32 g, 8.18 mmol). Yield: 1.92 g (97%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 7.73 (bs, 2H), 4.44 (t, *J* = 5.2 Hz, 1H), 4.10 (t, *J* = 7.1 Hz, 2H), 3.42-3.37 (m, 2H), 1.85-1.78 (m, 2H), 1.42-1.32 (m, 2H).

4-(6-amino-2-fluoro-purin-9-yl)butan-1-ol was prepared from 4-(6-amino-2-fluoro-purin-9-yl)butyl acetate (530 mg, 1.98 mmol). Yield: 384 mg (86%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.12 (s,

1H), 7.75 (bs, 2H), 4.44 (t, $J = 5.2$ Hz, 1H), 4.08 (t, $J = 7.1$ Hz, 2H), 3.43-3.37 (m, 2H), 1.85-1.76 (m, 2H), 1.42-1.32 (m, 2H).

4-(6-amino-2-amino-purin-9-yl)butan-1-ol was prepared from 4-(6-amino-2-amino-purin-9-yl)butyl acetate (339 mg, 1.28 mmol). Yield: 274 mg (96%) of the title compound as a white powder. ^1H NMR (300 MHz, DMSO- d_6) δ 7.69 (s, 1H), 6.60 (bs, 2H), 5.75 (bs, 2H), 4.44 (t, $J = 5.2$ Hz, 1H), 3.95 (t, $J = 7.1$ Hz, 2H), 3.43-3.36 (m, 2H), 1.80-1.71 (m, 2H), 1.42-1.33 (m, 2H).

Step (3): To a stirred solution of the compound (1 equiv.) in DMF (2 mL), carbonyldiimidazole (1.5 equiv.) was added under azote atmosphere. After 2 hours of stirring at room temperature, the appropriate amine (3 equiv.) was added and the reaction mixture was stirred at room temperature or 50°C until completion. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) and by reverse-phase chromatography (0-100% MeOH in water) to give the carbamate derivative. In some cases, an additional trituration with Et₂O was necessary to remove residual free amine.

The following compounds are examples illustrating step (3):

4-(6-aminopurin-9-yl)butyl N-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from 4-(6-aminopurin-9-yl)butan-1-ol (62 mg, 0.3 mmol). Yield: 75 mg (60%) of the title compounds as a white powder. ^1H NMR (300 MHz, DMSO- d_6) δ 8.12 (s, 1H), 7.60 (t, $J = 5.9$ Hz, 1H), 7.18 (bs, 2H), 6.83-6.78 (m, 2H), 6.67-6.70 (m, 2H), 5.97 (s, 2H), 4.16 (t, $J = 6.9$ Hz, 2H), 4.05 (d, $J = 6.1$ Hz, 2H), 3.97 (t, $J = 6.5$ Hz, 2H), 1.89-1.79 (m, 2H), 1.56-1.46 (m, 2H).

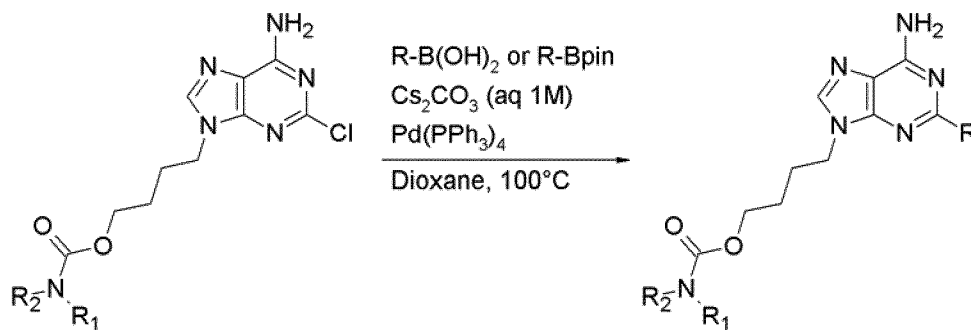
4-(6-amino-2-chloro-purin-9-yl)butyl-N-[[3-(trifluoromethyl)phenyl]methyl]carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (48 mg, 0.2 mmol). Yield: 54 mg (61%) of the title compounds as a white powder. ^1H NMR (300 MHz, DMSO- d_6) δ 8.15 (s, 1H), 7.79-7.74 (m, 3H), 7.58-7.54 (m, 4H), 4.26 (d, $J = 6.1$ Hz, 2H), 4.12 (t, $J = 6.9$ Hz, 2H), 3.99 (t, $J = 6.4$ Hz, 2H), 1.87-1.78 (m, 2H), 1.58-1.48 (m, 2H).

4-(6-amino-2-chloro-purin-9-yl)butyl-N-[(3-isopropylbenzimidazol-5-yl)methyl]carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (60 mg, 0.25 mmol). Yield: 98 mg (87%) of the title compounds as a white powder.

¹H NMR (300 MHz, DMSO-*d*₆) δ 8.27 (s, 1H), 8.15 (s, 1H), 7.73 (bs, 2H), 7.68 (t, *J* = 5.9 Hz, 1H), 7.56 (d, *J* = 8.1 Hz, 1H), 7.46 (s, 1H), 7.09 (dd, *J* = 7.1, 1.2 Hz, 1H), 4.68 (sept, *J* = 6.6 Hz, 1H), 4.29 (d, *J* = 6.0 Hz, 2H), 4.12 (t, *J* = 7.2 Hz, 2H), 3.99 (t, *J* = 6.6 Hz, 2H), 1.87-1.78 (m, 2H), 1.58-1.50 (m, 8H). ESI-MS: 457.0 (M+H)⁺.

4-(6-amino-2-chloro-purin-9-yl)butyl-N-[[4-[2-(4-fluorophenyl)ethylsulfamoyl]phenyl]methyl]carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (48 mg, 0.2 mmol). Yield: 80 mg (70%) of the title compounds as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 7.76-7.71 (m, 5H), 7.43-7.41 (m, 2H), 7.19-7.16 (m, 2H), 7.09-7.05 (m, 2H), 4.24 (d, *J* = 6.3 Hz, 2H), 4.13 (t, *J* = 6.8 Hz, 2H), 3.99 (t, *J* = 6.4 Hz, 2H), 2.93 (t, *J* = 7.4 Hz, 2H), 2.67 (t, *J* = 7.0 Hz, 2H), 1.87-1.80 (m, 2H), 1.57-1.50 (m, 2H).

Example 2A: General procedure for the preparation of 2-substituted alkyl or aryl purine acyclic nucleoside analogues



A (Hetero)aryl- or alkyl-boronic acid (R-B(OH)₂) or pinacol ester (R-Bpin) (0.3 mmol, 1.5 equiv.) and aqueous cesium carbonate (1M, 0.6 mmol, 3 equiv.) were added to a stirred solution of the 4-(6-amino-2-chloro-purin-9-yl)butyl-carbamate derivative (0.2 mmol, 1 equiv.) in dioxane (2 mL). The reaction mixture was purged three times with azote, then Pd(PPh₃)₄ (23 mg, 0.02 mmol, 0.1 equiv.) was introduced. The reaction mixture was warmed to 100°C overnight. Evaporation of the solvent under reduced pressure and purification of the crude mixture by flash column chromatography (0-10% MeOH in DCM) yielded the expected compound.

The following compounds are examples illustrating this procedure:

4-[6-amino-2-(3-furyl)purin-9-yl]butyl N-(1,3-benzodioxol-5-ylmethyl)carbamate

was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-(1,3-benzodioxol-5-ylmethyl)carbamate. Yield: 84 mg (93%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16-8.14 (m, 1H), 8.11 (s, 1H), 7.71 (t, *J* = 1.7 Hz, 1H), 7.58 (t, *J* = 5.8 Hz, 1H), 7.16 (bs, 2H), 6.96 (dd, *J* = 1.8, 0.7 Hz, 1H), 6.83-6.78 (m, 2H), 6.71-6.68 (m, 1H), 5.97 (s, 2H), 4.21 (t, *J* = 6.8 Hz, 2H), 4.06-4.00 (m, 4H), 1.91-1.84 (m, 2H), 1.58-1.51 (m, 2H).

4-[6-amino-2-(2-furyl)purin-9-yl]butyl N-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-(1,3-benzodioxol-5-ylmethyl)carbamate. Yield: 64 mg (71%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.14 (s, 1H), 7.79-7.78 (m, 1H), 7.58 (t, *J* = 5.8 Hz, 1H), 7.27 (bs, 2H), 7.06 (dd, *J* = 3.3, 0.8 Hz, 1H), 6.83-6.78 (m, 2H), 6.70-6.68 (m, 1H), 6.60 (dd, *J* = 1.8, 3.3 Hz, 1H), 5.97 (s, 2H), 4.19 (t, *J* = 6.7 Hz, 2H), 4.06-3.98 (m, 4H), 1.90-1.83 (m, 2H), 1.59-1.52 (m, 2H).

4-[6-amino-2-(2-methylpyrazol-3-yl)purin-9-yl]butyl-N-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-(1,3-benzodioxol-5-ylmethyl)carbamate. Yield: 49 mg (53%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.18 (s, 1H), 7.57 (t, *J* = 5.8 Hz, 1H), 7.42 (d, *J* = 1.9 Hz, 1H), 7.34 (bs, 2H), 6.82-6.78 (m, 3H), 6.70-6.67 (m, 1H), 5.97 (s, 2H), 4.26 (s, 3H), 4.22 (t, *J* = 6.9 Hz, 2H), 4.05 (d, *J* = 6.1 Hz, 2H), 3.99 (t, *J* = 6.6 Hz, 2H), 1.92-1.85 (m, 2H), 1.58-1.49 (m, 2H).

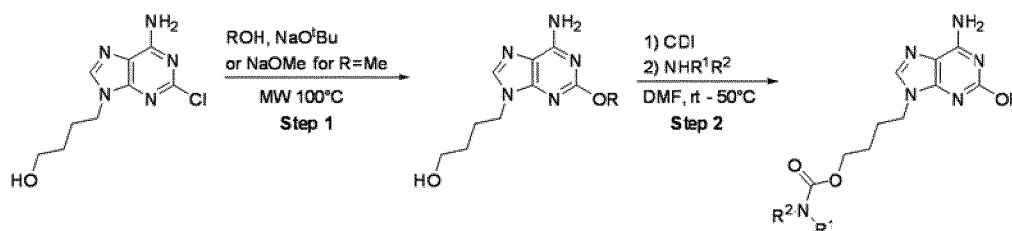
4-[6-amino-2-(4-pyridyl)purin-9-yl]butyl-N-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-(1,3-benzodioxol-5-ylmethyl)carbamate. Yield: 65 mg (71%) of the title compound as a yellow powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.69-8.67 (m, 2H), 8.23-8.21 (m, 3H), 7.59 (t, *J* = 6.0 Hz, 1H), 7.42 (bs, 2H), 6.82-6.69 (m, 3H), 5.96 (s, 2H), 4.27 (t, *J* = 6.8 Hz, 2H), 4.06-4.00 (m, 4H), 1.95-1.90 (m, 2H), 1.59-1.52 (m, 2H).

4-(6-amino-2-cyclopropyl-purin-9-yl)butyl-N-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-(1,3-benzodioxol-5-ylmethyl)carbamate. Yield: 25 mg (29%) of the title compound as a white powder. ¹H NMR (300 MHz, CDCl₃) δ 7.72 (s, 1H), 7.01 (bs, 1H),

6.70-6.67 (m, 3H), 5.87 (s, 2H), 4.19-4.04 (m, 6H), 2.22-2.13 (m, 1H), 1.90-1.82 (m, 2H), 1.59-1.52 (m, 2H), 1.19-1.02 (m, 4H).

When R is a methyl group, the general procedure is described in example 5, see below.

Example 2B: General procedure for the preparation of 2-alkoxide purine acyclic nucleoside analogues



Step 1: To 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (1 equiv.), prepared in example 1-step 2, the appropriate alcohol (30 equiv.) and sodium *tert*-butoxide (3 equiv.) were added. *NB: In the case of the methoxy group, sodium methoxide (7.5 equiv.) was used.* The reaction mixture was heated to 100-150°C in the microwave until completion (10-90 min). The solvent was then evaporated under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) to afford the expected compound.

The following compounds are examples illustrating step 1:

4-(6-amino-2-methoxy-purin-9-yl)butan-1-ol was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (241 mg, 1.0 mmol) after 10 min of microwave irradiation at 100°C. Yield: 172 mg (73%) of the title compound as a white powder. ESI-MS: 238.3 (M+H)⁺.

4-(6-amino-2-ethoxy-purin-9-yl)butan-1-ol was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (84 mg, 0.35 mmol) after 15 min of microwave irradiation at 100°C. Yield: 45 mg (51%) of the title compound as a white powder. ESI-MS: 252.4 (M+H)⁺.

4-(6-amino-2-propoxy-purin-9-yl)butan-1-ol was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (84 mg, 0.35 mmol) after 1h of microwave

irradiation at 100°C. Yield: 52 mg (56%) of the title compound as a white powder. ESI-MS: 266.4 (M+H)⁺.

4-(6-amino-2-isopropoxy-purin-9-yl)butan-1-ol was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (84 mg, 0.35 mmol) after 1h30 of microwave irradiation at 100°C and 30 min at 150°C. Yield: 26 mg (28%) of the title compound as a white powder. ESI-MS: 266.4 (M+H)⁺.

4-(6-amino-2-isobutoxy-purin-9-yl)butan-1-ol was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (84 mg, 0.35 mmol) after 30 min of microwave irradiation at 100°C and 30 min at 150°C. Yield: 46 mg (47%) of the title compound as a white powder.

4-[6-amino-2-(cyclopentylmethoxy)purin-9-yl]butan-1-ol was prepared from 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (84 mg, 0.35 mmol) after 30 min of microwave irradiation at 150°C. Yield: 40 mg (37%) of the title compound as a white powder. ESI-MS: 266.4 (M+H)⁺.

Step 2: To a stirred solution of 2-alkoxy derivative (1 equiv.) in DMF (10 mL), was added carbonyldiimidazole (1.5 equiv.) under azote atmosphere. After 2 hours of stirring at room temperature, the appropriate amine (1.5 equiv.) was added and the reaction mixture was stirred at 50°C over weekend. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) and by reverse-phase chromatography (0-100% MeOH in water) to give the carbamate derivative.

The following compounds are examples illustrating step 2:

4-(6-amino-2-methoxy-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]-phenyl]methyl] carbamate was prepared from 4-(6-amino-2-methoxy-purin-9-yl)butan-1-ol (47 mg, 0.2 mmol). Yield: 49 mg (43%) as a white powder. ESI-MS: 574.6 (M+H)⁺.

4-(6-amino-2-ethoxy-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]-phenyl]methyl] carbamate was prepared from 4-(6-amino-2-ethoxy-purin-9-yl)butan-1-ol (45 mg, 0.18 mmol). Yield: 79 mg (75%) as a white powder. ESI-MS: 589.4 (M+H)⁺.

4-(6-amino-2-propoxy-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]-

phenyl]methyl] carbamate was prepared from 4-(6-amino-2-propoxy-purin-9-yl)butan-1-ol (45 mg, 0.18 mmol). Yield: 73 mg (65%) as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 7.93 (s, 1H), 7.78-7.73 (m, 3H), 7.43-7.41 (m, 2H), 7.35-7.32 (m, 2H), 7.26-7.23 (m, 2H), 7.15 (bs, 2H), 4.24 (d, *J* = 5.9 Hz, 2H), 4.15 (t, *J* = 6.6 Hz, 2H), 4.08 (t, *J* = 6.7 Hz, 2H), 4.00 (t, *J* = 6.5 Hz, 2H), 3.95 (bs, 2H), 1.88-1.81 (m, 2H), 1.69 (quint., *J* = 7.1 Hz, 2H), 1.57-1.47 (m, 2H), 0.95 (t, *J* = 7.3 Hz, 2H).

4-(6-amino-2-isopropoxy-purin-9-yl)butyl N-[[4-(4chlorophenyl)

methylsulfamoyl]-phenyl]methyl] carbamate was prepared from 4-(6-amino-2-isopropoxy-purin-9-yl)butan-1-ol (26 mg, 0.10 mmol). Yield: 36 mg (60%) as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.15 (s, 1H), 7.92 (s, 1H), 7.79-7.70 (m, 3H), 7.43-7.41 (m, 2H), 7.35-7.33 (m, 2H), 7.26-7.23 (m, 2H), 7.11 (bs, 2H), 5.20-5.09 (m, 1H), 4.24 (d, *J* = 6.0 Hz, 2H), 4.07 (t, *J* = 6.7 Hz, 2H), 4.00 (t, *J* = 6.6 Hz, 2H), 3.95 (bs, 2H), 1.88-1.77 (m, 2H), 1.57-1.48 (m, 2H), 1.26 (d, *J* = 6.2 Hz, 6H).

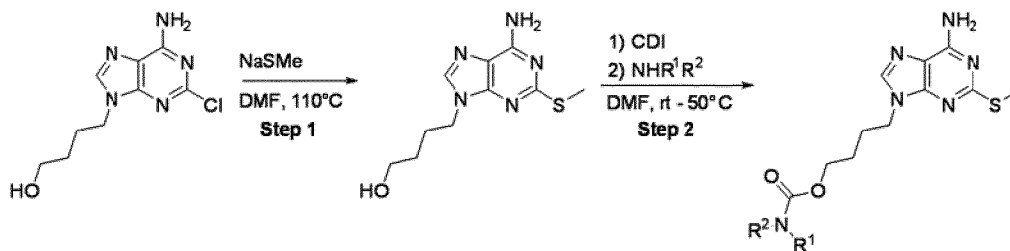
4-(6-amino-2-isobutoxy-purin-9-yl)butyl N-[[4-(4-chlorophenyl)

methylsulfamoyl]-phenyl]methyl] carbamate was prepared from 4-(6-amino-2-isobutoxy-purin-9-yl)butan-1-ol (46 mg, 0.16 mmol). Yield: 60 mg (61%) as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 7.94 (s, 1H), 7.80-7.70 (m, 3H), 7.43-7.41 (m, 2H), 7.35-7.33 (m, 2H), 7.26-7.23 (m, 2H), 7.16 (bs, 2H), 4.24 (d, *J* = 6.0 Hz, 2H), 4.08 (t, *J* = 6.6 Hz, 2H), 4.09-3.95 (m, 6H), 2.05-1.91 (m, 1H), 1.88-1.79 (m, 2H), 1.57-1.48 (m, 2H), 0.95 (d, *J* = 6.7 Hz, 6H).

4-(6-amino-2-cyclopentylmethoxy-purin-9-yl)butyl N-[[4-(4chlorophenyl)

methylsulfamoyl]phenyl]methyl] carbamate was prepared from 4-(6-amino-2-cyclopentylmethoxy -purin-9-yl)butan-1-ol (40 mg, 0.13 mmol). Yield: 52 mg (63%) as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 7.93 (s, 1H), 7.80-7.70 (m, 3H), 7.43-7.41 (m, 2H), 7.35-7.32 (m, 2H), 7.26-7.23 (m, 2H), 7.15 (bs, 2H), 4.25 (d, *J* = 5.9 Hz, 2H), 4.10-3.99 (m, 6H), 3.95 (bs, 2H), 2.31-2.21 (m, 1H), 1.88-1.67 (m, 4H), 1.62-1.48 (m, 6H), 1.35-1.24 (m, 2H).

Example 2C: Preparation of 2-methylsulfanyl purine acyclic nucleoside analogues



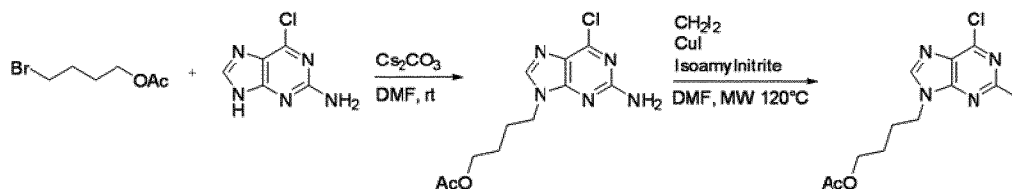
Step 1: To a stirred solution of 4-(6-amino-2-chloro-purin-9-yl)butan-1-ol (84 mg, 0.35 mmol, 1 equiv.), prepared in example 1-step 2, in DMF (3.5 mL), sodium thiomethoxide (245 mg, 3.5 mmol, 10 equiv.) was added. The reaction mixture was warmed to 110°C for 6 hours. Then, water was added and the mixture was extracted with ethyl acetate. The aqueous layer was then extracted twice. The combined organic layers were washed with brine, dried over Na₂SO₄ and concentrated to provide 4-(6-amino-2-methylsulfanylpurin-9-yl)butan-1-ol (65 mg, 74%) as a white powder, which was used in the next step without further purification. ESI-MS: 254.3 (M+H)⁺.

Step 2: To a stirred solution of 2-methylsulfanyl derivative (1 equiv.) in DMF (10 mL), was added carbonyldiimidazole (1.5 equiv.) under azote atmosphere. After 2 hours of stirring at room temperature, the appropriate amine (1.5 equiv.) was added and the reaction mixture was stirred at 50°C over weekend. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) and by reverse-phase chromatography (0-100% MeOH in water) to give the carbamate derivative.

The following compounds are examples illustrating step 2:

4-(6-amino-2-methylsulfanylpurin-9-yl)butyl-N-[[4-[(4 chlorophenyl) methylsulfamoyl]phenyl]methyl] carbamate was prepared from 4-(6-amino-2-methylsulfanylpurin-9-yl)butan-1-ol (65 mg, 0.26 mmol). Yield: 73 mg (48%) as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.15 (s, 1H), 8.02 (s, 1H), 7.79-7.73 (m, 3H), 7.44-7.41 (m, 2H), 7.35-7.32 (m, 2H), 7.26-7.23 (m, 4H), 4.25 (d, *J* = 5.9 Hz, 2H), 4.13 (t, *J* = 6.6 Hz, 2H), 4.01 (t, *J* = 6.6 Hz, 2H), 3.95 (bs, 2H), 2.46 (s, 3H), 1.90-1.81 (m, 2H), 1.57-1.48 (m, 2H).

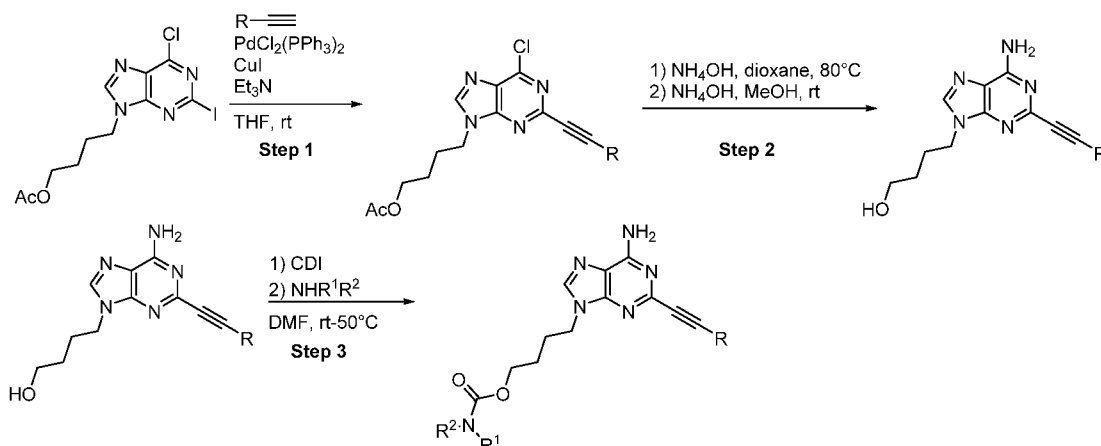
Example 3: Preparation of 2-iodo-2-chloro purine acyclic nucleoside analogue



To a stirred suspension 2-amino-6-chloropurine (1.70 g, 10 mmol, 1 equiv.) in DMF (25 mL), were added cesium carbonate (3.90 g, 12 mmol, 1.2 equiv.) and 4-bromobutyl acetate (1.74 mL, 12 mmol, 1.2 equiv.) dropwise. The reaction mixture was stirred at room temperature overnight under azote atmosphere. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) to provide 4-(2-amino-6-chloro-purin-9-yl)butyl acetate (2.15 g, 76%) as a white powder.

To a stirred suspension of 4-(2-amino-6-chloro-purin-9-yl)butyl acetate (284 mg, 1.0 mmol, 1 equiv.), obtained from the previous step, in DMF (5 mL), were added copper(I) iodide (19 mg, 0.1 mmol, 0.1 equiv.), diiodomethane (1.20 mL, 15 mmol, 15 equiv.) and isoamyl nitrite (0.67 mL, 5 mmol, 5 equiv.). The reaction mixture was heated to 120°C for 2h in the microwave. The solvents were evaporated under reduced pressure. The resultant oil was then purified by flash column chromatography (0-50% EtOAc in cyclohexane) to give 4-(6-chloro-2-iodo-purin-9-yl)butyl acetate (281 mg, 71%) as a brown powder. ESI-MS: 395.4 ($\text{M}+\text{H}$)⁺.

Example 4: General procedure for the preparation of 2-alkynyl purine acyclic nucleoside analogues



Step 1: To a stirred solution of 4-(6-chloro-2-iodo-purin-9-yl)butyl acetate (118 mg, 0.30 mmol, 1 equiv.) in THF (3 mL) under azote atmosphere, were added triethylamine (100 μ L, 0.72 mmol, 2.4 equiv.), bis(triphenylphosphine)palladium (II) chloride (11 mg, 0.015 mmol, 0.05 equiv.) and copper (I) iodide (6 mg, 0.03 mmol, 0.1 equiv.). Then, the appropriate alkyne (0.36 mmol, 1.2 equiv) was added dropwise and the reaction mixture was stirred at room temperature until completion (1-22h). The solvent was then evaporated under reduced pressure and the crude purified by flash column chromatography (0-50% EtOAc in cyclohexane) to yield the expected compound.

The following compounds are examples illustrating step 1:

4-[6-chloro-2-(2-trimethylsilylethynyl)purin-9-yl]butyl acetate was prepared from 4-(6-chloro-2-iodo-purin-9-yl)butyl acetate. Yield: 101 mg (92%) of the title compound as a pale yellow oil. ESI-MS: 365.6 ($M+H$)⁺.

4-[6-chloro-2-(3-methylbut-1-ynyl)purin-9-yl]butyl acetate was prepared from 4-(6-chloro-2-iodo-purin-9-yl)butyl acetate. Yield: 86 mg (86%) of the title compound as a yellow oil. ESI-MS: 335.4 ($M+H$)⁺.

Step 2: A solution of 2-alkynyl derivative (1 equiv.) in dioxane (10 mL/mmol) was placed in an autoclave. Aqueous ammonia solution (28%, 10 mL/mmol) was added and the reaction mixture was heated to $80^\circ C$ overnight. The solvents were then removed under reduced pressure. The residue was dissolved in methanol (5 mL/mmol) and aqueous ammonia solution (28%, 5 mL/mmol) was added. The resulting solution was stirred at room temperature

until complete removal of the acetate group (3-6h). The solvents were evaporated under reduced pressure and the crude purified by flash column chromatography (0-20% MeOH in DCM) to give the expected compound.

The following compounds are examples illustrating step 2:

5 4-(6-amino-2-ethynyl-purin-9-yl)butan-1-ol was prepared from 4-[6-chloro-2-(2-trimethylsilylethynyl)purin-9-yl]butyl acetate (101 mg, 0.28 mmol). Yield: 43 mg (67%) of the title compound as a yellow powder. ESI-MS: 232.3 (M+H)⁺.

10 4-[6-amino-2-(3-methylbut-1-ynyl)purin-9-yl]butan-1-ol was prepared from 4-[6-chloro-2-(3-methylbut-1-ynyl)purin-9-yl]butyl acetate (86 mg, 0.26 mmol). Yield: 52 mg (73%) of the title compound as a beige powder.

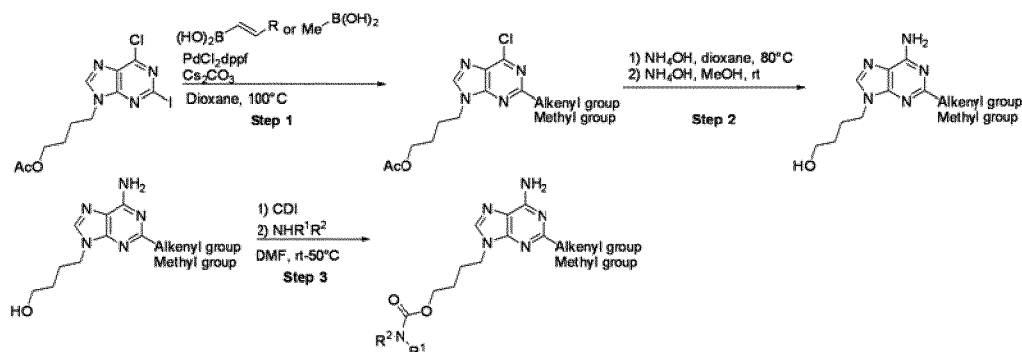
Step 3: To a stirred solution of alkynyl derivative (1 equiv.) in DMF (10 mL), was added carbonyldiimidazole (1.5 equiv.) under azote atmosphere. After 2 hours of stirring at room temperature, the appropriate amine (1.5 equiv.) was added and the reaction mixture was stirred at 50°C over weekend. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) and by reverse-phase chromatography (0-100% MeOH in water) to give the carbamate derivative.

The following compounds are examples illustrating step 3:

20 4-(6-amino-2-ethynyl-purin-9-yl)butyl N-[[4-[(4chlorophenyl)methylsulfamoyl]-phenyl]methyl]carbamate was prepared from 4-(6-amino-2-ethynyl-purin-9-yl)butan-1-ol (41 mg, 0.18 mmol). Yield: 72 mg (71%) of the title compound as a white powder. ESI-MS: 568.5 (M+H)⁺.

25 4-[6-amino-2-(3-methylbut-1-ynyl)purin-9-yl]butyl N-[[4-[(4chlorophenyl)methylsulfamoyl]phenyl]methyl]carbamate was prepared from 4-[6-amino-2-(3-methylbut-1-ynyl)purin-9-yl]butan-1-ol (49 mg, 0.18 mmol). Yield: 75 mg (69%) of the title compound as a white powder. ESI-MS: 610.6 (M+H)⁺.

Example 5: General procedure for the preparation of 2-alkenyl and 2-methyl purine acyclic nucleoside analogues



Step 1: To a stirred solution of 4-(6-chloro-2-iodo-purin-9-yl)butyl acetate (118 mg, 0.30 mmol, 1 equiv.) in dioxane (3 mL) under azote atmosphere, were added cesium carbonate (234 mg, 0.72 mmol, 2.4 equiv.), alkenylboronic acid or methylboronic acid (1.2 equiv.) and 1,1'-bis(diphenylphosphino)ferrocene-palladium(II)dichloride dichloromethane complex (24 mg, 0.03 mmol, 0.1 equiv.). The reaction mixture was warmed to 100°C until completion (4-5h). The solvent was then evaporated under reduced pressure and the crude residue purified by flash column chromatography (0-50% EtOAc in cyclohexane) to yield the expected compound.

The following compounds are examples illustrating step 1:

4-[6-chloro-2-[(Z)-prop-1-enyl]purin-9-yl]butyl acetate was prepared from 4-(6-chloro-2-iodo-purin-9-yl)butyl acetate. Yield: 61 mg (62%) of the title compound as a brown oil. ESI-MS: 309.4 (M+H)⁺.

4-(6-chloro-2-methyl-purin-9-yl)butyl acetate was prepared from 4-(6-chloro-2-iodo-purin-9-yl)butyl acetate. Yield: 42 mg (49%) of the title compound as a yellow oil. ESI-MS: 283.5 (M+H)⁺.

Step 2: A solution of 2-alkenyl or 2-methyl derivative (1 equiv.) in dioxane (10 mL/mmol) was placed in an autoclave. Aqueous ammonia solution (28%, 10 mL/mmol) was added and the reaction mixture was heated to 80°C overnight. The solvents were then removed under reduced pressure. The residue was dissolved in methanol (5 mL/mmol) and aqueous ammonia solution (28%, 5 mL/mmol) was added. The resulting solution was stirred at room temperature until complete removal of the acetate group (3-6h). The solvents were evaporated under reduced pressure and the crude purified by flash column

chromatography (0-20% MeOH in DCM) to give the expected compound.

The following compounds are examples illustrating step 2:

4-[6-amino-2-[(Z)-prop-1-enyl]purin-9-yl]butan-1-ol was prepared from 4-[6-chloro-2-[(Z)-prop-1-enyl]purin-9-yl]butyl acetate (61 mg, 0.20 mmol). Yield: 45 mg (92%) of the title compound as a white powder.

4-(6-amino-2-methyl-purin-9-yl)butan-1-ol was prepared from 4-(6-chloro-2-methyl-purin-9-yl)butyl acetate (86 mg, 0.26 mmol). Yield: 40 mg (83%) of the title compound as a white powder. ESI-MS: 222.3 (M+H)⁺.

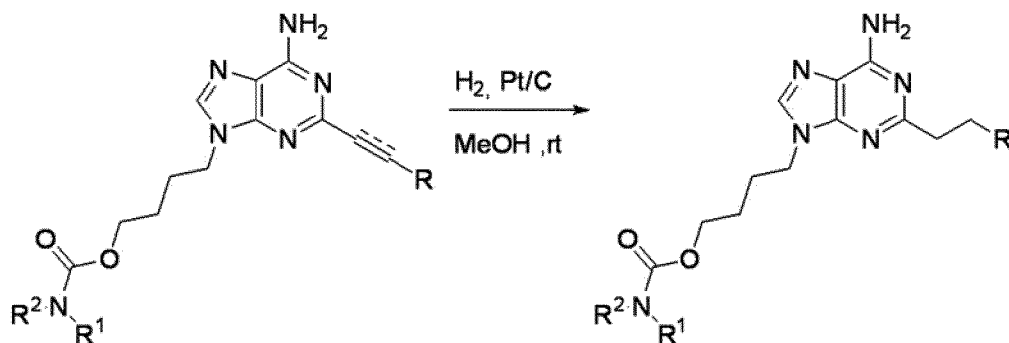
Step 3: To a stirred solution of 2-alkenyl or 2-methyl derivative (1 equiv.) in DMF (10 mL), was added carbonyldiimidazole (1.5 equiv.) under azote atmosphere. After 2 hours of stirring at room temperature, the appropriate amine (1.5 equiv.) was added and the reaction mixture was stirred at 50°C over weekend. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) and by reverse-phase chromatography (0-100% MeOH in water) to give the carbamate derivative.

The following compounds are examples illustrating step 3:

4-[6-amino-2-[(Z)-prop-1-enyl]purin-9-yl]butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]phenyl]methyl]carbamate was prepared from 4-[6-amino-2-[(Z)-prop-1-enyl]purin-9-yl]butan-1-ol (45 mg, 0.18 mmol). Yield: 48 mg (46%) of the title compound as a white powder. ESI-MS: 584.6 (M+H)⁺.

4-(6-amino-2-methyl-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]phenyl]methyl]carbamate was prepared from 4-(6-amino-2-methyl-purin-9-yl)butan-1-ol (40 mg, 0.18 mmol). Yield: 64 mg (64%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 8.05 (s, 1H), 7.81-7.72 (m, 3H), 7.44-7.41 (m, 2H), 7.35-7.33 (m, 2H), 7.26-7.23 (m, 2H), 7.06 (bs, 2H), 4.24 (d, *J* = 6.2 Hz, 2H), 4.13 (t, *J* = 6.9 Hz, 2H), 4.00 (t, *J* = 6.4 Hz, 2H), 3.94 (s, 2H), 2.39 (s, 3H), 1.89-1.79 (m, 2H), 1.57-1.47 (m, 2H).

Example 6: General procedure for the preparation of 2-alkyl purine acyclic nucleoside analogues



To a stirred solution of 2-alkenyl or alkynyl derivative (1 equiv.) in MeOH (10 mL/mmol), was added 10% platinum on carbon (~20 wt %) under azote atmosphere. Hydrogen gas was bubbled through the reaction mixture for 10 min and the mixture was stirred under hydrogen atmosphere until completion (18-72h). The mixture was passed through a plug of celite and the solvent was removed under reduced pressure. Purification by flash column chromatography (0-10% MeOH in DCM) yielded the expected derivative.

The following compounds are examples illustrating this procedure:

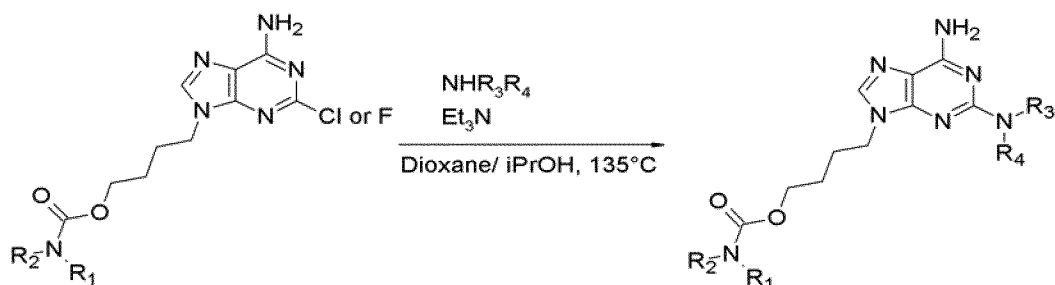
4-(6-amino-2-propyl-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]phenyl]methyl] carbamate was prepared from 4-[6-amino-2-[(Z)-prop-1-enyl]purin-9-yl]butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]phenyl]methyl] carbamate (36 mg, 0.06 mmol). Yield: 22 mg (63%) of the title compound as a white powder. ESI-MS: 586.6 (M+H)⁺.

4-(6-amino-2-ethyl-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]phenyl]methyl] carbamate was prepared from 4-(6-amino-2-ethynyl-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]phenyl]methyl]carbamate (57 mg, 0.10 mmol). Yield: 44 mg (77%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 8.05 (s, 1H), 7.80-7.73 (m, 3H), 7.43-7.41 (m, 2H), 7.35-7.33 (m, 2H), 7.26-7.23 (m, 2H), 7.04 (bs, 2H), 4.24 (d, *J* = 6.0 Hz, 2H), 4.14 (t, *J* = 6.6 Hz, 2H), 4.00 (t, *J* = 6.4 Hz, 2H), 3.95 (s, 2H), 2.66 (q, *J* = 7.4 Hz, 2H), 1.89-1.80 (m, 2H), 1.57-1.49 (m, 2H), 1.22 (t, *J* = 7.4 Hz, 3H). ESI-MS: 572.5 (M+H)⁺.

4-(6-amino-2-isopentyl-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]phenyl]methyl] carbamate was prepared from 4-(6-amino-2-isopentynyl-purin-9-yl)butyl N-[[4-[(4-chlorophenyl)methylsulfamoyl]phenyl]methyl]carbamate (57 mg, 0.10 mmol). Yield: 44 mg (77%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 8.05 (s, 1H), 7.80-7.73 (m, 3H), 7.43-7.41 (m, 2H), 7.35-7.33 (m, 2H), 7.26-7.23 (m, 2H), 7.04 (bs, 2H), 4.24 (d, *J* = 6.0 Hz, 2H), 4.14 (t, *J* = 6.6 Hz, 2H), 4.00 (t, *J* = 6.4 Hz, 2H), 3.95 (s, 2H), 2.66 (q, *J* = 7.4 Hz, 2H), 1.89-1.80 (m, 2H), 1.57-1.49 (m, 2H), 1.22 (t, *J* = 7.4 Hz, 3H). ESI-MS: 572.5 (M+H)⁺.

phenyl)methyl]carbamate was prepared from 4-[6-amino-2-(3-methylbut-1-ynyl)purin-9-yl]butyl *N*-[[4-[(4-chlorophenyl)methylsulfamoyl]-phenyl)methyl]carbamate (57 mg, 0.09 mmol). Yield: 28 mg (51%) of the title compound as a white powder. ESI-MS: 614.6 (M+H)⁺.

Example 7: General procedure for the preparation of 2-substituted amino acyclic purine nucleoside analogues



To a stirred suspension of a 4-(6-amino-2-chloro-purin-9-yl)butyl-carbamate or a 4-(6-amino-2-fluoro-purin-9-yl)butyl-carbamate derivative (0.2 mmol, 1 equiv.) in 2-propanol/dioxane (2/1 mL), triethylamine (0.6 mmol, 3 equiv.) and the appropriate amine (2 mmol, 10 equiv.) was added under azote atmosphere. The reaction mixture was warmed to 135°C in a sealed flask until completion. The solvent was removed under reduced pressure and the residue was purified by flash column chromatography (0-10% MeOH in DCM) and/or reverse-phase chromatography (0-100% MeOH in water) to give the expected compound.

The following compounds are examples illustrating this procedure:

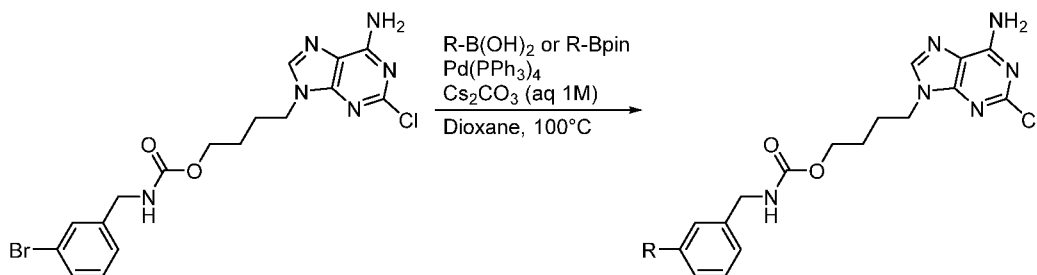
4-[6-amino-2-(methylamino)purin-9-yl]butyl-N-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl *N*-(1,3-benzodioxol-5-ylmethyl)carbamate. Yield: 58 mg (70%) of the title compound as a beige powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 7.68 (s, 1H), 7.58 (t, *J* = 6.3 Hz, 1H), 6.83-6.79 (m, 2H), 6.70-6.68 (m, 1H), 6.62 (bs, 2H), 6.15 (q, *J* = 6.2 Hz, 1H), 5.97 (s, 2H), 4.07 (d, *J* = 6.1 Hz, 2H), 3.99 (t, *J* = 6.5 Hz, 4H), 2.75 (d, *J* = 4.7 Hz, 3H), 1.84-1.75 (m, 2H), 1.55-1.48 (m, 2H).

4-[6-amino-2-(dimethylamino)purin-9-yl]butyl-N-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl *N*-(1,3-

benzodioxol-5-ylmethyl)carbamate. Yield: 50 mg (59%) of the title compound as a white powder. ^1H NMR (300 MHz, $\text{DMSO}-d_6$) δ 7.52 (s, 1H), 7.39 (t, J = 6.3 Hz, 1H), 6.61-6.58 (m, 2H), 6.52-6.47 (m, 1H), 5.75 (s, 2H), 3.85-3.75 (m, 6H), 3.99 (t, J = 6.5 Hz, 4H), 2.83 (s, 6H), 1.62-1.56 (m, 2H), 1.30-1.25 (m, 2H).

4-[6-amino-2-(methylamino)purin-9-yl]butyl-N-[[3-(trifluoromethyl)phenyl]methyl] was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-[[3-(trifluoromethyl)phenyl]methyl]carbamate. Yield: 65 mg (75%) of the title compound as a white powder. ^1H NMR (300 MHz, $\text{DMSO}-d_6$) δ 7.77 (t, J = 6.3 Hz, 1H), 7.69 (s, 1H), 6.60-6.55 (m, 4H), 6.62 (bs, 2H), 6.16-6.13 (m, 1H), 4.26 (d, J = 6.2 Hz, 2H), 4.02-3.98 (m, 4H), 2.75 (d, J = 4.7 Hz, 3H), 1.84-1.77 (m, 2H), 1.55-1.45 (m, 2H).

Example 8: General procedure for the preparation of 3-(hetero)aryl, or alkylene benzylcarbamate acyclic purine nucleoside analogues



A (Hetero)aryl- or alkyleneboronic acid ($\text{R}-\text{B}(\text{OH})_2$) or pinacol ester ($\text{R}-\text{Bpin}$) (0.275 mmol, 1.1 equiv.) and aqueous cesium carbonate (1M, 0.5 mmol, 2 equiv.) were added to a stirred solution of the 4-(6-amino-2-chloro-purin-9-yl)butyl-carbamate derivative (0.25 mmol, 1 equiv.) in dioxane (2.5 mL). The reaction mixture was purged three times with azote, then $\text{Pd}(\text{PPh}_3)_4$ (29 mg, 0.025 mmol, 0.1 equiv.) was introduced. The reaction mixture was warmed to 100°C overnight. Evaporation of the solvent and purification of the crude mixture by flash column chromatography (0-5% MeOH in DCM) yielded the expected compound.

The following compounds are examples illustrating this procedure:

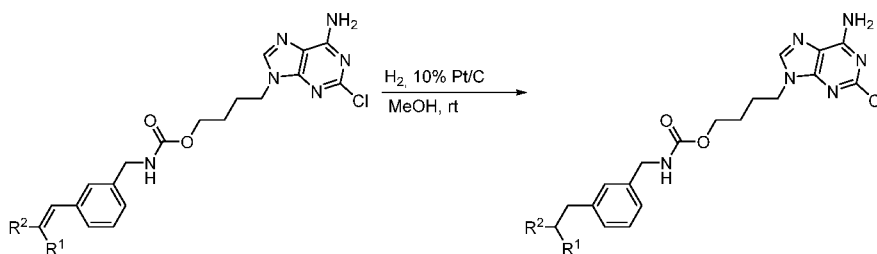
4-(6-amino-2-chloro-purin-9-yl)butyl-N-[[3-(3-furyl)phenyl]methyl]carbamate

was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-[(3-bromophenyl)methyl]carbamate (91 mg, 0.20 mmol). Yield: 46 mg (52%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.15-8.14 (m, 2H), 7.74-7.68 (m, 4H), 7.47 (bs, 2H), 7.35-7.29 (m, 1H), 7.17-7.11 (m, 1H), 6.90 (bs, 1H), 4.19 (d, *J* = 5.8 Hz, 2H), 4.13 (t, *J* = 7.2 Hz, 2H), 4.00 (t, *J* = 6.3 Hz, 2H), 1.85-1.78 (m, 2H), 1.56-1.51 (m, 2H).

4-(6-amino-2-chloro-purin-9-yl)butyl-N-[[3-(1-methylpyrrol-2-yl)phenyl]methyl]carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-[(3-bromophenyl)methyl]carbamate. Yield: 87 mg (77%) of the title compound as an orange powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.15 (s, 1H), 7.74-7.68 (m, 3H), 7.41-7.29 (m, 3H), 7.15 (d, *J* = 7.0 Hz, 1H), 6.82 (t, *J* = 2.0 Hz, 1H), 6.12-6.11 (m, 1H), 6.05-6.03 (m, 1H), 4.20 (d, *J* = 5.8 Hz, 2H), 4.12 (t, *J* = 7.2 Hz, 2H), 4.00-3.97 (m, 2H), 3.61 (s, 3H), 1.84-1.78 (m, 2H), 1.57-1.50 (m, 2H).

4-(6-amino-2-chloro-purin-9-yl)butyl-N-[[3-(2-methylprop-1-enyl)phenyl]methyl]carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-[(3-bromophenyl)methyl]carbamate (226 mg, 0.5 mmol). Yield: 133 mg (62%) of the title compound as a white powder. ESI-MS: 429.0 (M+H)⁺.

Example 9: General procedure for the preparation of saturated 3-alkylbenzylcarbamate acyclic purine nucleoside analogues.



To a stirred solution of an unsaturated compound (1 equiv.) in dry methanol (10 mL/mmol), was added 10% platinum on carbon (~20 wt %) under azote atmosphere. Hydrogen gas was bubbled through the reaction mixture for 10 min and the mixture was stirred overnight under hydrogen atmosphere until completion. The mixture was passed through a plug of celite and the solvent was removed under reduced pressure. Purification by flash column chromatography (0-10% MeOH in DCM) and/or by reverse-phase chromatography (0-100% Me OH in water) resulted in the expected compound.

The following compounds are examples illustrating this procedure:

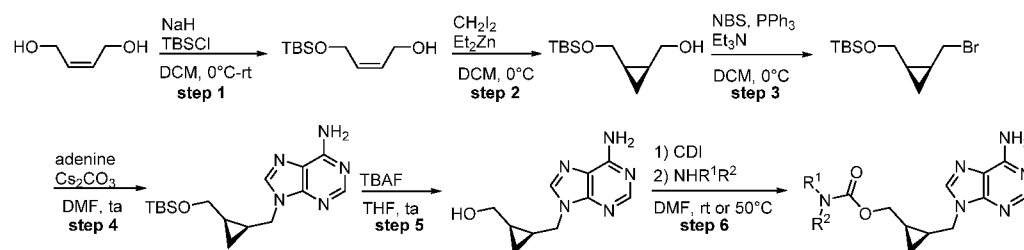
4-(6-amino-2-chloro-purin-9-yl)butyl N-[(3-propylphenyl)methyl]carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-[[3-[(Z)-prop-1-enyl]phenyl]methyl]carbamate (63 mg, 0.15 mmol). Yield: 30 mg (48%) of the title compound as a white powder. ESI-MS: 417.4 (M+H)⁺.

4-(6-amino-2-chloro-purin-9-yl)butyl N-[(3-isobutylphenyl)methyl]carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-[[3-(2-methylprop-1-enyl)phenyl]methyl]carbamate (90 mg, 0.21 mmol). Yield: 55 mg (61%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.15 (s, 1H), 7.73 (bs, 2H), 7.63 (t, *J* = 5.7 Hz, 1H), 7.20 (t, *J* = 7.7 Hz, 1H), 7.05-6.99 (m, 3H), 4.15-4.10 (m, 4H), 3.99 (t, *J* = 6.4 Hz, 2H), 2.40 (d, *J* = 7.1 Hz, 2H), 1.84-1.76 (m, 3H), 1.58-1.48 (m, 2H), 0.85 (s, 3H), 0.82 (s, 3H).

4-(6-amino-2-chloro-purin-9-yl)butyl N-[(3-isopentylphenyl)methyl]carbamate was prepared from 4-(6-amino-2-chloro-purin-9-yl)butyl N-[[3-(3-methylbut-1-ynyl)phenyl]methyl]carbamate (60 mg, 0.14 mmol). Yield: 31 mg (51%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.15 (s, 1H), 7.73 (bs, 2H), 7.62 (t, *J* = 6.1 Hz, 1H), 7.22-7.17 (m, 1H), 7.05-7.00 (m, 3H), 4.14-4.10 (m, 4H), 3.99 (t, *J* = 6.3 Hz, 2H), 2.51-2.49 (m, 2H, overlapped with DMSO), 1.87-1.77 (m, 2H), 1.57-1.38 (m, 5H), 0.90 (s, 3H), 0.88 (s, 3H). ESI-MS: 445.4 (M+H)⁺.

Example 10: General procedure for the preparation of modified alkyl chain acyclic purine nucleoside analogues

The following procedure illustrates the synthesis of cyclopropyl purine nucleoside analogues.



Step 1: To a stirred solution of sodium hydride (60% wt in oil, 750 mg, 18.90 mmol, 1 equiv.) in dry THF (28 mL), was added cis-but-2-ene, 1,4 diol (1.68 g, 18.90 mmol, 1 equiv.) dropwise over 50 minutes at 0°C under azote

atmosphere. The reaction mixture was warmed to room temperature and stirred for 1 hour. Then, *tert*-butyldimethylsilyl chloride (2.84 g, 18.90 mmol, 1 equiv.) in dry THF (28 mL) was added dropwise over 50 minutes and stirred for 1 hour. The reaction mixture was quenched by addition of a saturated solution of ammonium chloride (35 mL). After evaporation of THF, the aqueous layer was extracted twice with DCM and the combined organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. A purification of the residue by flash column chromatography (10-30% EtOAc in cyclohexane) provided (*Z*)-4-[*tert*-butyl(dimethyl)silyl]oxybut-2-en-1-ol (3.14 g, 88%) as a yellow oil. ¹H NMR (300 MHz, CDCl₃) δ 5.70-5.68 (m, 2H), 4.26-4.25 (m, 2H), 4.20-4.18 (m, 2H), 0.90 (s, 6H), 0.09 (s, 9H).

Step 2: To a stirred suspension of the previous intermediate (2.50 g, 12.35 mmol, 1 equiv.) in DCM (72 mL), were added dropwise diethyl zinc (3.25 g, 26.40 mmol, 2 equiv.) and diiodomethane (14.14 g, 52.80 mmol, 4 equiv.) at 0°C under azote atmosphere. The reaction mixture was kept at 0°C for 3 hours and then a saturated solution of ammonium chloride was added. The phases were separated and the aqueous layer was extracted once with DCM. The combined organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude was then purified by flash column chromatography (10-30% EtOAc in cyclohexane) to provide [(1*S*,2*R*)-2-[*tert*-butyl(dimethyl)silyl]oxymethyl]cyclopropyl]methanol (1.86 g, 68%) as a yellow oil. ¹H NMR (300 MHz, CDCl₃) δ 4.14 (dd, *J* = 11.5, 5.4 Hz, 1H), 3.96 (dd, *J* = 12.2, 5.4 Hz, 1H), 3.28-3.21 (m, 2H), 1.43-1.30 (m, 1H), 1.28-1.15 (m, 1H), 0.90 (s, 9H), 0.76-0.74 (m, 1H), 0.19 (q, *J* = 5.6 Hz, 1H), 0.10 (s, 6H).

Step 3: To a stirred solution of the previous intermediate (1.47 g, 6.80 mmol, 1 equiv.) in dry DCM (87 mL), were added triphenylphosphine (3.56 g, 13.60 mmol, 2 equiv.) and triethylamine (1.83 mL, 13.60 mmol, 2 equiv.) under azote atmosphere. The mixture was cooled to 0°C and *N*-bromosuccinimide (2.42 g, 13.60 mmol, 2 equiv.) was added portionwise. The reaction was then warmed to 40°C for 1h30. The resulting solution was diluted with DCM and the aqueous phase was extracted once with DCM. The combined organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. A

purification of the residue by flash column chromatography (10% EtOAc in cyclohexane) afforded [(1*R*,2*S*)-2-(bromomethyl)cyclopropyl]methoxy-*tert*-butyl-dimethyl-silane (1.89 g, 90%) as a colorless oil. ¹H NMR (300 MHz, CDCl₃) δ 3.82 (dd, *J* = 11.2, 5.6 Hz, 1H), 3.69-3.40 (m, 3H), 1.47-1.25 (m, 2H), 0.88 (s, 9H), 0.40 (q, *J* = 5.5 Hz, 2H), 0.06 (s, 6H).

Step 4: To a stirred solution of the previous intermediate (1.72 g, 6.15 mmol, 1 equiv.) in dry DMF (15 mL), were added adenine (830 mg, 6.15 mmol, 1 equiv.) and cesium carbonate (2.40 g, 7.38 mmol, 1.2 equiv.) under azote atmosphere. The mixture was left at room temperature overnight. After evaporation of DMF, the residue was taken up with DCM and washed three times with water. The organic layer was then dried over Na₂SO₄, filtered and concentrated under vacuum. A purification of the residue by flash column chromatography (0-10% MeOH in DCM) yielded 9-[[[(1*S*,2*R*)-2-[[*tert*-butyl(dimethyl)silyl]oxymethyl]cyclopropyl]methyl]purin-6-amine (850 mg, 42%) as a white solid. ¹H NMR (300 MHz, CDCl₃) δ 8.33 (s, 1H), 8.29 (s, 1H), 7.04 (bs, 2H), 4.47 (dd, *J* = 14.6, 6.5 Hz, 1H), 4.18-4.07 (m, 2H), 3.54 (dd, *J* = 11.6, 8.7 Hz, 1H), 3.52 (d, *J* = 11.6 Hz, 1H), 1.47-1.39 (m, 1H), 1.38-1.28 (m, 1H), 0.90 (s, 9H), 0.41 (q, *J* = 11.1, 5.6 Hz, 2H), 0.07 (s, 6H).

Step 5: To a stirred solution of the previous intermediate (850 mg, 2.56 mmol, 1 equiv.) in dry THF (13 mL), was added dropwise TBAF (1M in THF, 3.07 mmol, 1.2 equiv.) at 0°C under azote atmosphere. The reaction was warmed to room temperature and stirred for 3 hours. The mixture was then concentrated under vacuum and the crude was purified by flash column chromatography (0-15% MeOH in DCM) to give [(1*R*,2*S*)-2-[(6-aminopurin-9-yl)methyl]cyclopropyl]methanol (550 mg, 95%) as a white solid. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.19 (s, 1H), 8.10 (s, 1H), 7.15 (s, 2H), 4.74 (t, *J* = 5.2 Hz, 1H), 4.23-4.04 (m, 2H), 3.74-3.66 (m, 1H), 3.43-3.33 (m, 1H), 1.38-1.23 (m, 1H), 1.19-1.07 (m, 1H), 0.67-0.60 (m, 1H), 0.31-0.23 (q, *J* = 5.5 Hz, 1H).

Step 6: To a stirred solution of the previous intermediate (44 mg, 0.20 mmol, 1 equiv.) in dry DMF (2 mL), was added carbonyldiimidazole (49 mg, 0.30 mmol, 1.5 equiv.) under azote atmosphere. After 2 hours of stirring at room temperature, the appropriate amine (3 equiv.) was added and the

reaction mixture was stirred at room temperature or 50°C until completion. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) and by reverse-phase chromatography (0-100% MeOH in water) to give the carbamate derivative.

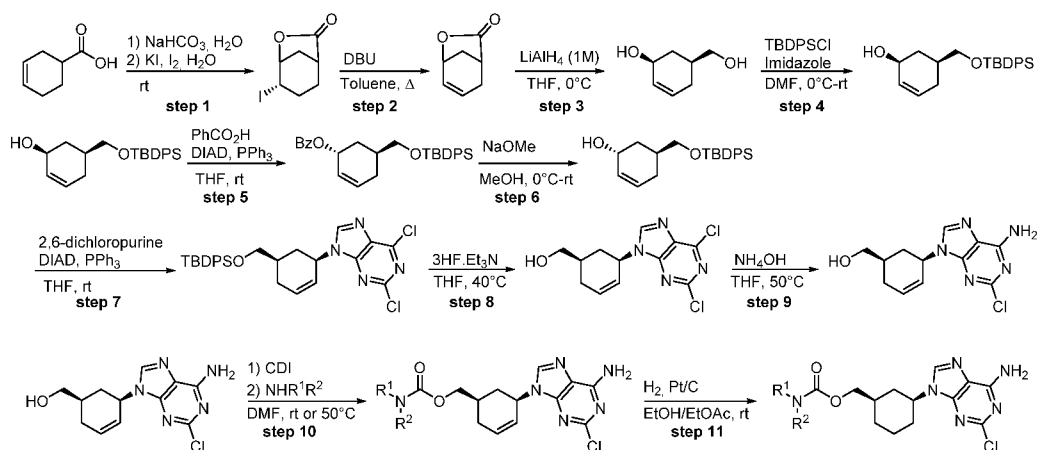
5 The following compounds are examples illustrating this procedure.

[(1*R*,2*S*)-2-[(6-aminopurin-9-yl)methyl]cyclopropyl]methylN-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from [(1*R*,2*S*)-2-[(6-aminopurin-9-yl)methyl]cyclopropyl]methanol. Yield: 51 mg (64%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 8.14 (s, 1H), 7.64 (t, *J* = 6.1 Hz, 1H), 7.16 (s, 2H), 6.83 (d, *J* = 8.1 Hz, 2H), 6.72 (d, *J* = 7.8 Hz, 1H), 5.96 (s, 2H), 4.34-4.21 (m, 2H), 4.12-3.91 (m, 4H), 1.56-1.40 (m, 1H), 1.37-1.24 (m, 1H), 0.81-0.69 (m, 1H), 0.50 (q, *J* = 5.0 Hz, 1H).

[(1*R*,2*S*)-2-[(6-aminopurin-9-yl)methyl]cyclopropyl]methylN-[2-(4-fluorophenyl)ethyl]carbamate was prepared from [(1*R*,2*S*)-2-[(6-aminopurin-9-yl)methyl]cyclopropyl]methanol. Yield: 46 mg (62%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.16 (s, 1H), 8.14 (s, 1H), 7.26-7.21 (m, 5H), 7.09 (t, *J* = 9.0 Hz, 2H), 4.35-4.20 (m, 2H), 4.07-3.93 (m, 2H), 3.19 (q, *J* = 6.5 Hz, 2H), 2.70 (t, *J* = 7.7 Hz, 2H), 1.56-1.41 (m, 1H), 1.35-1.20 (m, 1H), 0.81-0.70 (m, 1H), 0.50 (q, *J* = 5.3 Hz, 1H).

[(1*R*,2*S*)-2-[(6-aminopurin-9-yl)methyl]cyclopropyl]methyl- N-[(3-phenylphenyl)methyl]carbamate was prepared from [(1*R*,2*S*)-2-[(6-aminopurin-9-yl)methyl]cyclopropyl]methanol. Yield: 66 mg (77%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.17 (s, 1H), 8.14 (s, 1H), 7.78 (t, *J* = 6.0 Hz, 1H), 7.63 (d, *J* = 7.4 Hz, 2H), 7.58-7.22 (m, 9H), 4.39-4.24 (m, 4H), 4.11-3.98 (m, 2H), 1.56-1.42 (m, 1H), 1.40-1.25 (m, 1H), 0.82-0.72 (m, 1H), 0.53 (q, *J* = 5.3 Hz, 1H).

The following procedure illustrates the synthesis of 1,3- cyclohexenyl and cyclohexanyl purine nucleoside analogues.



Step 1: To a stirred solution of sodium hydrogencarbonate (7.50 g, 90 mmol, 3 equiv.) in water (73 mL), was added 3-cyclo-hexen-1-carboxylic acid (3.78 g, 30 mmol, 1 equiv.). The mixture was stirred at room temperature until it became clear. Then, a solution of potassium iodide (29.90 g, 180 mmol, 6 equiv.) and iodine (7.98 g, 31.50 mmol, 1.05 equiv.) in water (73 mL) was added in one portion and the reaction mixture was protected from light and stirred at room temperature overnight. Extraction with DCM was performed three times and the combined organic layers were washed successively with 10% aqueous of sodium thiosulfate; 10 % aqueous sodium hydrogencarbonate and water, dried over Na₂SO₄, filtered and concentrated under vacuum to give (4*S*)-4-iodo-6-oxabicyclo[3.2.1]octan-7-one (7.21 g , 95%) as a yellow-white solid.

Step 2: To a stirred suspension of the iodo intermediate (7.21 g, 28.60 mmol, 1 equiv.) in toluene (72 mL), was added dropwise DBU (6.40 mL, 42.91 mmol, 1.5 equiv.) under azote atmosphere. The mixture was warmed to reflux for 3 hours, and then concentrated under vacuum. The crude was purified by flash column chromatography (50% EtOAc in cyclohexane) to provide 6-oxabicyclo[3.2.1]oct-3-en-7-one (3.35 g, 94%) as a colorless oil. ¹H NMR (300 MHz, CDCl₃) δ 6.26-6.19 (m, 1H), 5.87-5.81 (m, 1H), 4.75 (tt, *J* = 5.5, 1.1 Hz, 1H), 2.93 (m, 1H), 2.57-2.39 (m, 3H), 2.10-2.07 (m, 1H).

Step 3: To a stirred solution of alkene intermediate (1.68 g, 13.50 mmol, 1 equiv.) in dry THF (70 mL), was added dropwise lithium aluminum

hydride (1M in THF, 20 mL, 20 mmol, 1.5 equiv.) at 0°C under azote atmosphere. The reaction mixture was kept at 0°C for 1 hours. Then, water (2 mL), 15% aqueous sodium hydroxide (2 mL) and water (5 mL) were successively added, and the mixture was allowed to warm to room temperature and stirred for 2h30. The salts were filtered through a pad of celite and the filtrate was dried over Na₂SO₄ and concentrated under vacuum to yield (1*S*,5*S*)-5-(hydroxymethyl)cyclohex-2-en-1-ol (1.87 g, quant.) as a colorless oil.

Step 4: To a stirred solution of the diol intermediate (1.87 g, 13.50 mmol, 1 equiv.) in dry DMF (67 mL), were added imidazole (1.84 g, 27 mmol, 2 equiv.) and *tert*-butyl(chloro)diphenylsilane (3.51 mL, 13.50 mmol, 1 equiv.) dropwise at 0°C under azote atmosphere. The reaction mixture was allowed to warm to room temperature and stirred for 1h30. The mixture was diluted with ethyl acetate and washed with brine. The organic layer was dried over Na₂SO₄, filtered and concentrated under vacuum. The residue was purified by flash column chromatography (0-30% EtOAc in cyclohexane) to afford (1*S*,5*S*)-5-[[*tert*-butyl(diphenyl)silyl]oxymethyl]cyclohex-2-en-1-ol (2.77 g, 56%) as a colorless oil. ¹H NMR (300 MHz, CDCl₃) δ 7.68-7.66 (m, 4H), 7.44-7.37 (m, 6H), 5.81-5.75 (m, 1H), 5.72-5.66 (m, 1H), 4.38-4.29 (m, 1H), 3.57 (d, *J* = 5.8 Hz, 2H), 2.24-2.15 (m, 1H), 2.14-2.04 (m, 1H), 2.00-1.76 (m, 2H), 1.52 (d, *J* = 6.6 Hz, 1H), 1.31-1.20 (m, 1H), 1.07 (s, 9H).

Step 5: To a stirred solution of the previous intermediate (940 mg, 2.56 mmol, 1 equiv.) in dry THF (13 mL), were added triphenylphosphine (1.35 g, 5.13 mmol, 2 equiv.) and benzoic acid (626 mg, 5.13 mmol, 2 equiv.) under azote atmosphere. Then, DIAD (1 mL, 5.13 mmol, 2 equiv.) was added dropwise. The reaction mixture was left overnight at room temperature. The resulting solution was diluted with ethyl acetate and washed with a saturated solution of sodium hydrogencarbonate. The organic layer was dried over Na₂SO₄, filtered and concentrated under vacuum. The crude oil was purified by flash column chromatography (0-5% EtOAc in cyclohexane) to give [(1*R*,5*S*)-5-[[*tert*-butyl(diphenyl)silyl]oxymethyl]cyclohex-2-en-1-yl] benzoate (1.01 g, 84%) as a colorless oil.

Step 6: The previous intermediate (1.0 g, 2.12 mmol, 1 equiv.) was

treated with sodium methoxide (0.5 M in MeOH, 4.7 mL, 2.33 mmol, 1.1 equiv.) in methanol (20 mL) at 0°C. The reaction mixture was allowed to warm to room temperature overnight. Concentration of the crude followed by purification by flash column chromatography (0-30% EtOAc in cyclohexane) provided (1*R*, 5*S*)-5-[[*tert*-butyl(diphenyl)silyl]oxymethyl]cyclohex-2-en-1-ol (606 mg, 78%) as a colorless oil. ¹H NMR (300 MHz, CDCl₃) δ 7.69-7.66 (m, 4H), 7.44-7.37 (m, 6H), 5.95-5.81 (m, 2H), 4.23 (bs, 1H), 3.65-3.54 (m, 2H), 2.26-2.17 (m, 1H), 2.11-1.97 (m, 1H), 1.89-1.77 (m, 2H), 1.59-1.40 (m, 1H), 1.40 (d, *J* = 6.7 Hz, 1H), 1.07 (s, 9H).

Step 7: To a stirred solution of the alcohol intermediate (600 mg, 1.64 mmol, 1 equiv.) in dry THF (16 mL), were added triphenylphosphine (859 mg, 3.28 mmol, 2 equiv.) and 2,6-dichloropurine (620 mg, 3.28 mmol, 2 equiv.) under azote atmosphere. Then, DIAD (645 µL, 3.28 mmol, 2 equiv.) was added dropwise over 40 minutes. The reaction mixture was stirred at room temperature for 2 hours and then concentrated under vacuum. The residue was purified by flash column chromatography (0-30% EtOAc in cyclohexane) to yield *tert*-butyl-[[[(1*R*,5*R*)-5-(2,6-dichloropurin-9-yl)cyclohex-3-en-1-yl]methoxy]-diphenyl-silane (395 mg, 45%) as a white powder, contaminated with 25% of the trans derivative. ¹H NMR (300 MHz, CDCl₃) δ 8.14 (s, cis, 0.75H), 8.12 (s, trans, 0.25H), 7.64-7.54 (m, 4H), 7.43-7.35 (m, 6H), 6.40-6.35 (m, trans, 0.25H), 6.21-6.15 (m, cis, 0.75H), 5.89-5.84 (m, trans, 0.25H), 5.72-5.69 (m, cis, 0.75H), 5.44-5.40 (m, cis, 0.75H), 5.33-5.29 (m, trans, 0.25H), 3.62 (d, *J* = 5.2 Hz, cis, 1.5H), 3.54 (d, *J* = 5.6 Hz, trans, 0.5H), 2.40-1.86 (m, 4H), 1.76-1.44 (m, 1H), 1.05 (s, cis, 6.4H), 0.99 (s, trans, 2.1H).

Step 8: To a stirred solution of the previous intermediate (231 mg, 0.43 mmol, 1 equiv.) in dry THF (4.3 mL), was added dropwise triethylamine trihydrofluoride (350 µL, 2.15 mmol, 5 equiv.) under azote atmosphere. The reaction mixture was stirred at 40°C for 24 hours. A saturated solution of sodium hydrogencarbonate was then slowly added until a neutral pH was achieved. The mixture was diluted with ethyl acetate and the aqueous layer was extracted twice with ethyl acetate. The combined organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. A purification of

the residue by flash column chromatography (0-10% MeOH in DCM) provided [(1*R*, 5*R*)-5-(2,6-dichloropurin-9-yl)cyclohex-3-en-1-yl]methanol (125 mg, 97%) as a white, contaminated with 25% of trans derivative. ¹H NMR (300 MHz, CDCl₃) δ 8.16 (s, 1H), 6.44-6.37 (m, trans, 0.25H), 6.23-6.16 (m, 1H, cis, 0.75H), 5.92-5.86 (m, trans, 0.25H), 5.75-5.72 (m, cis, 0.75H), 5.50-5.43 (m, cis, 0.75H), 5.38-5.34 (m, trans, 0.25H), 3.70-3.55 (m, 2H), 2.51-1.87 (m, 4H), 1.41-1.33 (m, 1H).

Step 9: To a stirred solution of the previous intermediate (170 mg, 0.57 mmol, 1 equiv.) in dry THF (1.4 mL), was added an aqueous ammonia solution (28%, 1.4 mL). The reaction mixture was warmed to 50°C overnight and then concentrated under vacuum. A purification of the residue by flash column chromatography (0-10% MeOH in DCM) provided [(1*R*, 5*R*)-5-(6-amino-2-chloro-purin-9-yl)cyclohex-3-en-1-yl]methanol (158 mg, 99%) as a white solid, contaminated with 25% of trans derivative. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.10 (s, cis, 0.75H), 7.98 (s, trans, 0.25H), 7.75 (bs, 2H), 6.26-6.19 (m, trans, 0.25H), 6.04-5.99 (m, cis, 0.75H), 5.86-5.81 (m, trans, 0.25H), 5.73-5.68 (m, cis, 0.75H), 5.17-5.07 (m, 1H), 4.60 (t, *J* = 4.8 Hz, cis, 0.75H), 4.51-4.48 (m, trans, 0.25H), 3.34-3.32 (m, 2H, overlapped with DMSO), 2.28-1.55 (m, 5H). ESI-MS: 280.2 (M+H)⁺.

Step 10: To a stirred solution of the previous intermediate (56 mg, 0.20 mmol, 1 equiv.) in DMF (2 mL), was added carbonyldiimidazole (49 mg, 0.30 mmol, 1.5 equiv.) under azote atmosphere. After 2 hours of stirring at room temperature, the appropriate amine (3 equiv.) was added and the reaction mixture was stirred at room temperature or 50°C until completion. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) and by reverse-phase chromatography (0-100% MeOH in water) to give the carbamate derivative.

The following compounds are examples illustrating this procedure.

[(1*R*,5*R*)-5-(6-amino-2-chloro-purin-9-yl)cyclohex-3-en-1-yl]methylN-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from [(1*R*,5*R*)-5-(6-amino-2-chloro-purin-9-yl)cyclohex-3-en-1-yl]methanol. Yield: 67 mg (74%) of the title compound as a white powder, along with 25% of the trans derivative. ESI-MS:

457.4 (M+H)⁺.

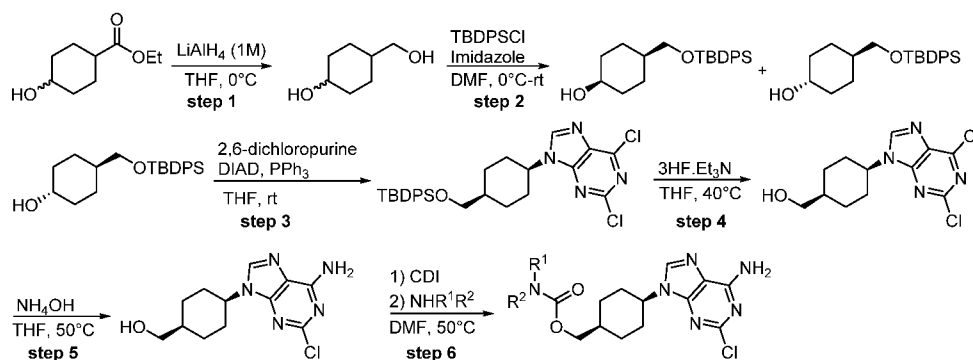
[(1R,5R)-5-(6-amino-2-chloro-purin-9-yl)cyclohex-3-en-1-yl]methyl-N-[[3-(trifluoromethyl)phenyl]methyl]carbamate was prepared from [(1R,5R)-5-(6-amino-2-chloro-purin-9-yl)cyclohex-3-en-1-yl]methanol. Yield: 40 mg (41%) of the title compound as a white powder, along with 25% of the trans derivative. ESI-MS: 481.4 (M+H)⁺.

Step 11: To a stirred solution of the previous compound (1 equiv.) in EtOH/EtOAc (30 mL/mmol each), was added 10% platinum on carbon under azote atmosphere. Hydrogen gas via balloon was bubbled for 10 min and the reaction mixture was stirred under hydrogen atmosphere until completion. The mixture was passed through a plug of celite and the solvent was removed under reduced pressure. Purification by flash column chromatography (0-10% MeOH in DCM) and/or by reverse-phase chromatography (0-100% MeOH in water) afforded the expected compound.

The following compound are example illustrating this procedure.

[(1R,3S)-3-(6-amino-2-chloro-purin-9-yl)cyclohexyl]methyl-N-(1,3-benzodioxol-5-ylmethyl)carbamate was prepared from [(1R, 5R)-5-(6-amino-2-chloro-purin-9-yl)cyclohex-3-en-1-yl]methanol. Yield: 30 mg (81%) of the title compound as a white powder, along with 25% of the trans derivative. ESI-MS: 459.5 (M+H)⁺.

The following procedure illustrates the synthesis of 1,4 cyclohexanyl purine nucleoside analogues.



Step 1: To a stirred solution ethyl 4-hydroxycyclohexanecarboxylate (2.78 g, 16.0 mmol, 1 equiv.) in dry THF (80 mL), was added dropwise lithium aluminum hydride (1M in THF, 24 mL, 24.0 mmol, 1.5 equiv.) at 0°C under azote atmosphere. The reaction mixture was warmed to room temperature and

stirred for 3h30. The mixture was then cooled to 0°C and water (1 mL), 15% aqueous sodium hydroxide (1 mL) and water (3 mL) were successively added. The mixture was allowed to warm to room temperature and stirred overnight. The salts were filtered through a pad of celite and the filtrate was dried over Na₂SO₄ and concentrated under vacuum to yield 4-(hydroxymethyl)cyclohexanol (2.10 g, quant.) as a colorless oil.

Step 2: To a stirred solution of the previous intermediate (755 mg, 5.80 mmol, 1 equiv.) in dry DMF (67 mL), were added imidazole (790 mg, 11.60 mmol, 2 equiv.) and *tert*-butyl(chloro)diphenylsilane (1.5 mL, 5.80 mmol, 1 equiv.) dropwise at 0°C under azote atmosphere. The reaction mixture was allowed to warm to room temperature and stirred for 2 hours. The mixture was diluted with ethyl acetate and washed with brine. The organic layer was dried over Na₂SO₄, filtered and concentrated under vacuum. The residue was purified by flash column chromatography (10-30% EtOAc in cyclohexane) to afford the cis isomer (1*S*,4*S*)-4-(((*tert*-butyldiphenylsilyl)oxy)methyl)cyclohexan-1-ol (first eluted product, 606 mg) and trans isomer (1*R*,4*R*)-4-(((*tert*-butyldiphenylsilyl)oxy)methyl)cyclohexan-1-ol (second eluted product, 754 mg). ¹H NMR (300 MHz, CDCl₃) δ cis compound: 7.71-7.69 (m, 4H), 7.47-7.38 (m, 6H), 4.01 (bs, 1H), 3.54 (d, *J* = 6.4 Hz, 2H), 1.74-1.54 (m, 7H), 1.49-1.44 (m, 2H), 1.33-1.27 (m, 2H), 1.08 (s, 9H). trans compound: 7.69-7.67 (m, 4H), 7.47-7.38 (m, 6H), 3.57 (bs, 1H), 3.49 (d, *J* = 6.2 Hz, 2H), 2.04-2.00 (m, 2H), 1.88-1.84 (m, 2H), 1.56-1.48 (m, 1H), 1.44 (bs, 1H), 1.30-1.23 (m, 2H), 1.10-1.03 (m, 10H).

Step 3: To a stirred solution of the trans isomer (662 mg, 1.80 mmol, 1 equiv.) in dry THF (18 mL), were added triphenylphosphine (944 mg, 3.60 mmol, 2 equiv.) and 2,6-dichloropurine (680 mg, 3.60 mmol, 2 equiv.) under azote atmosphere. Then, DIAD (710 µL, 3.28 mmol, 2 equiv.) was added dropwise over 30 minutes. The reaction mixture was stirred at room temperature overnight and then concentrated under vacuum. The residue was purified by flash column chromatography (0-30% EtOAc in cyclohexane) to yield 9-((1*S*,4*S*)-4-(((*tert*-butyldiphenylsilyl)oxy)methyl)cyclohexyl)-2,6-dichloro-9H-purine (414 mg, 43%) as a colorless oil. ¹H NMR (300 MHz, CDCl₃) δ 7.94

(s, 1H), 7.71-7.67 (m, 4H), 7.50-7.38 (m, 6H), 4.98 (q, $J = 6.1$ Hz, 1H), 3.72 (d, $J = 7.4$ Hz, 2H), 2.06-1.62 (m, 9H), 1.09 (s, 9H).

Step 4: To a stirred solution of the previous intermediate (1.10 g, 2.04 mmol, 1 equiv.) in dry THF (20 mL), was added dropwise triethylamine trihydrofluoride (1.70 mL, 10.20 mmol, 5 equiv.) under azote atmosphere. The reaction mixture was stirred at 40°C for 24 hours. A saturated solution of sodium hydrogencarbonate was then slowly added until a neutral pH was achieved. The mixture was diluted with ethyl acetate and the aqueous layer was extracted twice with ethyl acetate. The combined organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. A purification of the residue by flash column chromatography (0-10% MeOH in DCM) provided ((1*S*,4*S*)-4-(2,6-dichloropurin-9-yl)cyclohexyl)methanol (479 mg, 78%) as a white solid. ¹H NMR (300 MHz, CDCl₃) δ 8.20 (s, 1H), 4.66-4.56 (m, 1H), 3.77 (d, $J = 7.3$ Hz, 2H), 2.19-1.73 (m, 9H).

Step 5: To a stirred solution of the previous intermediate (301 mg, 1 mmol, 1 equiv.) in dry THF (2.5 mL), was added an aqueous ammonia solution (28%, 2.5 mL). The reaction mixture was warmed to 50°C overnight and then concentrated under vacuum. A purification of the residue by flash column chromatography (0-10% MeOH in DCM) provided (1*S*,4*S*)-4-(6-amino-2-chloro-purin-9-yl)cyclohexyl)methanol (268 mg, 95%) as a white solid. ¹H NMR (300 MHz, CDCl₃) δ 8.19 (s, 1H), 4.63-4.56 (m, 1H), 3.74 (d, $J = 7.3$ Hz, 2H), 3.47 (s, 1H), 2.17-2.07 (m, 2H), 2.04-1.72 (m, 7H). ESI-MS: 282.3 (M+H)⁺.

Step 6: To a stirred solution of the previous intermediate (56 mg, 0.20 mmol, 1 equiv.) in DMF (2 mL), was added carbonyldiimidazole (49 mg, 0.30 mmol, 1.5 equiv.) under azote atmosphere. After 2 hours of stirring at room temperature, the appropriate amine (3 equiv.) was added and the reaction mixture was stirred at room temperature or 50°C until completion. The solvent was then removed under reduced pressure and the residue purified by flash column chromatography (0-10% MeOH in DCM) to give the carbamate derivative.

The following compounds are examples illustrating this procedure.

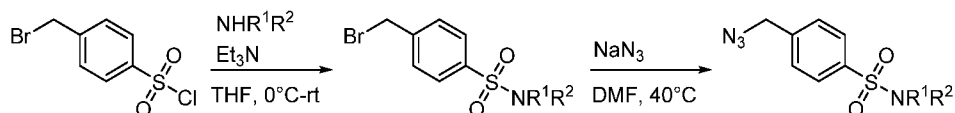
2-[(1*S*,4*S*)-4-(6-amino-2-chloro-purin-9-yl)cyclohexyl]ethyl N-(1,3-benzodioxol-

5-ylmethyl)carbamate was prepared from (1*S*,4*S*)-4-(6-amino-2-chloro-purin-9-yl)cyclohexyl)methanol. Yield: 81 mg (89%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.33 (s, 1H), 7.71 (bs, 2H), 7.64 (t, *J* = 6.0 Hz, 1H), 6.86-6.80 (m, 2H), 6.74-6.71 (m, 1H), 5.97 (s, 2H), 4.36-4.29 (m, 1H), 4.15-4.07 (m, 4H), 2.09-1.67 (m, 9H).

2-[(1*S*,4*S*)-4-(6-amino-2-chloro-purin-9-yl)cyclohexyl]ethyl-N-[[3-(trifluoromethyl)phenyl]methyl]carbamate was prepared from (1*S*,4*S*)-4-(6-amino-2-chloro-purin-9-yl)cyclohexyl)methanol. Yield: 76 mg (78%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 8.33 (s, 1H), 7.82 (t, *J* = 6.0 Hz, 1H), 7.72 (bs, 2H), 7.62-7.56 (m, 4H), 4.37-4.27 (m, 3H), 4.16 (d, *J* = 7.6 Hz, 2H), 2.08-1.99 (m, 3H), 1.81-1.72 (m, 6H).

Example 11: Preparation of various amine intermediates.

Preparation of 4-benzylaminesulfonamide derivatives



To a stirred solution of 4-(bromomethyl)benzenesulfonyl chloride (1.35 g, 5 mmol, 1 equiv.) in dry THF (20 mL), triethylamine (700 μL, 5 mmol, 1 equiv.) and the appropriate amine (1 equiv.) were added at 0°C under azote atmosphere. The reaction mixture was allowed to warm to room temperature and stirred until completion. The mixture was then diluted with ethyl acetate and washed with water and brine. The organic layer was dried over Na₂SO₄, filtered and concentrated under vacuum.

The crude residue was dissolved in dry DMF (10 mL) and treated with sodium azide (390 mg, 6 mmol, 1.2 equiv.) under azote atmosphere. The reaction mixture was stirred at 40°C overnight. The mixture was then diluted with ethyl acetate and washed with water and brine. The organic layer was dried over Na₂SO₄, filtered and concentrated under vacuum. Purification of the crude mixture resulted in the expected compound.

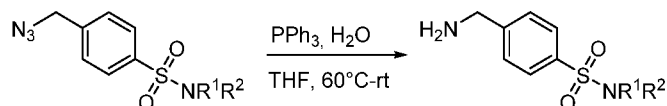
The following compounds are examples illustrating this procedure:

4-(azidomethyl)-N-benzyl-benzenesulfonamide was prepared from 4-(bromomethyl)benzenesulfonyl chloride. Yield: 1.18 g (78 %) of the title

compound as a yellow oil.

4-(azidomethyl)-N-[2-(4-fluorophenyl)ethyl]benzenesulfonamide was prepared from 4-(Bromomethyl)benzenesulfonyl chloride. Yield: 1.39 g (83 %) of the title compound as a yellow oil.

5 4-(azidomethyl)-N-methyl-benzenesulfonamide was prepared from 4-(Bromomethyl)benzenesulfonyl chloride. Yield: 876 mg (78 %) of the title compound as a colorless oil.



10 To a stirred solution of azide (1 equiv.) in THF (5mL/mmol), triphenylphosphine (2 equiv.) was added under azote atmosphere. The reaction mixture was warmed to 60°C for 1 hr. Water (20 equiv.) was added and the solution was stirred at room temperature overnight. Concentration of the crude mixture under vacuum and purification by flash column chromatography (0-10% MeOH in DCM + 2% NH₄OH) provided the amino derivative.

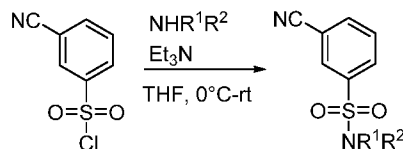
The following compounds are examples illustrating this procedure:

20 4-(aminomethyl)-N-benzyl-benzenesulfonamide was prepared from 4-(azidomethyl)-N-benzyl-benzenesulfonamide (1.18 g, 3.90 mmol). Yield: 1.07 g (99%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 7.77-7.73 (m, 2H), 7.54-7.52 (m, 2H), 7.32-7.20 (m, 5H), 3.94 (s, 2H), 3.79 (s, 2H).

25 4-(aminomethyl)-N-[2-(4-fluorophenyl)ethyl]benzenesulfonamide was prepared from 4-(azidomethyl)-N-[2-(4-fluorophenyl)ethyl]benzenesulfonamide (1.39 g, 4.16 mmol). Yield: 1.19 g (93%) of the title compound as a white powder. ESI-MS: 212.2 (M+H)⁺.

30 4-(aminomethyl)-N-methyl-benzenesulfonamide was prepared from 4-(azidomethyl)-N-methyl-benzenesulfonamide (856 mg, 3.78 mmol). Yield: 546 mg (72%) of the title compound as a white powder. ¹H NMR (300 MHz, DMSO-*d*₆) δ 7.71-7.68 (m, 2H), 7.56-7.53 (m, 2H), 3.80 (s, 2H), 2.39 (s, 3H).

Preparation of 3-benzylaminesulfonamide derivatives



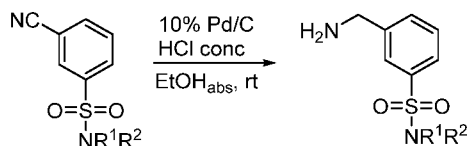
To a stirred solution of 3-cyanobenzenesulfonyl chloride (1 g, 5 mmol) in dry THF (10 mL), triethylamine (700 μ L, 5 mmol, 1 equiv.) and the appropriate amine (1 equiv.) were added at 0°C under azote atmosphere. The reaction mixture was stirred for 1 hr at room temperature, then diluted with ethyl acetate and washed with water and brine. The organic layer was dried over Na₂SO₄, filtered and concentrated under vacuum to provide the expected compound which was used without further purification.

The following compounds are examples illustrating this procedure:

N-benzyl-4-cyano-benzenesulfonamide was prepared from 3-cyanobenzenesulfonyl chloride. Yield: 1.31 g (92%) of the title compound as a white powder.

N-methyl-4-cyano-benzenesulfonamide was prepared from 3-cyanobenzenesulfonyl chloride. Yield: 899 mg (92%) of the title compound as a yellow oil.

4-morpholinosulfonylbenzonitrile was prepared from 3-cyanobenzenesulfonyl chloride. Yield: 812 mg (64 %) of the title compound as a colorless oil.



To a stirred solution of 3-cyanobenzenesulfonyl derivative (1 equiv.) in absolute ethanol (4 mL/mmol) and conc. HCl (0.4 mL/mmol), 10% palladium on carbon (~20 wt %) was added under azote atmosphere. Hydrogen gas was bubbled through the reaction mixture for 10 min and the mixture was stirred overnight under hydrogen atmosphere until completion. The mixture was passed through a plug of celite and the solvent was removed under reduced pressure. Purification by flash column chromatography (0-10% MeOH in DCM + 2% NH₄OH) yielded the expected compound.

The following compounds are examples illustrating this procedure:

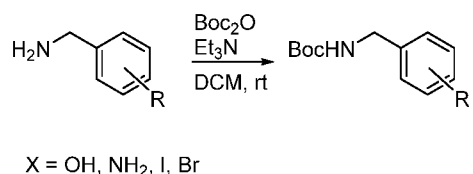
N-benzyl-4-amino-benzenesulfonamide was prepared from N-benzyl-4-cyano-

benzenesulfonamide (817 mg, 3 mmol). Yield: 602 mg (73 %) of the title compound as a white powder. ^1H NMR (300 MHz, DMSO- d_6) δ 8.49 (bs, 2H), 7.94-7.92 (m, 1H), 7.79-7.77 (m, 2H), 7.68-7.65 (m, 2H), 7.59-7.56 (m, 1H), 4.12 (s, 2H), 2.43 (d, J = 4.8 Hz, 3H).

N-methyl-4-amino-benzenesulfonamide was prepared from N-methyl-4-cyano-benzenesulfonamide (450 mg, 2.29 mmol). Yield: 399 mg (87%) of the title compound as a white powder. ^1H NMR (300 MHz, DMSO- d_6) δ 8.50 (bs, 2H), 8.25 (t, J = 6.3 Hz, 1H), 7.97-7.96 (m, 1H), 7.82-7.75 (m, 2H), 7.63 (t, J = 7.6 Hz, 1H), 7.33-7.20 (m, 5H), 4.11 (s, 2H), 4.00 (d, J = 6.0 Hz, 2H).

(4-morpholinosulfonylphenyl)methanamine was prepared from 4-morpholinosulfonylbenzonitrile (812 mg, 3.13 mmol). Yield: 714 mg (89 %) of the title compound as a colorless oil.

General procedure for Boc protection



To a stirred solution of benzylamine derivative (1 equiv.) in dry DCM, triethylamine (1.5 equiv.) and di-*tert*-butyl dicarbonate (1-1.2 equiv.) were added under azote atmosphere. The reaction mixture was stirred at room temperature until completion. Water was then added, the phases were separated and the aqueous phase was extracted once with DCM. The combined organic layers were washed with brine, dried over Na_2SO_4 , filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (0-10% MeOH in DCM) to provide the expected compound.

The following compounds are examples illustrating this procedure:

Tert-butyl N-[(3-bromophenyl)methyl]carbamate was prepared from 3-bromobenzylamine (2 g, 10.75 mmol). Yield: 2.47g (80%) of the title compound as a white powder.

Tert-butyl N-[(4-aminophenyl)methyl]carbamate was prepared from 4-aminobenzylamine (2 g, 16.37 mmol). Yield: 3.275g (90%) of the title

compound as a white powder. ESI-MS: 223.3 (M+H)⁺.

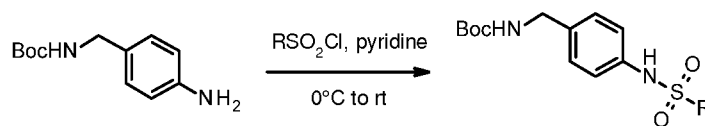
Tert-butyl N-[(3-hydroxyphenyl)methyl]carbamate was prepared from 3-(aminomethyl)phenol (1 g, 8.12 mmol). Yield: 1.281g (70%) of the title compound as a yellow oil. ¹H NMR (300 MHz, CDCl₃) δ 7.17 (t, *J* = 7.8 Hz, 1H), 6.81-6.72 (m, 3H), 4.89 (bs, 1H), 4.25 (s, 2H), 1.46 (s, 9H).

Tert-butyl N-[(4-hydroxyphenyl)methyl]carbamate was prepared from 4-hydroxybenzylamine (2 g, 16.24 mmol). Yield: 3.17g (87%) of the title compound as a colorless oil. ¹H NMR (300 MHz, CDCl₃) δ 7.08 (d, *J* = 8.1 Hz, 2H), 6.89-6.74 (m, 2H), 4.87 (bs, 1H), 4.20 (s, 2H), 1.46 (s, 9H).

Tert-butyl N-[(3-iodophenyl)methyl]carbamate was prepared from 3-iodobenzylamine (1.18 g, 5.06 mmol). Yield: 1.42g (84%) of the title compound as a white powder.

Tert-butyl N-[(4-iodophenyl)methyl]carbamate was prepared from 4-iodobenzylamine (967 mg, 4.15 mmol). Yield: 1.25g (91%) of the title compound as a white powder.

Preparation of 4-benzylaminesulfonamide derivatives "inverse"



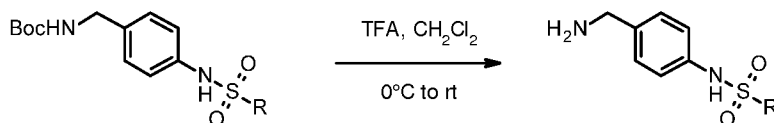
To a stirred solution of *tert*-butyl N-[(4-aminophenyl)methyl]carbamate (300 mg, 1.35 mmol) in dry pyridine (2.7 mL), the appropriate sulfonyl chloride (1.2 equiv.) was added dropwise at 0°C under azote atmosphere. The reaction mixture was stirred at room temperature until completion. The mixture was then diluted with ethyl acetate and washed with saturated aqueous solution of ammonium chloride. The organic layer was dried over Na₂SO₄, filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound.

The following compounds are examples illustrating this procedure:

Tert-butyl N-[[4-(methanesulfonamido)phenyl]methyl]carbamate was prepared from *tert*-butyl N-[(4-aminophenyl)methyl]carbamate. Yield: 405 mg (100%) of the title compound as a light brown powder. ESI-MS: 299.4 (M-H)⁻.

Tert-butyl N-[[4-(isobutylsulfonylamino)phenyl]methyl]carbamate was prepared from *tert*-butyl N-[(3-aminophenyl)methyl]carbamate. Yield: 446 mg (97%) of the title compound as a white powder. ESI-MS: 341.4 (M-H)⁺.

Tert-butyl N-[[4-(benzenesulfonamido)phenyl]methyl]carbamate was prepared from *tert*-butyl N-[(4-aminophenyl)methyl]carbamate. Yield: 450 mg (92%) of the title compound as a white powder. ESI-MS: 361.4 (M-H)⁺.



To a stirred solution of carbamate (1 equiv.) in dry DCM TFA (13 equiv.) was added at 0°C. The reaction mixture was stirred at room temperature for 2h. The mixture was quenched with a saturated aqueous solution of sodium bicarbonate and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum to provide the expected compound which was used without further purification.

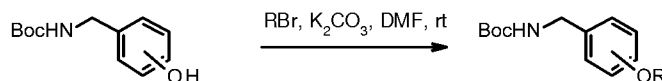
The following compounds are examples illustrating this procedure:

N-[4-(aminomethyl)phenyl]methanesulfonamide was prepared from *tert*-butyl N-[[4-(methanesulfonamido)phenyl]methyl]carbamate (230 mg, 0.77 mmol). Yield: 128 mg (84%) of the title compound as a yellow powder.

N-[4-(aminomethyl)phenyl]-2-methyl-propane-1-sulfonamide was prepared from *tert*-butyl N-[[4-(isobutylsulfonylamino)phenyl]methyl]carbamate (260 mg, 0.76 mmol). Yield: 190 mg (100%) of the title compound as a white powder.

N-[4-(aminomethyl)phenyl]benzenesulfonamide was prepared from *tert*-butyl N-[[4-(benzenesulfonamido)phenyl]methyl]carbamate (275 mg, 0.76 mmol). Yield: 170 mg (85%) of the title compound as a white powder.

Preparation of 3 and 4-alkoxybenzylamine derivatives



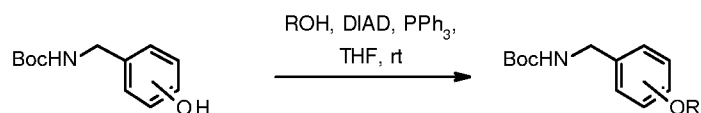
To a stirred solution of phenol (300 mg, 1.34 mmol) in DMF (13 mL), K₂CO₃ (557 mg, 4.03 mmol) was added under azote atmosphere. The

appropriate alkyl bromide (1.1 equiv.) was then added and the reaction mixture was stirred at room temperature for 48h. The mixture was concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound.

5 The following compounds are examples illustrating this procedure:

Tert-butyl N-[(3-isopentyloxyphenyl)methyl]carbamate was prepared from *tert*-butyl N-[(3-hydroxyphenyl)methyl]carbamate (300 mg, 1.34 mmol). Yield: 346 mg (88%) of the title compound as a colorless oil. ESI-MS: 294.2 (M+H)⁺.

10 *Tert*-butyl N-[(4-isopentyloxyphenyl)methyl]carbamate was prepared from *tert*-butyl N-[(4-hydroxyphenyl)methyl]carbamate (500 mg, 2.24 mmol). Yield: 565 mg (86%) of the title compound as a colorless oil.



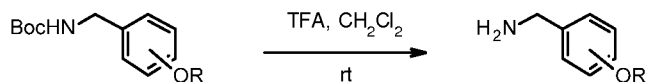
To a stirred solution of phenol (200 mg, 0.90 mmol) in dry THF (7 mL), triphenylphosphine (470 mg, 1.79 mmol) was added under azote atmosphere. The mixture was cooled and the corresponding alcohol (2 equiv.) was added. DIAD (0.353 mL, 1.79 mmol) was then added dropwise and the reaction mixture was stirred at room temperature overnight. The mixture was concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) provide afford the expected compound.

15 20

The following compounds are examples illustrating this procedure:

Tert-butyl N-[(3-isobutoxyphenyl)methyl]carbamate was prepared from *tert*-butyl N-[(3-hydroxyphenyl)methyl]carbamate (200 mg, 0.90 mmol). Yield: 145 mg (58%) of the title compound as a yellow oil. ESI-MS: 280.2 (M+H)⁺.

25 *Tert*-butyl N-[(4-isobutoxyphenyl)methyl]carbamate was prepared from *tert*-butyl N-[(4-hydroxyphenyl)methyl]carbamate (500 mg, 2.24 mmol). Yield: 503 mg (80%) of the title compound as a white powder.



To a stirred solution of carbamate (1 equiv.) in dry DCM, TFA (10

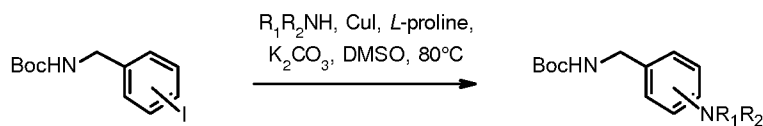
equiv.) was added. The reaction mixture was stirred at room temperature for 2h. The mixture was quenched with a saturated aqueous solution of sodium bicarbonate and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum to provide the expected compound which was used without further purification.

The following compounds are examples illustrating this procedure:

(3-isopentyloxyphenyl)methanamine was prepared from *tert*-butyl N-[(3-isopentyloxyphenyl)methyl]carbamate (346 mg, 1.18 mmol). Yield: 228 mg (100%) of the title compound as a yellow oil.

(4-isopentyloxyphenyl)methanamine was prepared from *tert*-butyl N-[(4-isopentyloxyphenyl)methyl]carbamate (200 mg, 0.72 mmol). Yield: 120 mg (100%) of the title compound as a colorless oil.

Preparation of 3 and 4-alkylaminobenzylamine derivatives

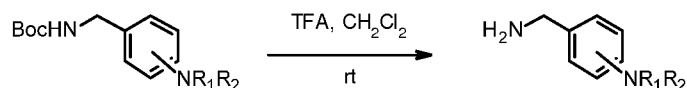


A mixture of a iodo derivative (300 mg, 0.90 mmol), CuI (26 mg, 0.14 mmol), *L*-proline (26 mg, 0.23 mmol), K₂CO₃ (498 mg, 3.60 mmol), the appropriate amine (4 equiv.) in DMSO (6 mL) under azote atmosphere was stirred at 80°C until completion. Water was added and product was extracted with EtOAc. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude was then purified by flash column chromatography (cyclohexane/EtOAc) to afford the expected compound.

The following compounds are examples illustrating this procedure:

Tert-butyl N-[(3-pyrrolidin-1-ylphenyl)methyl]carbamate was prepared from *tert*-butyl N-[(3-iodophenyl)methyl]carbamate (300 mg, 0.90 mmol). Yield: 205 mg (82%) of the title compound as a white powder. ESI-MS: 277.2 (M+H)⁺.

Tert-butyl N-[(4-pyrrolidin-1-ylphenyl)methyl]carbamate was prepared from *tert*-butyl N-[(4-iodophenyl)methyl]carbamate (300 mg, 0.90 mmol). Yield: 229 mg (92%) of the title compound as a white powder.



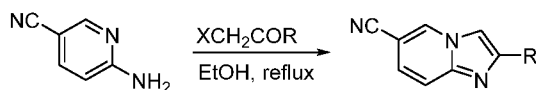
To a stirred solution of carbamate (1 equiv.) in dry DCM TFA (10 equiv.) was added. The reaction mixture was stirred at room temperature for 2h. The mixture was quenched with a saturated aqueous solution of sodium bicarbonate and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum to provide the expected compound which was used without further purification.

The following compounds are examples illustrating this procedure:

(3-pyrrolidin-1-ylphenyl)methanamine was prepared from *tert*-butyl N-[(3-pyrrolidin-1-ylphenyl)methyl]carbamate (203 mg, 0.74 mmol). Yield: 130 mg (100%) of the title compound as a brown oil.

(4-pyrrolidin-1-ylphenyl)methanamine was prepared from *tert*-butyl N-[(4-pyrrolidin-1-ylphenyl)methyl]carbamate (150 mg, 0.54 mmol). Yield: 100 mg (100%) of the title compound as a yellow oil.

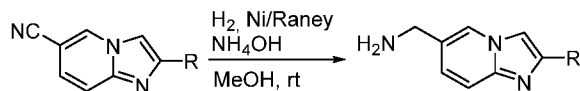
Preparation of imidazo[1,2-a]pyridine benzylamine derivatives



Imidazo[1,2-a]pyridine-6-carbonitrile: To a solution of 6-aminonicotinonitrile (2.38 g, 20 mmol) in absolute EtOH (50 mL), was added the chloroacetaldehyde (50% in water, 12.7 mL, 100 mmol). The reaction was refluxed for 5h and then concentrated. The resulting yellow solid was dissolved in water (20 mL) and saturated NaHCO₃ solution was added until precipitation (pH = 8). The precipitate was then collected and dried over KOH to afford the title compound (1.56 g, 55%) as a yellow powder. ESI-MS: 144.2 (M+H)⁺.

2-phenylimidazo[1,2-a]pyridine-6-carbonitrile: To a solution of 6-aminonicotinonitrile (1.12 g, 10 mmol) in absolute EtOH (50 mL), was added the 2-bromoacetophenone (1.99 g, 10 mmol). The reaction was refluxed for 24h (conversion 50%) and then concentrated. The resulting yellow solid was dissolved in water and saturated NaHCO₃ solution was added until precipitation (pH = 8). The precipitate was then collected and dried over KOH

to afford a beige solid. The mother liquid was concentrated and purified by flash column chromatography (0-50% EtOAc in cyclohexane) to give the title compound (654 mg, 30%).

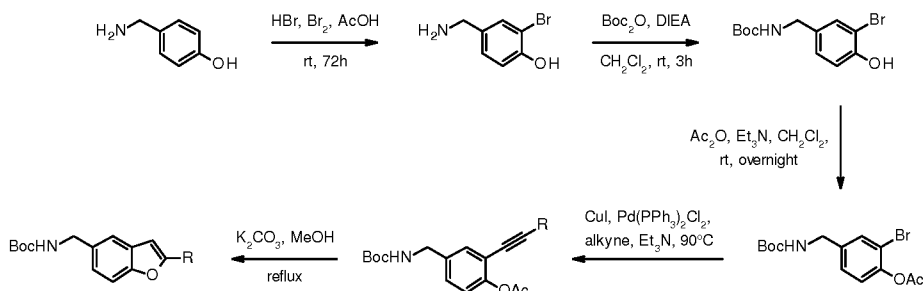


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To a stirred solution of imidazo[1,2-a]pyridine-6-carbonitrile analogue (2 mmol) in MeOH (5 mL), Raney nickel (slurry in water, 1g) and aqueous ammonia (2 mL) were added under azote atmosphere. Hydrogen gas was bubbled through the reaction mixture for 10 min and the mixture was stirred overnight under hydrogen atmosphere. The mixture was passed carefully through a plug of celite and concentrated to yield the expected compound in a quantitative yield.

10

Preparation of benzofuran derivatives



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To a suspension of 4-hydroxybenzylamine (1 g, 8.12 mmol) in AcOH, HBr (33% in AcOH, 4 mL) and a solution of Br₂ (0.458 mL, 8.93 mmol) in AcOH (2.8 mL) were successively added over 1h. The reaction mixture was stirred at room temperature for 48h. The precipitate was filtered and washed several times with AcOH and Et₂O to obtain 4-(aminomethyl)-2-bromophenol.HBr as a white powder (1.785 g , 78%). ¹H NMR (300 MHz, DMSO-*d*₆) δ 10.45 (s, 1H), 8.06 (bs, 3H), 7.63 (d, *J* = 2.1 Hz, 1H), 7.26 (dd, *J* = 8.4, 2.1 Hz, 1H), 6.97 (d, *J* = 8.4 Hz, 1H), 3.93-3.89 (m, 2H).

20

To a stirred solution of the previous intermediate (1.755 g, 6.20 mmol) in dry DCM (20 mL) diisopropylethylamine (3.24 mL, 18.61 mmol) and di-*tert*-

25

butyl dicarbonate (1.57 mL, 6.82 mmol) were added under azote atmosphere. The reaction mixture was stirred at room temperature for 3h. Water was added and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide *tert*-butyl N-[(3-bromo-4-hydroxyphenyl)methyl]-carbamate as a colorless oil (1.795 g, 95%). ESI-MS: 301.9-303.9 (M+H)⁺.

To a stirred solution of the previous intermediate (1.795 g, 5.94 mmol) in dry DCM (35 mL) triethylamine (2.49 mL, 17.82 mmol) and acetic anhydride (0.62 mL, 6.53 mmol) were added under azote atmosphere. The reaction mixture was stirred overnight at room temperature. Water was added and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to afford [2-bromo-4-[(*tert*-butoxycarbonylamino)methyl]phenyl] acetate as a white powder (1.780 g, 87%). ESI-MS: 341.9-343.9 (M-H)⁻.

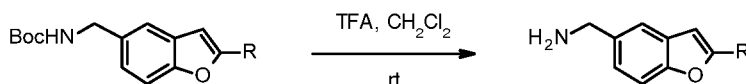
To a mixture of the previous intermediate (1 g, 2.91 mmol), CuI (55 mg, 0.29 mmol), Pd(PPh₃)₂Cl₂ (102 mg, 0.15 mmol), the appropriate alkyne (1.5 equiv.) in Et₃N (10 mL) were added under azote atmosphere and stirred at 90°C until completion. The mixture was concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound. The coupling product was dissolved in MeOH (15 mL) and K₂CO₃ (1.5 equiv.) was added and the mixture was stirred under reflux until completion. Water was added and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound.

The following compounds are examples illustrating this procedure:

Tert-butyl N-[(2-cyclopropylbenzofuran-5-yl)methyl]carbamate was prepared from [2-bromo-4-[(*tert*-butoxycarbonylamino)methyl]phenyl] acetate (1 g, 2.91 mmol). Yield: 238 mg (29%) of the title compound as a white powder. ¹H NMR

(300 MHz, CDCl₃) δ 7.35 (d, J = 1.5 Hz, 1H), 7.30 (d, J = 8.4 Hz, 1H), 7.09 (dd, J = 8.4, 1.5 Hz, 1H), 6.31 (s, 1H), 4.81 (bs, 1H), 4.35 (s, 2H), 2.06-1.97 (m, 1H), 1.46 (s, 9H), 1.00-0.93 (m, 4H).

Tert-butyl N-[(2-phenylbenzofuran-5-yl)methyl]carbamate was prepared from [2-bromo-4-[(*tert*-butoxycarbonylamino)methyl]phenyl] acetate (1 g, 2.91 mmol). Yield: 226 mg (24%) of the title compound as a white powder. ¹H NMR (300 MHz, CDCl₃) δ 7.88-7.85 (m, 2H), 7.50-7.42 (m, 4H), 7.38-7.33 (m, 1H), 7.20 (dd, J = 8.4, 1.5 Hz, 1H), 6.99 (d, J = 0.6 Hz, 1H), 4.86 (bs, 1H), 4.39 (s, 2H), 1.48 (s, 9H).



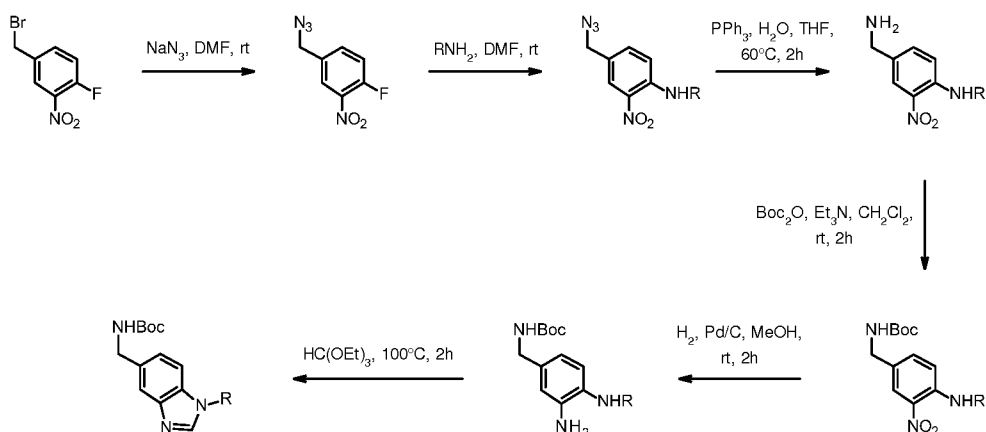
To a stirred solution of benzofuran (1 equiv.) in dry DCM, TFA (10 equiv.) was added. The reaction mixture was stirred at room temperature for 2h. The mixture was quenched with a saturated aqueous solution of sodium bicarbonate and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum to provide the expected compound which was used without further purification.

The following compounds are examples illustrating this procedure:

(2-cyclopropylbenzofuran-5-yl)methanamine was prepared from *tert*-butyl N-[(2-cyclopropylbenzofuran-5-yl)methyl]carbamate (185 mg, 0.64 mmol). Yield: 122 mg (100%) of the title compound as a yellow oil.

(2-phenylbenzofuran-5-yl)methanamine was prepared from *tert*-butyl N-[(2-phenylbenzofuran-5-yl)methyl]carbamate (150 mg, 0.46 mmol). Yield: 105 mg (100%) of the title compound as a white powder.

Preparation of benzimidazole derivatives



To a stirred solution of 4-fluoro-3-nitrobenzyl bromide (1 g, 4.27 mmol) in DMF (34 mL) sodium azide (333 mg, 5.13 mmol) was added under azote atmosphere. The reaction mixture was stirred overnight at room temperature. Water was added and the product was extracted with EtOAc. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum to provide 4-(azidomethyl)-1-fluoro-2-nitrobenzene as an orange oil. The compound was used without further purification.

To a stirred solution of the previous intermediate (912 mg) in DMF (35 mL), isopropylamine (0.55 mL, 6.41 mmol) was added under azote atmosphere. The reaction mixture was stirred at room temperature until completion. Water was added and the product was extracted with EtOAc. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound as an orange oil (745 mg, 74%, 2 steps). ESI-MS: 236.2 (M+H)⁺.

To a mixture of the previous intermediate (733 mg, 3.12 mmol), PPh₃ (1.06 g, 4.05 mmol), H₂O (0.43 mL) and THF (20 mL) was added and stirred at 60°C for 2h. The mixture was concentrated under vacuum. The crude mixture was then purified by flash column chromatography (DCM/MeOH) to provide the expected compound as an orange oil (565 mg, 87%).

To a stirred solution of the previous intermediate (565 mg, 2.70 mmol) in dry DCM (18 mL) triethylamine (0.83 mL, 5.94 mmol) and di-*tert*-butyl dicarbonate (0.62 mL, 2.70 mmol) were added under azote atmosphere. The

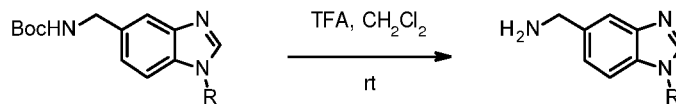
reaction mixture was stirred at room temperature for 2h. Water was added and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound as an orange powder (800 mg, 96%).

To a mixture of the previous intermediate (800 mg, 2.59 mmol) in MeOH (20 mL), 10% Pd/C (80 mg) was added. After stirring under a hydrogen atmosphere for 3h, the reaction mixture was filtered through a pad of Celite, rinsed with MeOH, and concentrated under reduced pressure to provide the expected compound as purple oil which was used without further purification.

A mixture of the previous intermediate (753 mg) and triethyl orthoformate (13 mL) was stirred at 100°C for 2h. The mixture was concentrated under vacuum. The crude mixture was then purified by flash column chromatography (DCM/MeOH) to provide *tert*-butyl N-[(1-isopropylbenzimidazol-5-yl)methyl]carbamate as white powder (653 mg, 87%, 2 steps). ¹H NMR (300 MHz, CDCl₃) δ 8.19 (s, 1H), 7.74 (s, 1H), 7.42 (d, *J* = 8.4 Hz, 1H), 7.30 (d, *J* = 8.4 Hz, 1H), 4.67 (sept, *J* = 6.6 Hz, 1H), 4.44 (d, *J* = 5.7 Hz, 2H), 1.64 (d, *J* = 6.6 Hz, 6H), 1.46 (s, 9H).

The following compound is an example illustrating this procedure:

Tert-butyl N-[(1-methylbenzimidazol-5-yl)methyl]carbamate: light brown powder. ¹H NMR (300 MHz, CDCl₃) δ 8.03 (s, 1H), 7.70 (s, 1H), 7.36 (d, *J* = 8.4 Hz, 1H), 7.29 (d, *J* = 8.4 Hz, 1H), 4.43 (d, *J* = 5.7 Hz, 2H), 3.86 (s, 3H), 1.46 (s, 9H).



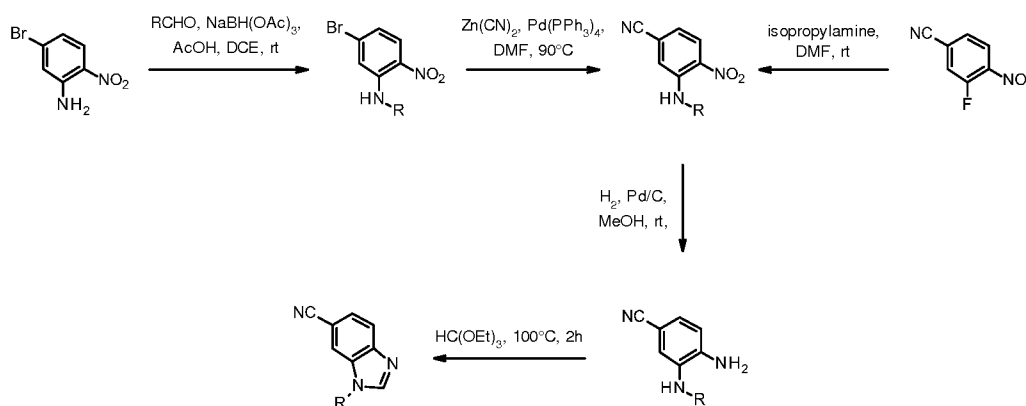
To a stirred solution of the protected benzimidazole (1 equiv.) in dry DCM TFA (10 equiv.) was added. The reaction mixture was stirred at room temperature for 2h. The mixture was quenched with a saturated aqueous solution of sodium bicarbonate and the product was extracted with DCM. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum to provide the expected compound which was used without further

purification.

The following compounds are examples illustrating this procedure:

(1-isopropylbenzimidazol-5-yl)methanamine was prepared from *tert*-butyl N-[(1-isopropylbenzimidazol-5-yl)methyl]carbamate (200 mg, 0.64 mmol). Yield: 131 mg (100%) of the title compound as a brown oil.

(1-methylbenzimidazol-5-yl)methanamine was prepared from *tert*-butyl N-[(1-methylbenzimidazol-5-yl)methyl]carbamate (150 mg, 0.57 mmol). Yield: 160 mg (87%) of the title compound as a light brown powder.



To a suspension of 5-bromo-2-nitroaniline (100 mg, 0.46 mmol) in DCE (1.2 mL) and AcOH (0.16 mL, 2.72 mmol) the appropriate aldehyde (1.9 equiv.) was added under azote atmosphere. $\text{NaBH}(\text{OAc})_3$ (273 mg, 1.29 mmol) was added and the reaction mixture was stirred at room temperature until completion. The mixture was quenched with a saturated aqueous solution of sodium bicarbonate and the product was extracted with DCM. The organic layers were dried over Na_2SO_4 , filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound.

The following compounds are examples illustrating this procedure:

5-bromo-N-isopentyl-2-nitroaniline was prepared from 5-bromo-2-nitroaniline (100 mg, 0.46 mmol). Yield: 126 mg (95%) of the title compound as a yellow oil. ESI-MS: 286.9-288.9 ($\text{M}+\text{H}^+$).

5-bromo-N-isobutyl-2-nitroaniline was prepared from 5-bromo-2-nitroaniline

(600 mg, 2.76 mmol). Yield: 426 mg (56%) of the title compound as a red oil. ESI-MS: 273.0-275.0 (M+H)⁺.

To a stirred solution of the previous intermediate (426 mg, 1.56 mmol) in DMF (6.6 mL) zinc cyanide (238 mg, 2.03 mmol) was added under azote atmosphere. Pd(PPh₃)₄ (180 mg, 0.16 mmol) was added and the reaction mixture was stirred overnight at 90°C. The mixture was concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound.

The following compounds are examples illustrating this procedure:

3-isopentylamino-4-nitrobenzonitrile was prepared from 5-bromo-N-isopentyl-2-nitroaniline (602 mg, 2.10 mmol). Yield: 440 mg (90%) of the title compound as an orange powder. ESI-MS: 234.1 (M+H)⁺.

3-isobutylamino-4-nitrobenzonitrile was prepared from 5-bromo-N-isobutyl-2-nitroaniline (426 mg, 1.56 mmol). Yield: 315 mg (92%) of the title compound as red powder.

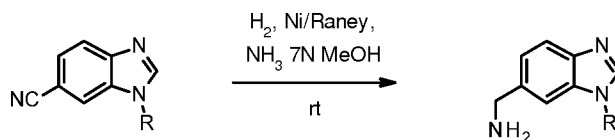
3-isopropylamino-4-nitrobenzonitrile: To a stirred solution of 3-fluoro-4-nitrobenzonitrile (500 mg, 3.01 mmol) in DMF (7 mL), isopropylamine (0.39 mL, 4.51 mmol) was added under azote atmosphere. The reaction mixture was stirred at room temperature until completion. Water was added and the product was extracted with EtOAc. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound as a red powder. ESI-MS: 205.2 (M+H)⁺.

To a mixture of nitrobenzonitrile (440 mg, 1.89 mmol) in MeOH (15 mL), 10% Pd/C (44 mg) was added. After stirring overnight under a hydrogen atmosphere, the reaction mixture was filtered through a pad of Celite, rinsed with MeOH, and concentrated under reduced pressure to afford the expected compound as a light brown powder which was used without further purification. This intermediate and triethyl orthoformate (9.5 mL) was stirred at 100°C for 2h. The mixture was concentrated under vacuum. The crude mixture was then purified by flash column chromatography (DCM/MeOH) to provide the expected compound.

The following compounds are examples illustrating this procedure:

3-isopentylbenzimidazole-5-carbonitrile was prepared from 3-isopentylamino-4-nitrobenzonitrile (440 mg, 1.44 mmol). Yield: 266 mg (93% 2 steps) of the title compound as light brown powder. ESI-MS: 214.2 (M+H)⁺.

5 3-isobutylbenzimidazole-5-carbonitrile was prepared from 3-isobutylamino-4-nitrobenzonitrile (315 mg, 1.89 mmol). Yield: 341 mg (85% 2 steps) of the title compound as light brown powder. ESI-MS: 200.2 (M+H)⁺.



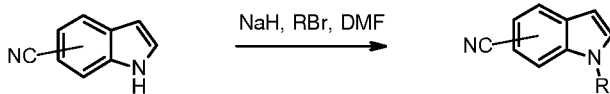
To a mixture of benzimidazole (190 mg, 0.89 mmol) in ammonia (solution 7N in MeOH, 9 mL) Raney nickel (slurry in water, 1g) was added. After stirring overnight under a hydrogen atmosphere, the reaction mixture was filtered through a pad of Celite, rinsed with MeOH, and concentrated under reduced pressure to provide the expected compound which was used without further purification.

The following compounds are examples illustrating this procedure:

(3-isopentylbenzimidazol-5-yl)methanamine was prepared from 3-isopentylbenzimidazole-5-carbonitrile (190 mg, 0.89 mmol). Yield: 195 mg (100%) of the title compound as a green oil.

(3-isobutylbenzimidazol-5-yl)methanamine was prepared from 3-isobutylbenzimidazole-5-carbonitrile (175 mg, 0.88 mmol). Yield: 180 mg (100%) of the title compound as an orange oil.

Preparation of indole derivatives



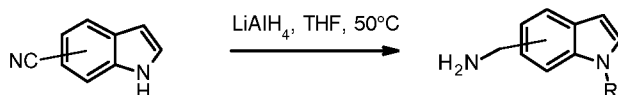
To a stirred solution of indole (500 mg, 3.52 mmol) in DMF (8.7 mL), NaH (60% in mineral oil, 211 mg, 5.28 mmol) was added under azote atmosphere. The reaction mixture was stirred at 50°C for 1h. The mixture was cooled to room temperature and the appropriate alkyl bromide (1.5 equiv.) was

added. The reaction mixture was stirred at room temperature overnight. Water was added and the product was extracted with EtOAc. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum. The crude mixture was then purified by flash column chromatography (cyclohexane/EtOAc) to provide the expected compound.

The following compounds are examples illustrating this procedure:

1-isobutylindole-5-carbonitrile was prepared from 5-cyanoindole (500 mg, 3.52 mmol). Yield: 680 mg (98%) of the title compound as a colorless oil. ESI-MS: 199.2 (M+H)⁺.

1-isobutylindole-6-carbonitrile was prepared from 6-cyanoindole (500 mg, 3.52 mmol). Yield: 645 mg (92%) of the title compound as a colorless oil. ¹H NMR (300 MHz, CDCl₃) δ 7.68-7.65 (m, 2H), 7.31 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.26 (m, 1H), 6.55 (dd, *J* = 3.3, 0.9 Hz, 1H), 3.94 (d, *J* = 7.2 Hz, 2H), 2.19 (sept, *J* = 6.6 Hz, 1H), 0.93 (d, *J* = 6.6 Hz, 6H).



To a stirred solution of indole (120 mg, 0.61 mmol) in dry THF (1 mL), LiAlH₄ (1M THF, 1.21 mL, 1.21 mmol) was added under azote atmosphere. The reaction mixture was stirred overnight at 50°C. The mixture was quenched with a 10% aqueous solution of sodium hydroxide and the product was extracted with EtOAc. The organic layers were dried over Na₂SO₄, filtered and concentrated under vacuum to provide the expected compound which was used without further purification.

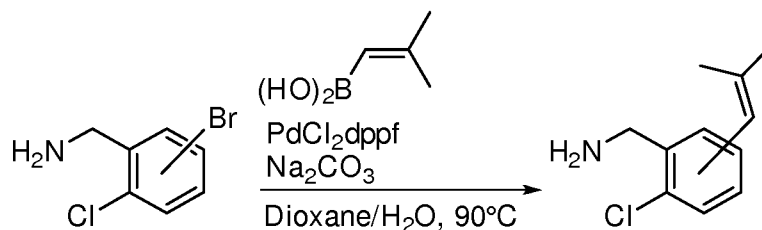
The following compounds are examples illustrating this procedure:

(1-isobutylindol-5-yl)methanamine was prepared from 1-isobutylindole-5-carbonitrile (120 mg, 0.61 mmol). Yield: 122 mg (100%) of the title compound as a green oil.

(1-isobutylindol-6-yl)methanamine was prepared from 1-isobutylindole-6-carbonitrile (200 mg, 1.01 mmol). Yield: 204 mg (100%) of the title compound as a green oil.

Preparation of 2-chloro-3-isopropylbenzylamine and 2-chloro-5-

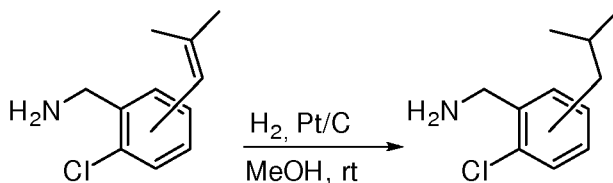
isopropylbenzylamine



To a stirred solution of 2-chloro-X-bromobenzylamine derivative (1 equiv.) in dioxane/water (6/1, 5 mL/mmol) under azote atmosphere, were added sodium carbonate (2 equiv.), 2,2-dimethylethenylboronic acid (1.1 equiv.) and 1,1'-bis(diphenylphosphino)ferrocene-palladium(II)dichloride dichloromethane complex (0.1 equiv.). The reaction mixture was warmed to 90°C overnight. Then, the reaction mixture was partitioned between EtOAc and H_2O . The layers were separated and the aqueous layer was extracted twice with EtOAc. The combined organic layers were dried over Na_2SO_4 and concentrated. Purification of the crude was achieved by flash column chromatography (0-10% MeOH in DCM) to give the expected compound.

[2-chloro-5-(2-methylprop-1-enyl)phenyl]methanamine was prepared from (5-bromo-2-chloro-phenyl)methanamine (500 mg, 2.27 mmol). Yield: 248 mg (56%) of the title compound as a dark oil. ESI-MS: 196.2 ($\text{M}+\text{H}$)⁺.

[2-chloro-3-(2-methylprop-1-enyl)phenyl]methanamine was prepared from (3-bromo-2-chloro-phenyl)methanamine (500 mg, 2.27 mmol). Yield: 326 mg (73%) of the title compound as a dark oil. ESI-MS: 196.2 ($\text{M}+\text{H}$)⁺.



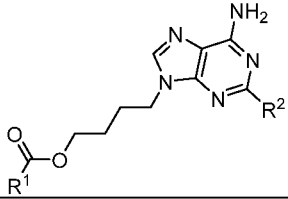
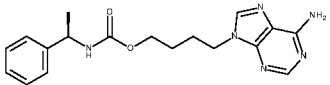
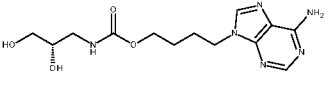
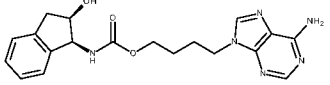
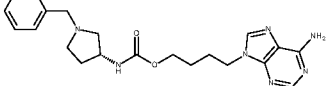
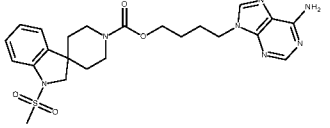
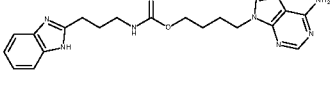
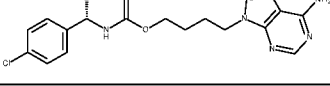
To a stirred solution of the alkene derivative (1 equiv.) in MeOH (10 mL/mmol), was added 10% platinum on carbon (~30 wt %) under azote atmosphere. Hydrogen gas was bubbled through the reaction mixture for 10 min and the mixture was stirred under hydrogen atmosphere over weekend.

The mixture was passed through a plug of celite and the solvent was removed under reduced pressure to afford the saturated compound which was used without further purification.

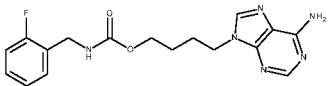
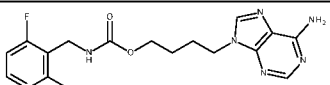
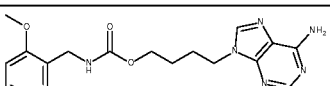
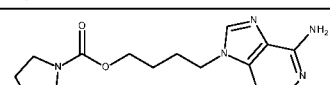
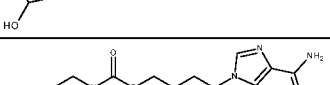
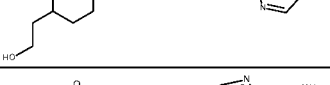
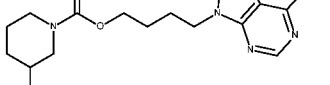
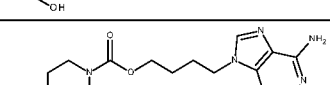
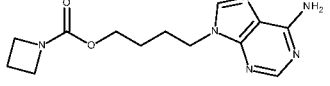
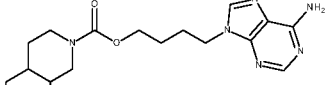
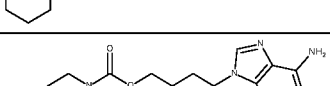
(2-chloro-5-isobutyl-phenyl)methanamine was prepared from [2-chloro-5-(2-methylprop-1-enyl)phenyl]methanamine (248 mg, 1.27 mmol). Yield: 205 mg (82%) of the title compound as a yellow oil. ESI-MS: 198.2 (M+H)⁺.

(2-chloro-3-isobutyl-phenyl)methanamine was prepared from [2-chloro-3-(2-methylprop-1-enyl)phenyl]methanamine (326 mg, 1.67 mmol). Yield: 275 mg (83%) of the title compound as a brown oil. ESI-MS: 198.2 (M+H)⁺.

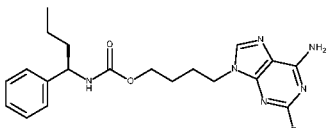
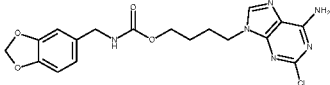
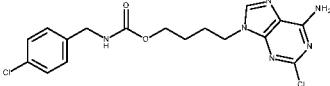
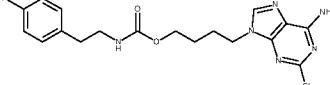
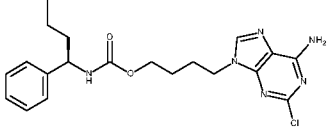
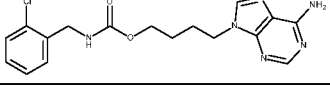
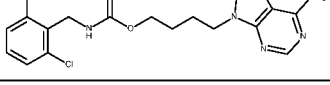
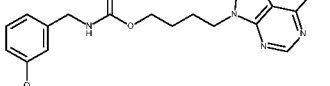
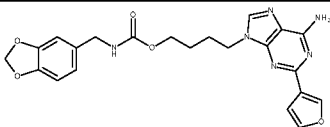
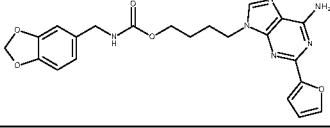
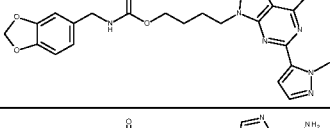
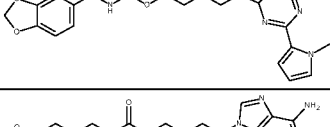
Table 1: Examples of compounds

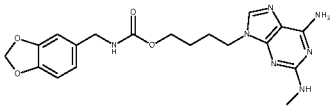
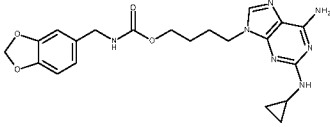
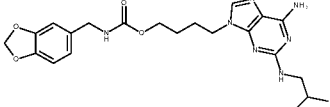
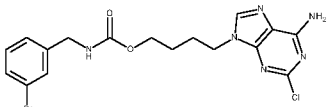
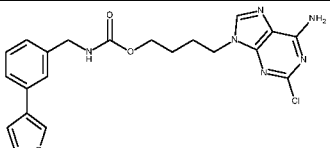
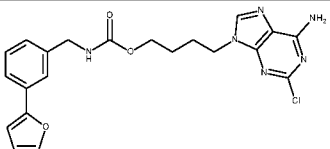
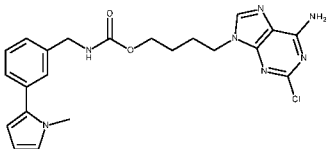
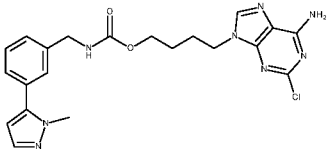
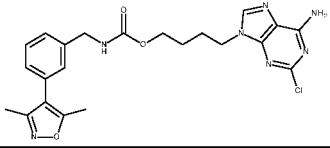
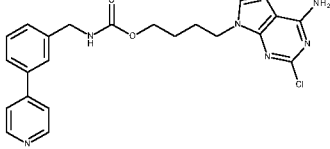
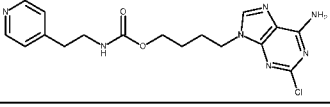
N°	Structure		
		Substituent R ¹	Substituent R ²
1		(1 <i>R</i>)-1-(4-chlorophenyl)ethanamine	H
2		(2 <i>S</i>)-3-aminopropane-1,2-diol	H
3		(1 <i>S</i> ,2 <i>R</i>)-1-aminoindan-2-ol	H
4		(3 <i>R</i>)-1-benzylpyrrolidin-3-amine	H
5		1-methylsulfonylspiro [indoline-3,4'-piperidine]	H
6		3-(1 <i>H</i> -benzimidazol-2-yl)propan-1-amine	H
7		(1 <i>S</i>)-1-(4-chlorophenyl)ethanamine	H

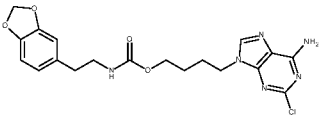
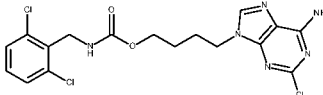
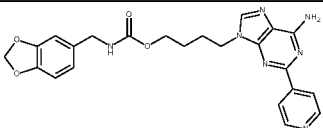
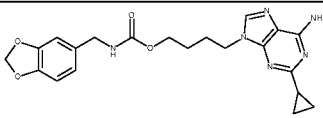
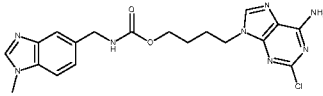
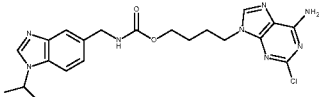
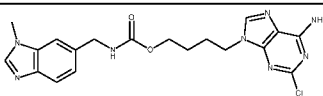
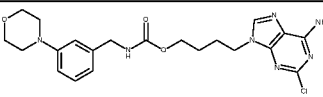
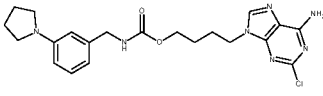
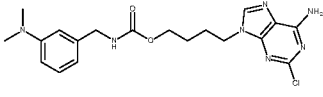
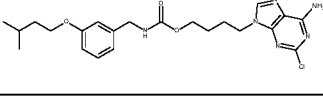
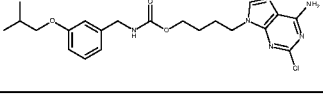
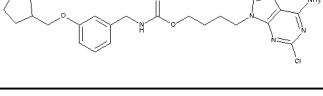
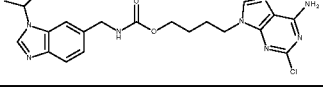
8		(4-chlorophenyl) methanamine	H
9		(1 <i>R</i>)-1-phenyl ethanamine	H
10		phenylmethanamine	H
11		2-(2-pyridyl)ethanamine	H
12		2-(4-fluorophenyl) ethanamine	H
13		1-[4-(1-piperidyl)phenyl] ethanamine	H
14		(1 <i>R</i>)-1-(4-methoxyphenyl) ethanamine	H
15		(4-phenylphenyl) methanamine	H
16		1,3-benzodioxol-5-yl methanamine	H
17		(1 <i>R</i>)-1-phenylbutan-1-amine	H
18		(1 <i>R</i>)-1-(<i>p</i> -tolyl) ethanamine	H
19		(1 <i>R</i>)-1-(3-chlorophenyl) Ethanamine	H
20		(1 <i>R</i>)-1-(4-chlorophenyl) ethanamine	H
21		(1 <i>R</i>)-1-(4-chlorophenyl) ethanamine	NH ₂
22		2-methylpropan-1-amine	H

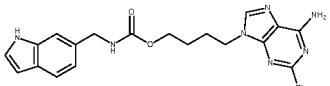
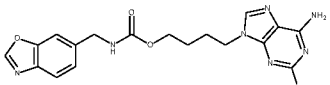
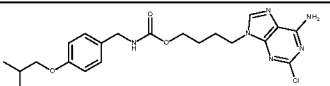
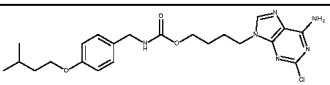
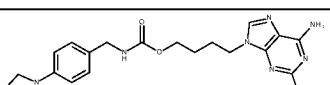
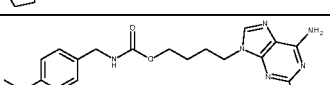
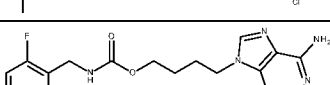
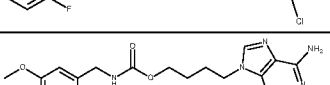
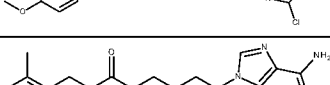
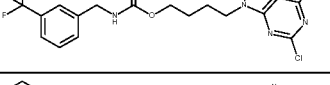
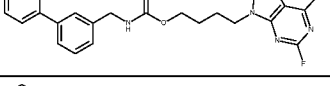
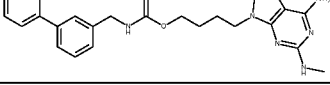
23		(2-fluorophenyl) methanamine	H
24		(2,6-difluorophenyl) methanamine	H
25		(2-methoxyphenyl) methanamine	H
26		pyrrolidin-3-ol	H
27		2-(4-piperidyl)ethanol	H
28		3-piperidylmethanol	H
29		1-(2-methoxyethyl) piperazine	H
30		azetidine	H
31		1,2,3,4,4a,5,6,7,8,8a- Decahydroisoquinoline	H
32		1-butylpiperazine	H
33		1-piperazin-1-ylethanone	H
34		1-methyl-1,4-diazepane	H

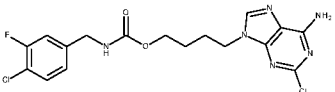
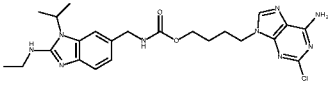
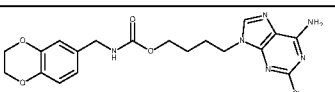
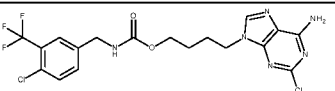
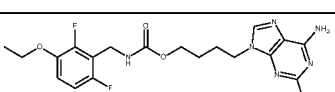
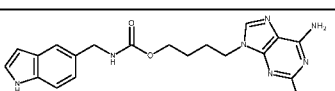
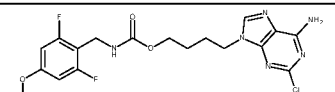
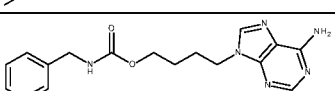
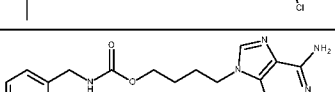
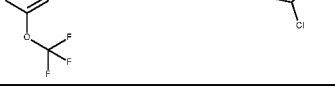
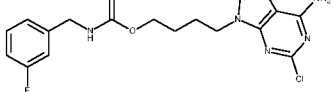
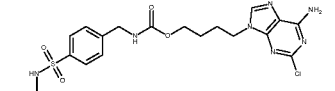
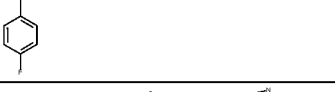
35		1,2,3,6-tetrahydropyridine	H
36		1-(cyclopropylmethyl) piperazine	H
37		4-fluoropiperidine	H
38		(3 <i>S</i>)-3-fluoropyrrolidine	H
39		(3 <i>R</i>)-3-fluoropyrrolidine	H
40		4-phenylpiperidine-4- carbonitrile	H
41		1,3-benzodioxol-5-yl methanamine	NH ₂
42		(4-chlorophenyl) methanamine	NH ₂
43		2-(4-fluorophenyl) ethanamine	NH ₂
44		(1 <i>R</i>)-1-phenylbutan-1-amine	NH ₂
45		1,3-benzodioxol-5- ylmethanamine	F
46		(4-chlorophenyl) methanamine	F
47		2-(4-fluorophenyl) ethanamine	F

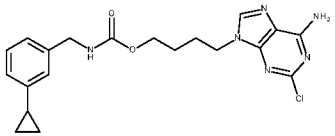
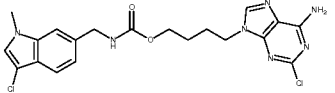
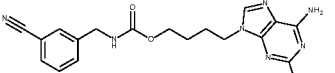
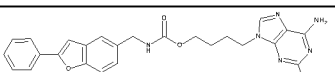
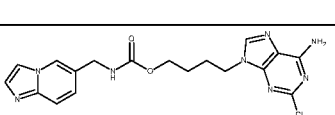
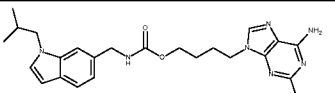
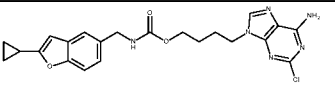
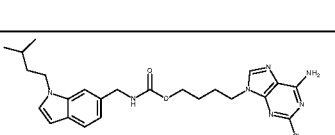
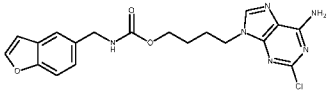
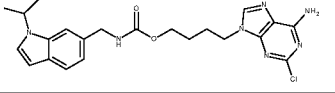
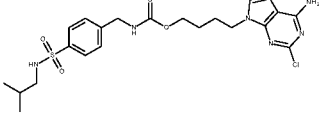
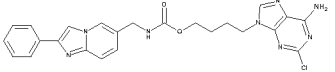
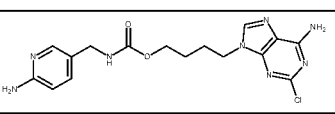
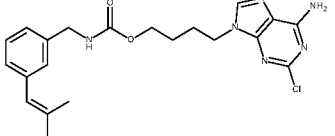
48		(1 <i>R</i>)-1-phenylbutan-1-amine	F
49		1,3-benzodioxol-5-yl methanamine	Cl
50		(4-chlorophenyl) methanamine	Cl
51		2-(4-fluorophenyl) ethanamine	Cl
52		(1 <i>R</i>)-1-phenylbutan-1-amine	Cl
53		(2-chlorophenyl) ethanamine	H
54		(2,6-dichlorophenyl) methanamine	H
55		(3-methoxyphenyl) methanamine	H
56		1,3-benzodioxol-5-ylmethanamine	furan-3-yl
57		1,3-benzodioxol-5-ylmethanamine	furan-2-yl
58		1,3-benzodioxol-5-ylmethanamine	2-methyl pyrazol-3-yl
59		1,3-benzodioxol-5-ylmethanamine	1-methyl pyrrol-2-yl
60		1,3-benzodioxol-5-ylmethanamine	3,5-dimethyl isoxazol-4-yl

61		1,3-benzodioxol-5-ylmethanamine	methyl amine
62		1,3-benzodioxol-5-ylmethanamine	cyclopropyl amine
63		1,3-benzodioxol-5-ylmethanamine	isobutyl amine
64		(3-bromophenyl)methanamine	Cl
65		[3-(3-furyl)phenyl]methanamine	Cl
66		3-(2-furyl)phenyl]methanamine	Cl
67		[3-(1-methylpyrrol-2-yl)phenyl]methanamine	Cl
68		[3-(2-methylpyrazol-3-yl)phenyl]methanamine	Cl
69		[3-(3,5-dimethylisoxazol-4-yl)phenyl]methanamine	Cl
70		[3-(4-pyridyl)phenyl]methanamine	Cl
71		2-(4-pyridyl)ethanamine	Cl

72		2-(1,3-benzodioxol-5-yl)ethanamine	Cl
73		(2,6-dichlorophenyl) methanamine	Cl
74		1,3-benzodioxol-5-ylmethanamine	4-pyridinyl
75		1,3-benzodioxol-5-ylmethanamine	cyclopropyl
76		(1-methylbenzimidazol-5-yl)methanamine	Cl
77		(1-isopropyl-benzimidazol-5-yl)methanamine	Cl
78		(3-methylbenzimidazol-5-yl)methanamine	Cl
79		(3-morpholinophenyl) Methanamine	Cl
80		(3-pyrrolidin-1-yl-phenyl) methanamine	Cl
81		3-(aminomethyl)-N,N-dimethyl-aniline	Cl
82		(3-isopentyloxyphenyl) methanamine	Cl
83		(3-isobutoxyphenyl) methanamine	Cl
84		[3-(cyclopentylmethoxy) phenyl]methanamine	Cl
85		(3-isopropyl-benzimidazol-5-yl) methanamine	Cl

86		1H-indol-6-ylmethanamine	Cl
87		1,3-benzoxazol-6-ylmethanamine	Cl
88		(4-isobutoxyphenyl) methanamine	Cl
89		(4-isopentyloxyphenyl) Methanamine	Cl
90		(4-pyrrolidin-1-ylphenyl)methanamine	Cl
91		4-(aminomethyl)-N,N-dimethyl-aniline	Cl
92		(2,6-difluorophenyl) methanamine	Cl
93		(3,4-dimethoxyphenyl) methanamine	Cl
94		(2,6-dimethylphenyl) methanamine	Cl
95		(3-chlorophenyl) methanamine	Cl
96		1,3-benzodioxol-5-ylmethanamine	dimethyl amine
97		[3-(trifluoromethyl) phenyl]methanamine	Cl
98		(3-phenylphenyl) methanamine	F
99		(3-phenylphenyl) methanamine	methyl amine
100		(4-phenylphenyl) methanamine	Cl

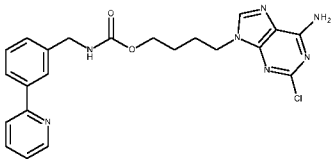
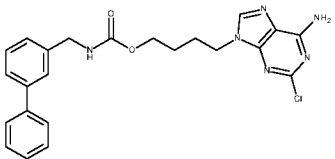
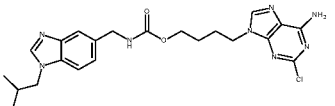
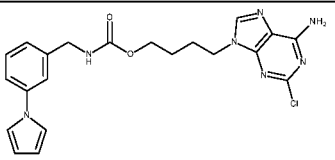
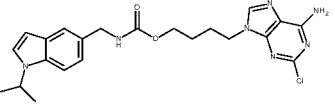
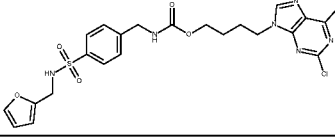
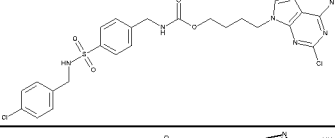
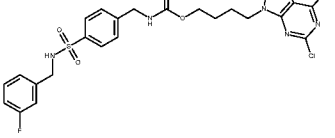
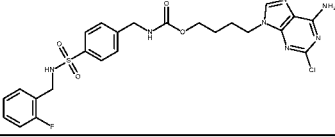
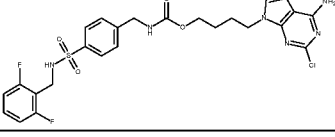
101		(4-chloro-3-fluoro-phenyl)methanamine	Cl
102		6-(aminomethyl)- <i>N</i> -ethyl-1-isopropyl-benzimidazol-2-amine	Cl
103		2,3-dihydro-1,4-benzodioxin-6-ylmethanamine	Cl
104		[4-chloro-3-(trifluoromethyl)phenyl]methanamine	Cl
105		(3-ethoxy-2,6-difluorophenyl)methanamine	Cl
106		1H-indol-5-yl methanamine	Cl
107		(4-ethoxy-2,6-difluorophenyl)methanamine	Cl
108		<i>m</i> -tolylmethanamine	Cl
109		[3-(trifluoromethoxy)phenyl]methanamine	Cl
110		(3-fluorophenyl)methanamine	Cl
111		4-(aminomethyl)- <i>N</i> -[2-(4-fluorophenyl)ethyl]benzenesulfonamide	Cl
112		(4-morphinosulfonyl phenyl)methanamine	Cl
113		[3-(trifluoromethyl)phenyl]methanamine	methylamine

114		(3-cyclopropylphenyl) methanamine	Cl
115		(3-chloro-1-methyl-indol-6-yl) methanamine	Cl
116		3-(aminomethyl) benzonitrile	Cl
117		(2-phenylbenzofuran-5-yl)methanamine	Cl
118		imidazo[1,2-a]pyridin-6-ylmethanamine	Cl
119		(1-isobutylindol-6-yl)methanamine	Cl
120		(2-cyclopropyl-benzofuran-5-yl) methanamine	Cl
121		(1-isopentylindol-6-yl)methanamine	Cl
122		benzofuran-5-ylmethanamine	Cl
123		(1-isopropylindol-6-yl) methanamine	Cl
124		4-(aminomethyl)-N-isobutyl-benzene-sulfonamide	Cl
125		(2-phenylimidazo[1,2-a]pyridin-6-yl) methanamine	Cl
126		5-(aminomethyl)pyridin-2-amine	Cl
127		[3-(2-methylprop-1-enyl)phenyl] methanamine	Cl

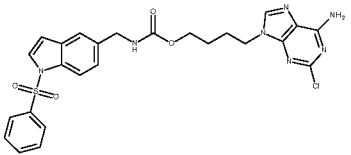
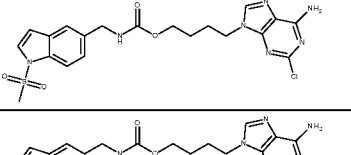
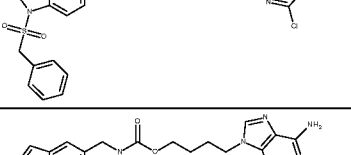
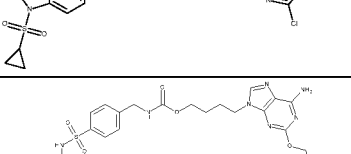
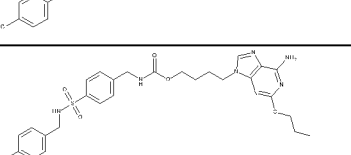
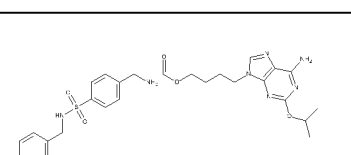
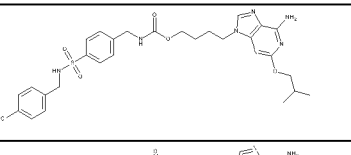
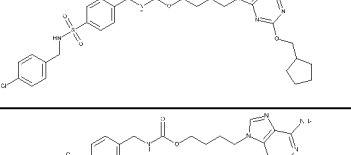
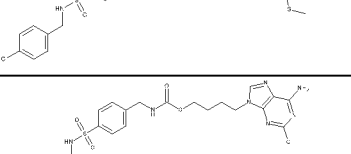
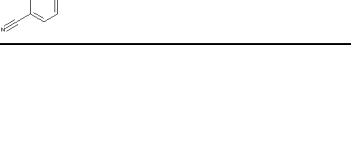
128		4-(aminomethyl)-N-methyl-benzene-sulfonamide	Cl
129		4-(aminomethyl)-N-benzyl-benzene-sulfonamide	Cl
130		4-(aminomethyl)-N-(2-morpholinoethyl) benzenesulfonamide	Cl
131		(3-isopentyl-benzimidazol-5-yl)methanamine	Cl
132		(3-isobutyl-benzimidazol-5-yl)methanamine	Cl
133		(3-isobutylphenyl) methanamine	Cl
134		4-(aminomethyl)-N-phenyl-benzene-sulfonamide	Cl
135		2-[3-(aminomethyl) phenyl]benzamide	Cl
136		2-[3-(aminomethyl) phenyl]benzonitrile	Cl
137		4-[3-(aminomethyl) phenyl]benzonitrile	Cl

138		3-[3-(aminomethyl) phenyl] benzonitrile	Cl
139		N-[4-(aminomethyl) phenyl]methane-sulfonamide	Cl
140		N-[4-(aminomethyl) phenyl]cyclohexane-sulfonamide	Cl
141		[3-(3-pyridyl)phenyl] methanamine	Cl
142		N-[4-(aminomethyl) phenyl]benzene-sulfonamide	Cl
143		N-[4-(aminomethyl) phenyl]cyclopropane-sulfonamide	Cl
144		N-[4-(aminomethyl) phenyl]-2-methyl-propane-1-sulfonamide	Cl
145		[3-(3-thienyl)phenyl] methanamine	Cl
146		3-[3-(aminomethyl)phenyl] aniline	Cl
147		(3-imidazol-1-ylphenyl) methanamine	Cl

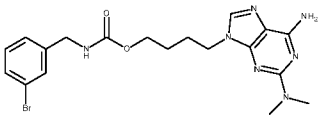
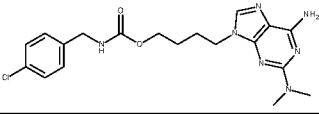
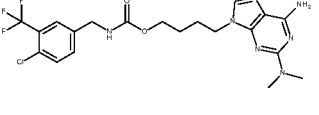
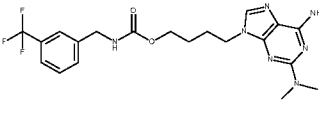
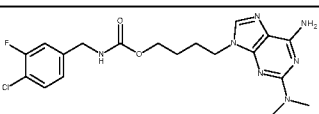
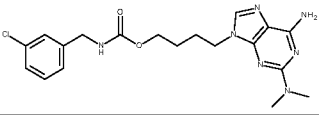
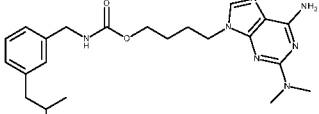
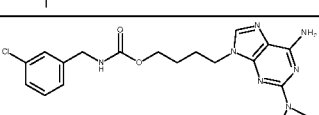
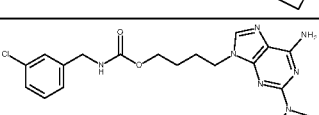
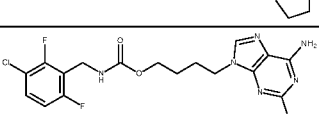
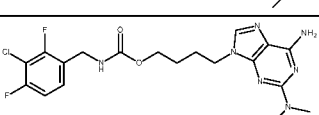
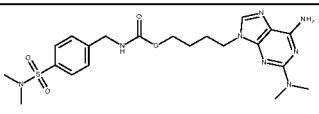
148		(1-isopropylindol-5-yl) methanamine	Cl
149		(3-isopropyl-1H-indol-5-yl) methanamine	Cl
150		(4-pyrrolidin-1-yl sulfonylphenyl) methanamine	Cl
151		4-(aminomethyl)-N-cyclohexylbenzenesulfonamide	Cl
152		(3-propylphenyl) methanamine	Cl
153		[4-[4-(cyclopropylmethyl)piperazin-1-yl] sulfonylphenyl] methanamine	Cl
154		3-(aminomethyl)-N-methylbenzene-sulfonamide	Cl
155		3-(aminomethyl)-N-benzylbenzene-sulfonamide	Cl
156		2-[3-(aminomethyl)phenyl]aniline	Cl
157		4-[3-(aminomethyl)phenyl]aniline	Cl

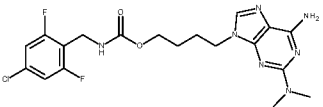
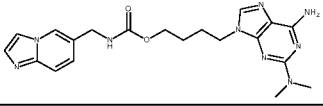
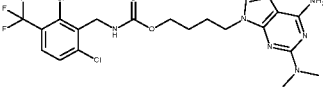
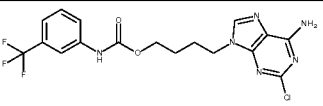
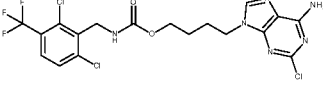
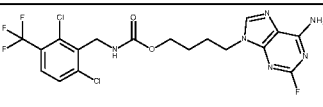
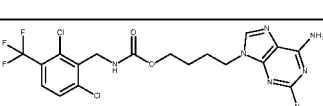
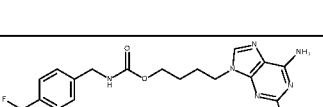
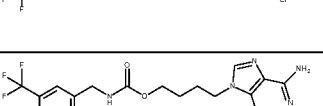
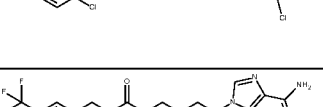
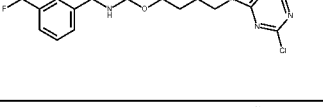
158		[3-(2-pyridyl)phenyl] methanamine	Cl
159		(3-phenylphenyl) methanamine	Cl
160		(1-isobutyl-benzimidazol-5-yl) methanamine	Cl
161		(3-pyrrol-1-ylphenyl) methanamine	Cl
162		(1-isobutylindol-5-yl) methanamine	Cl
171		4-(aminomethyl)- <i>N</i> -(2- furylmethyl)benzenesulfona mide	Cl
172		4-(aminomethyl)- <i>N</i> -[(4- chlorophenyl)methyl]benzen esulfonamide	Cl
173		4-(aminomethyl)- <i>N</i> -[(3- fluorophenyl)methyl]benzene sulfonamide	Cl
174		4-(aminomethyl)- <i>N</i> -[(2- fluorophenyl)methyl]benzene sulfonamide	Cl
175		4-(aminomethyl)- <i>N</i> -[(2,6- difluorophenyl)methyl]benze nesulfonamide	Cl

176		4-(aminomethyl)- <i>N</i> -[[3-(trifluoromethyl)phenyl]methyl]benzenesulfonamide	Cl
177		4-(aminomethyl)- <i>N</i> -[(3-methoxyphenyl)methyl]benzenesulfonamide	Cl
178		4-(aminomethyl)- <i>N</i> -benzylbenzenesulfonamide	F
179		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	dimethylamine
180		4-(aminomethyl)- <i>N</i> -[(1 <i>S</i>)-1-(4-chlorophenyl)ethyl]benzenesulfonamide	Cl
181		4-(aminomethyl)- <i>N</i> -[(1 <i>R</i>)-1-(4-chlorophenyl)ethyl]benzenesulfonamide	Cl
182		4-(aminomethyl)- <i>N</i> -[(4-fluorophenyl)methyl]benzenesulfonamide	Cl
183		4-(aminomethyl)- <i>N</i> -[[4-(trifluoromethyl)phenyl]methyl]benzenesulfonamide	Cl
184		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	F
185		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	methoxy

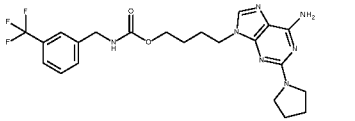
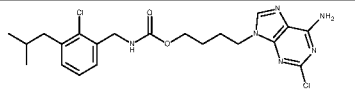
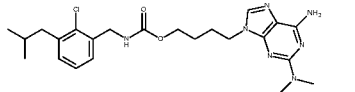
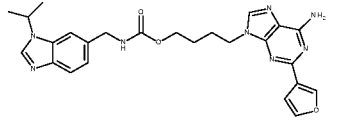
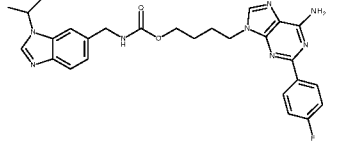
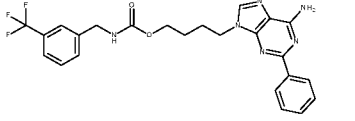
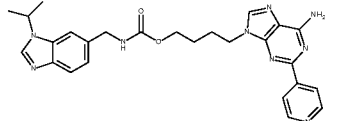
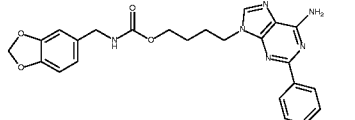
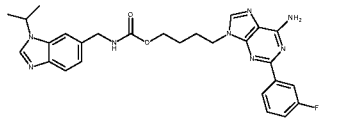
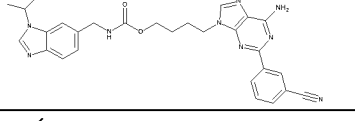
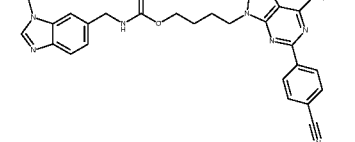
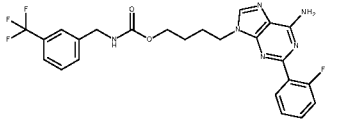
186		[1-(benzenesulfonyl)indol-5-yl]methanamine	Cl
187		(1-methylsulfonylindol-5-yl)methanamine	Cl
188		(1-benzylsulfonylindol-5-yl)methanamine	Cl
189		(1-cyclopropylsulfonylindol-5-yl)methanamine	Cl
190		4-(aminomethyl)-N-[(4-chlorophenyl)methyl]benzenesulfonamide	diethoxy
191		4-(aminomethyl)-N-[(4-chlorophenyl)methyl]benzenesulfonamide	propoxy
192		4-(aminomethyl)-N-[(4-chlorophenyl)methyl]benzenesulfonamide	isopropoxy
193		4-(aminomethyl)-N-[(4-chlorophenyl)methyl]benzenesulfonamide	isobutoxy
194		4-(aminomethyl)-N-[(4-chlorophenyl)methyl]benzenesulfonamide	cyclopentylmethoxy
195		4-(aminomethyl)-N-[(4-chlorophenyl)methyl]benzenesulfonamide	methylsulfanyl
196		4-(aminomethyl)-N-[(4-cyanophenyl)methyl]benzenesulfonamide	Cl

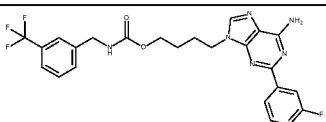
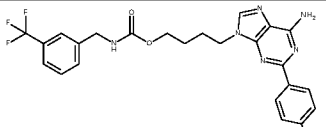
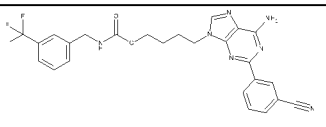
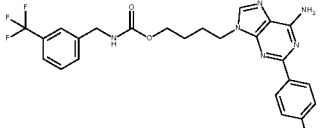
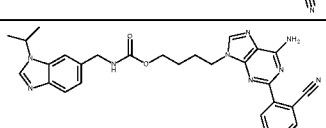
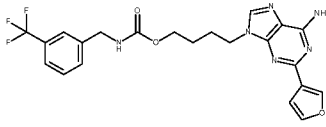
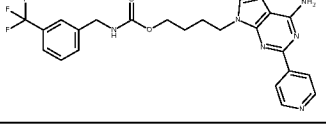
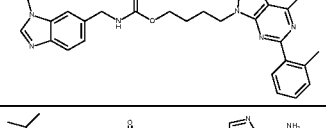
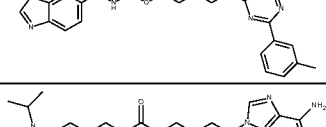
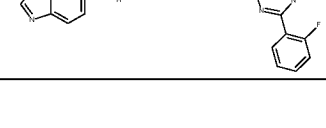
197		4-(aminomethyl)- <i>N</i> -[(4-bromophenyl)methyl]benzenesulfonamide	Cl
198		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	ethyne
199		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	ethyl
200		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	methyl
201		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	isopropylethyne
202		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	(<i>Z</i>)-prop-1-enyl
203		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	isopentyl
204		4-(aminomethyl)- <i>N</i> -[(4-chlorophenyl)methyl]benzenesulfonamide	propyl
205		4-(aminomethyl)- <i>N</i> -[(4-(trifluoromethyl)phenyl)methyl]benzenesulfonamide	F
206		4-(aminomethyl)- <i>N</i> -methylbenzenesulfonamide	dimethylamine
207		(4-methylsulfonylphenyl)methanamine	dimethylamine
208		(1-methylsulfonylindol-5-yl)methanamine	dimethylamine

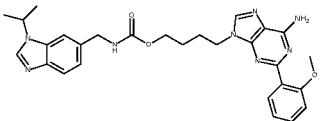
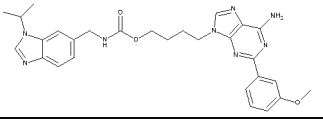
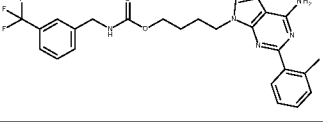
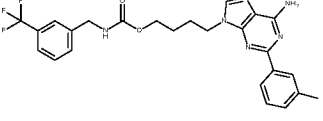
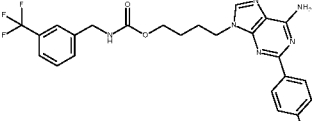
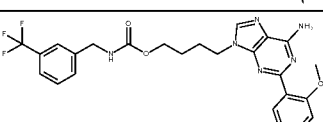
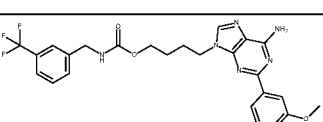
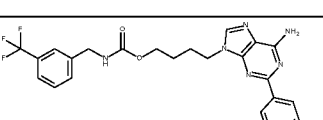
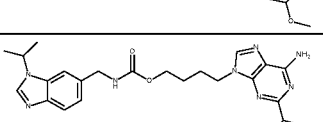
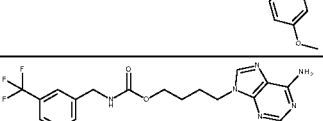
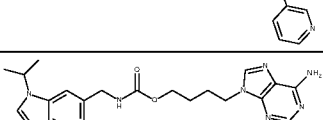
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210		(4-chlorophenyl)methanamine	dimethylamine
211		[4-chloro-3-(trifluoromethyl)phenyl]methanamine	dimethylamine
212		[3-(trifluoromethyl)phenyl]methanamine	dimethylamine
213		(4-chloro-3-fluorophenyl)methanamine	dimethylamine
214		(3-chlorophenyl)methanamine	dimethylamine
215		(3-isobutylphenyl)methanamine	dimethylamine
216		(3-chlorophenyl)methanamine	azetidine
217		(3-chlorophenyl)methanamine	pyrrolidine
218		(3-chloro-2,6-difluorophenyl)methanamine	dimethylamine
219		(3-chloro-2,4-difluorophenyl)methanamine	dimethylamine
220		4-(aminomethyl)-N,N-dimethylbenzenesulfonamide	dimethylamine

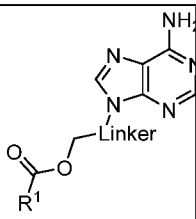
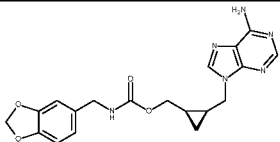
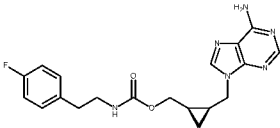
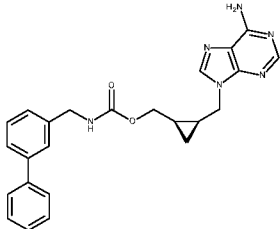
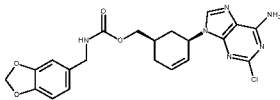
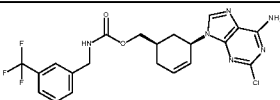
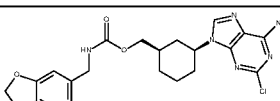
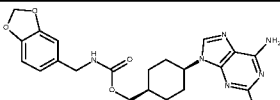
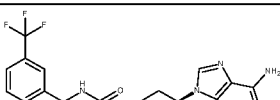
221		(4-chloro-2,6-difluorophenyl)methanamine	dimethylamine
222		imidazo[1,2-a]pyridin-6-ylmethanamine	dimethylamine
223		[2,6-dichloro-3-(trifluoromethyl)phenyl]methanamine	dimethylamine
224		3-(trifluoromethyl)aniline	Cl
225		[2,6-dichloro-3-(trifluoromethyl)phenyl]methanamine	Cl
226		[2,6-dichloro-3-(trifluoromethyl)phenyl]methanamine	F
227		[2,6-dichloro-3-(trifluoromethyl)phenyl]methanamine	methylamine
228		[4-(trifluoromethyl)phenyl]methanamine	Cl
229		[2-chloro-5-(trifluoromethyl)phenyl]methanamine	Cl
230		[3,5-bis(trifluoromethyl)phenyl]methanamine	Cl
231		[2-chloro-3-(trifluoromethyl)phenyl]methanamine	Cl
232		(3,6-dichloro-2-fluorophenyl)methanamine	Cl

233		(3,6-dichloro-2-fluoro-phenyl)methanamine	F
234		(3,6-dichloro-2-fluoro-phenyl)methanamine	methylamine
235		(3,6-dichloro-2-fluoro-phenyl)methanamine	dimethylamine
236		[2,3-dichloro-6-(trifluoromethyl)phenyl]methanamine	Cl
237		[2,3-dichloro-6-(trifluoromethyl)phenyl]methanamine	F
238		[2,3-dichloro-6-(trifluoromethyl)phenyl]methanamine	dimethylamine
239		(2-chloro-5-isobutyl-phenyl)methanamine	Cl
240		(2-chloro-5-isobutyl-phenyl)methanamine	F
241		(2-chloro-5-isobutyl-phenyl)methanamine	dimethylamine
242		(3-isopropylbenzimidazol-5-yl)methanamine	azetidine
243		(3-isopropylbenzimidazol-5-yl)methanamine	phenyl
244		[3-(trifluoromethyl)phenyl]methanamine	azetidine

245		[3-(trifluoromethyl)phenyl]methanamine	pyrrolidine
246		(2-chloro-3-isobutylphenyl)methanamine	Cl
247		(2-chloro-3-isobutylphenyl)methanamine	dimethylamine
248		(3-isopropylbenzimidazol-5-yl)methanamine	furan-3-yl
249		(3-isopropylbenzimidazol-5-yl)methanamine	4-fluorophenyl
250		[3-(trifluoromethyl)phenyl]methanamine	phenyl
251		(3-isopropylbenzimidazol-5-yl)methanamine	4-pyridinyl
252		1,3-benzodioxol-5-ylmethanamine	phenyl
253		(3-isopropylbenzimidazol-5-yl)methanamine	3-fluorophenyl
254		(3-isopropylbenzimidazol-5-yl)methanamine	3-cyanophenyl
255		(3-isopropylbenzimidazol-5-yl)methanamine	4-cyanophenyl
256		[3-(trifluoromethyl)phenyl]methanamine	2-fluorophenyl

257		[3-(trifluoromethyl)phenyl]methanamine	3-fluorophenyl
258		[3-(trifluoromethyl)phenyl]methanamine	4-fluorophenyl
259		[3-(trifluoromethyl)phenyl]methanamine	3-cyanophenyl
260		[3-(trifluoromethyl)phenyl]methanamine	4-cyanophenyl
261		(3-isopropylbenzimidazol-5-yl)methanamine	2-cyanophenyl
262		[3-(trifluoromethyl)phenyl]methanamine	furan-3-yl
263		[3-(trifluoromethyl)phenyl]methanamine	4-pyridyl
264		(3-isopropylbenzimidazol-5-yl)methanamine	<i>o</i> -tolyl
265		(3-isopropylbenzimidazol-5-yl)methanamine	<i>m</i> -tolyl
266		(3-isopropylbenzimidazol-5-yl)methanamine	<i>p</i> -tolyl
267		(3-isopropylbenzimidazol-5-yl)methanamine	2-fluorophenyl

268		(3-isopropylbenzimidazol-5-yl)methanamine	2-methoxyphenyl
269		(3-isopropylbenzimidazol-5-yl)methanamine	3-methoxyphenyl
270		[3-(trifluoromethyl)phenyl]methanamine	<i>o</i> -tolyl
271		[3-(trifluoromethyl)phenyl]methanamine	<i>m</i> -tolyl
272		[3-(trifluoromethyl)phenyl]methanamine	<i>p</i> -tolyl
273		[3-(trifluoromethyl)phenyl]methanamine	2-methoxyphenyl
274		[3-(trifluoromethyl)phenyl]methanamine	3-methoxyphenyl
275		[3-(trifluoromethyl)phenyl]methanamine	4-methoxyphenyl
276		(3-isopropylbenzimidazol-5-yl)methanamine	4-methoxyphenyl
277		[3-(trifluoromethyl)phenyl]methanamine	3-pyridinyl
278		(3-isopropylbenzimidazol-5-yl)methanamine	3-pyridinyl

N°	Structure	 Substituent		
		Linker	R ¹	R ²
163		cyclopropyl methyl	1,3-benzodioxol-5-ylmethanamine	H
164		cyclopropyl methyl	2-(4-fluoro phenyl)ethanamine	H
165		cyclopropyl methyl	(3-phenyl phenyl)methanamine	H
166		(1 <i>R</i> ,5 <i>R</i>)-cyclohex-3-en-1-yl	1,3-benzo dioxol-5-yl methanamine	Cl
167		(1 <i>R</i> , 5 <i>R</i>)-cyclohex-3-en-1-yl	[3-(trifluoro methyl)phenyl]methanamine	Cl
168		(1 <i>R</i> , 3 <i>S</i>)-cyclohexyl	1,3-benzo dioxol-5-yl methanamine	Cl
169		(1 <i>S</i> , 4 <i>S</i>)-cyclohexyl	1,3-benzo dioxol-5-yl methanamine	Cl
170		(1 <i>S</i> , 4 <i>S</i>)-cyclohexyl	[3-(trifluoro methyl)phenyl]methanamine	Cl

Example 12: Biological assay measuring the protein kinase inhibition

A biochemical assay was performed in order to measure the protein kinase inhibition. The kinase binding assays were performed against different kinases using the SelectScreen Biochemical Kinase Profiling Service®. For all kinases, the Z'-Lyte® biochemical kinase assay technology was used except for FLT3-ITD where the LanthaScreen® kinase assay technology was used.

Inhibitions were measured at 50 nM in duplicate for each compound and are reported in percentage. Some data are presented in Table 2.

NB: Inhibition are reported as follows:

0-29%

30-60%

> 61%

Table 2: Results biological assay

N°	FLT3wt	FLT3ITD	FLT3D835Y	KIT	CSF1R (FMS)	PDGFR alpha	PDGFR beta	RET
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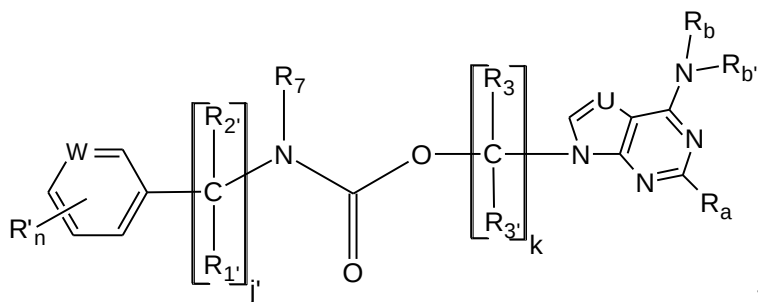
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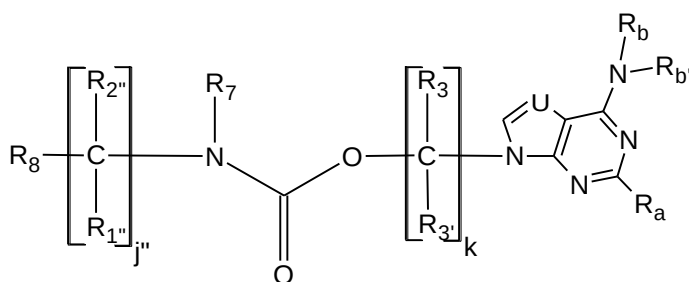
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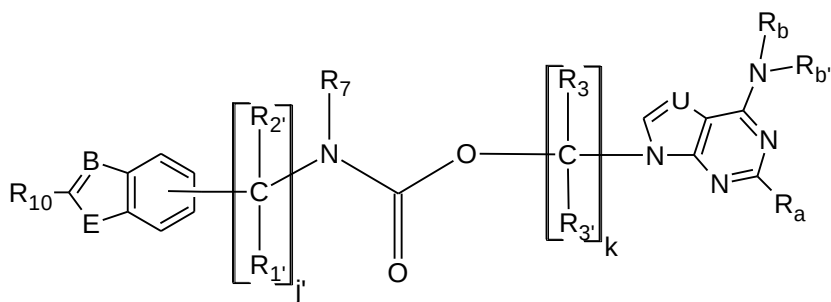
1. A compound (C) or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein said compound (C) is chosen among those of formulae (II) to (V) [compounds (C) of class (I), herein after]:



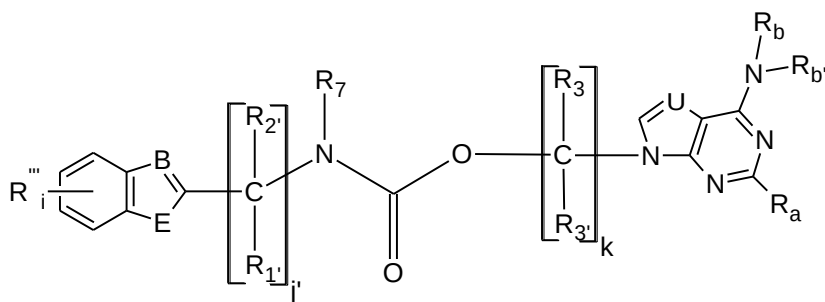
formula (II)



formula (III)



formula (IV)



formula (V)

wherein:

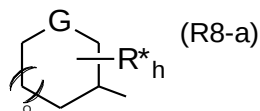
- 5 - each of R_a is independently selected from the group consisting of hydrogen, halo, CF_3 , $N(R_{14})_2$, CN, C_{1-15} alkyl, C_{2-15} alkenyl, C_{2-15} alkynyl, cycloalkyl, heterocyclyl, aryl, and heteroaryl, wherein said alkyl, cycloalkyl, heterocyclyl, aryl, and heteroaryl are optionally substituted with one or more substituents selected from halo, C_{1-15} alkyl, $O-C_{1-6}$ alkyl; and wherein each of R_{14} , independent from each other, is selected from hydrogen, C_{1-15} alkyl, cycloalkyl; preferably each of R_a is independently selected from the group consisting of hydrogen, halo,
10 $N(R_{14})_2$, heterocyclyl, and heteroaryl, wherein said heterocyclyl, and heteroaryl are optionally substituted with one or more substituents selected from halo, C_{1-4} alkyl; preferably each of R_{14} , independent from each other, is selected from hydrogen, C_{1-4} alkyl, cycloalkyl; or preferably each of R_a is C_{1-15} alkyl, C_{1-15} cycloalkyl, C_{2-15} alkenyl, C_{2-15}
15 alkynyl, more preferably each of R_a is C_{1-10} alkyl, C_{1-6} cycloalkyl, C_{2-10} alkenyl, C_{2-10} alkynyl;
- each of U is independently selected from the group consisting of N, C- R_d wherein R_d is hydrogen, C_{1-5} alkyl or halo; preferably U is N or C- R_d wherein R_d is hydrogen or halo; more preferably U is N;
- 20 - each of R' and R'' independently from each other and at each occurrence, are selected from halo, C_{1-6} alkyl, C_{1-6} alkenyl, cycloalkyl, heterocyclyl, aryl, heteroaryl, CF_3 , CN, OR_{21} , $N(R_{21})_2$, $OC(R_{21})_2O$, $OC(R_{21})_2C(R_{21})_2O$, SO_2R_{22} or $SO_2N(R_{21})_2$, wherein said alkyl, alkenyl, cycloalkyl, aryl, heterocyclyl, heteroaryl group is further optionally
25 substituted with one or more substituents selected from halo, alkyl, cycloalkyl, aryl, $N(R_{21})_2$, $CON(R_{21})_2$, SO_2R_{22} , or CN; wherein each of R_{21} and R_{22} are independently selected from the group consisting of hydrogen, C_{1-5} alkyl, heterocyclyl, aryl, aralkyl and CF_3 , wherein said alkyl, heterocyclyl, aryl and aralkyl substituents are optionally
30 substituted with halo or heterocyclyl; and wherein R' may be attached to two carbon atoms of the aryl group thereby forming a bicyclic system; or alternatively when W is a nitrogen, R' may be attached to

one carbon atom and the nitrogen atom of the aryl group thereby forming a bicyclic system and n is an integer in the range from 0 to 4, preferably n is an integer in the range from 0 to 3; and i is an integer in the range from 0 to 4, preferably i is 0 or 1;

- 5 - each of R_1' , R_2' , R_3 and R_3' , independently from each other and at each occurrence, are selected from the group consisting of hydrogen, C_{1-10} alkyl and C_{2-10} alkenyl wherein said alkyl and alkenyl, are optionally substituted with a halogen atom, an aryl group or an aralkyl group; preferably each of R_1' , R_2' , R_3 and R_3' , independently from each other and at each occurrence, are selected from hydrogen or an C_{1-4} alkyl;
- 10 - each of R_1'' and R_2'' , independently from each other and at each occurrence are selected from the group consisting of hydrogen; C_{1-10} alkyl wherein said alkyl is optionally substituted with a halogen atom or an aryl group; OR_{23} or $N(R_{23})_2$ wherein each of R_{23} , independent from each other, is selected from hydrogen or an C_{1-10} alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group; preferably each of R_1'' and R_2'' , independently from each other and at each occurrence are selected from the group consisting of hydrogen; C_{1-5} alkyl; OR_{23} wherein each of R_{23} , independent from each other, is selected from hydrogen or C_{1-4} alkyl;
- 15 - each of R_b and $R_{b'}$, independent from each other and at each occurrence, are selected from hydrogen; an C_{1-15} alkyl which is optionally substituted by a halogen atom, an aryl, a heterocyclyl or an aralkyl group; preferably each of R_b and $R_{b'}$, independent from each other and at each occurrence, are each selected from hydrogen; a C_{1-5} alkyl which is optionally substituted by an aryl, a heterocyclyl or an aralkyl group, most preferably R_b is hydrogen;
- 20 - each of R_7 is independently selected from hydrogen or C_{1-6} alkyl such as, for example, methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl, pentyl, hexyl and the like; preferably R_7 is hydrogen;
- 25 - each of k is an integer in the range from 2 to 5;
- 30

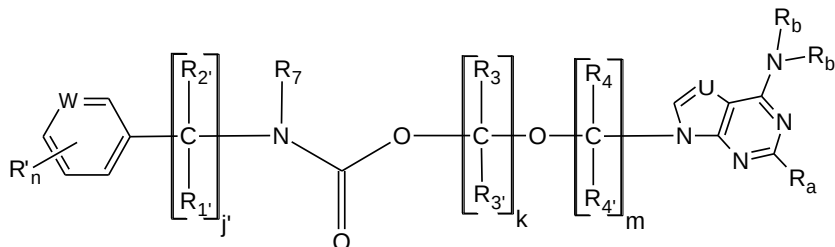
- each of W is selected, independently and at each occurrence, from C-halo, C-R₂₄, O or N; and wherein R₂₄ is selected from hydrogen or an C₁₋₁₀ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group, preferably W is selected, independently and at each occurrence, from C-halo, C-R₂₄ or N; and preferably R₂₄ is hydrogen or C₁₋₅ alkyl;
- each of E is independently selected from CH₂, O, CH-halo or NR₂₅; and wherein R₂₅ is selected from hydrogen or an C₁₋₁₀ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group; preferably each of E is independently selected from CH₂, O, or NR₂₅; and preferably R₂₅ is selected from hydrogen or C₁₋₅ alkyl;
- each of B is selected, independently and at each occurrence, from C-halo, C-R₂₆, O, or N; and wherein R₂₆ is selected from hydrogen or an C₁₋₁₀ alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group; preferably each of B is selected, independently and at each occurrence, from C-R₂₆, O, N; and preferably R₂₆ is selected from hydrogen; C₁₋₅ alkyl;
- each of j' is an integer in the range from 0 to 5, preferably j' is an integer in the range from 1 to 3;
- each of j'' is an integer in the range from 0 to 15, preferably j'' is an integer in the range from 0 to 8, more preferably j'' is an integer in the range from 0 to 4;
- each of R₈ is independently selected from the group consisting of hydrogen, or the moiety of formula (R8-a) wherein G is N or C; wherein R* is selected from C₁₋₆ alkyl, OH, O-C₁₋₆alkyl, an aryl or aralkyl group and R* may be attached to one atom, including G, or two atoms of the cyclic group thereby forming a bicyclic system; wherein h is an integer in the range between 0 to 4; and wherein o is an integer in the range between 0 to 1; preferably each of R₈ is independently selected from the group consisting of hydrogen, or the moiety of formula (R8-a) wherein G is N or C; preferably R* is selected from OH, an aryl or aralkyl group and R* may be attached to one atom, including G, or two

atoms of the cyclic group thereby forming a bicyclic system; preferably h is an integer in the range between 1 to 3; preferably o is 0;

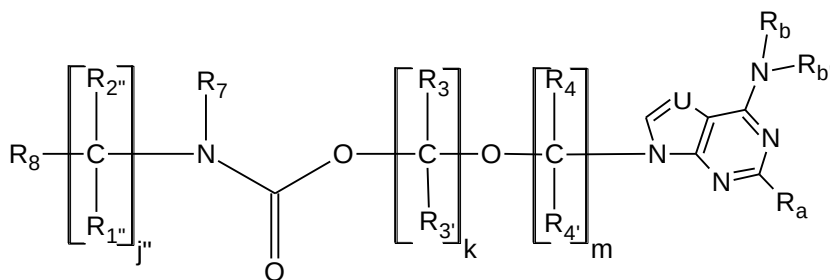


- 5 - each of R_{10} is independently selected from hydrogen, halo, C_{1-6} alkyl, C_{1-6} alkenyl, cycloalkyl or $N(R_{27})_2$; and wherein R_{27} is independently selected from hydrogen or an C_{1-10} alkyl which is optionally substituted by a halogen atom, an aryl group or an aralkyl group, preferably each of R_{10} is independently selected from hydrogen, C_{1-4} alkyl, cycloalkyl, or $N(R_{27})_2$; and preferably R_{27} is independently selected from hydrogen or an C_{1-5} alkyl.
- 10

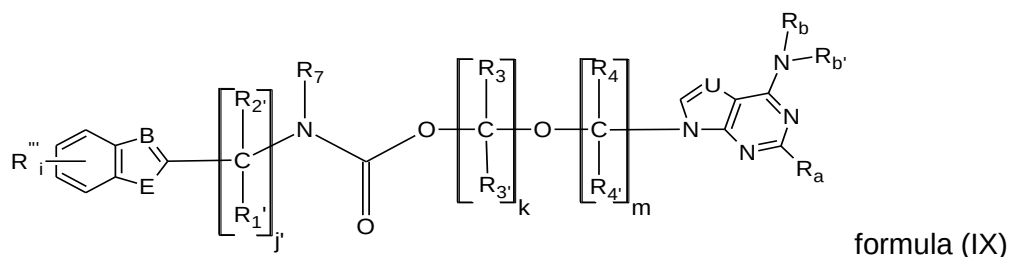
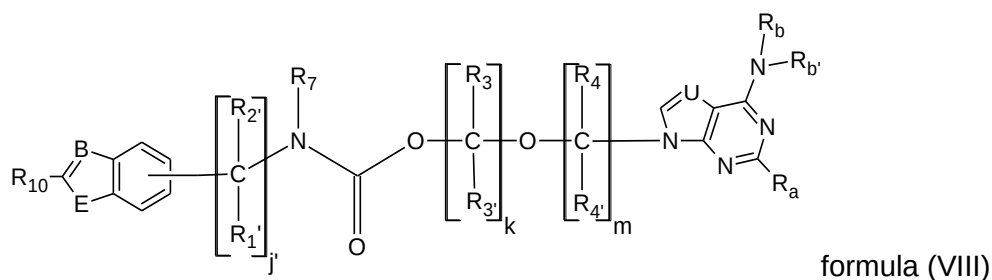
2. A compound (C) or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein wherein said compound (C) is chosen among those of formulae (VI) to (IX) [compounds (C) of class (II), herein after]:



formula (VI)

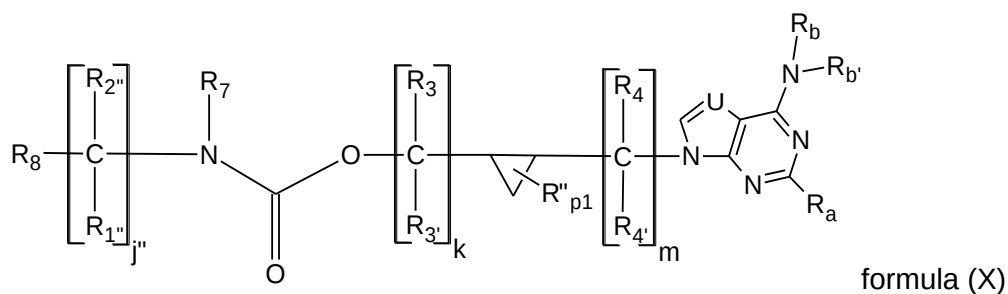
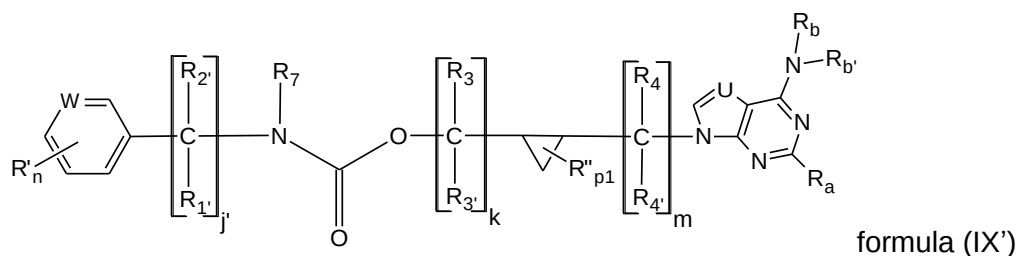


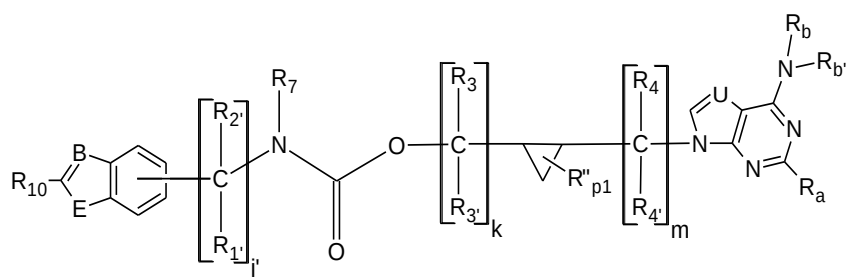
formula (VII)



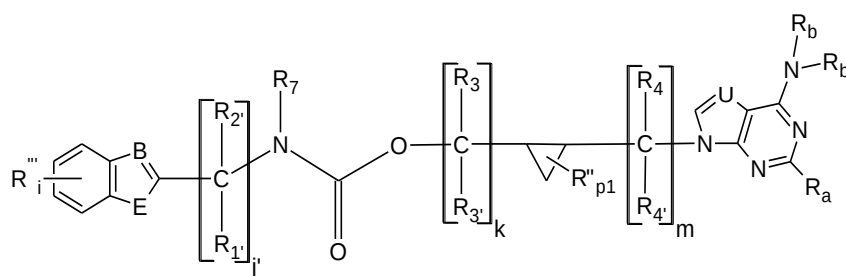
wherein R', R''', R₁', R₂', R₁'', R₂'', R₃, R₄, R₃', R₄', R₈, R₁₀, R_a, R_b, R_b', U, W, B, E, j', j'', i and n are as defined in claim 1; and wherein k and m are each independently and at each occurrence selected from an integer in the range from 1 to 4, preferably k is 2 and m is 1.

3. A compound (C) or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein wherein said compound (C) is chosen among those of formulae (IX') to (XII) [compounds (C) of class (III), herein after]:





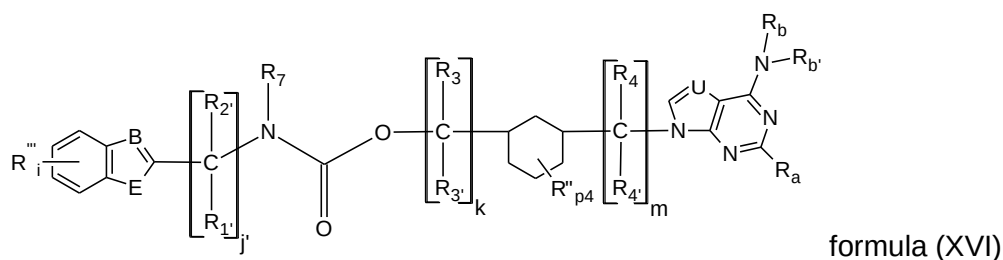
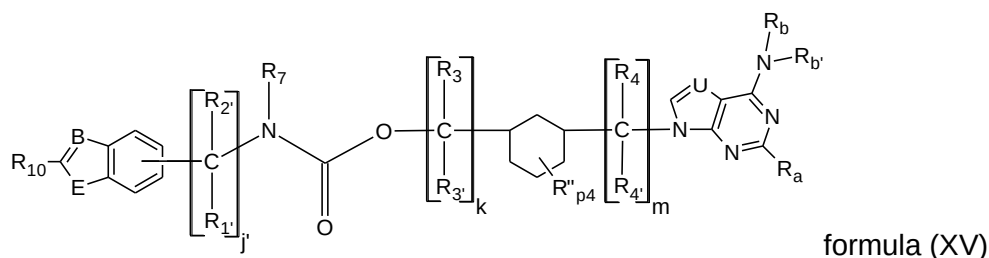
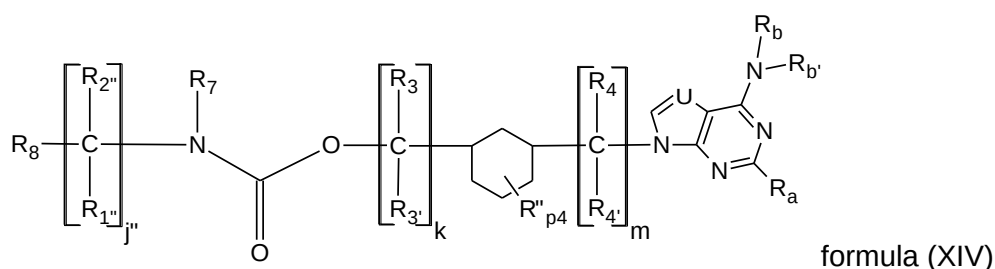
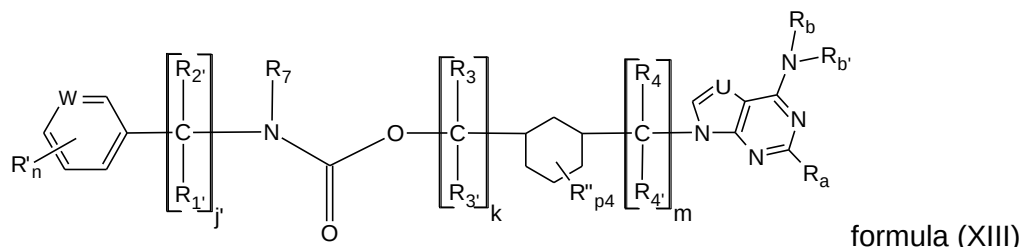
formula (XI)



formula (XII)

5 wherein R', R'', R₁', R₂', R₁'', R₂'', R₃, R₄, R₃', R₄', R₈, R₁₀, R_a, R_b, R_b', U, W, B, E, j', j'', i and n are as defined in claim 1; and wherein k and m are each independently and at each occurrence selected from an integer in the range from 0 to 4, preferably k and m are 1; wherein p₁ is an integer in the range from 0 to 2, preferably p₁ is 0; and wherein R'' is independently selected from hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group, preferably R'' is independently selected from hydrogen, C₁₋₄ alkyl such as methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl, and with the proviso when in formula (IX'), W is C-H, R' and R'' is hydrogen, m is 0, k is 1, R₃, R₃' and R₇ is hydrogen then j' is an integer in the range from 1 to 3.

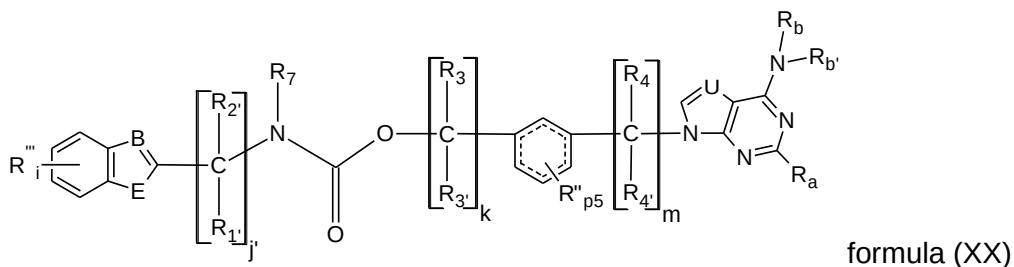
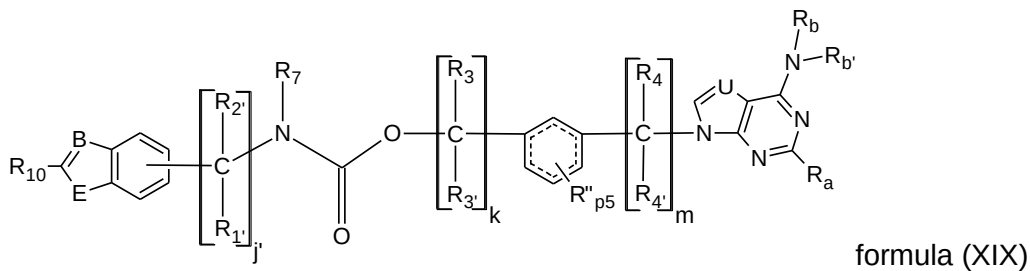
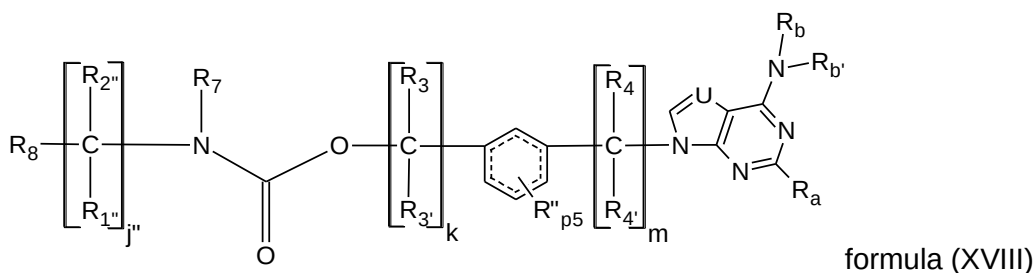
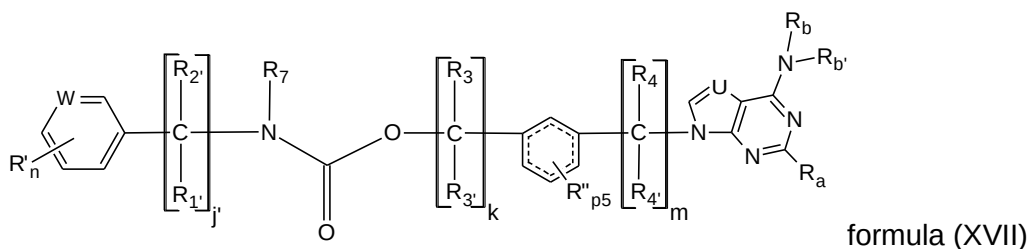
4. A compound (C) or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein said compound (C) is chosen among those of formulae (XIII) to (XVI) [compounds (C) of class (IV), herein after]:



10 wherein R', R'', R1', R2', R1'', R2'', R3, R4, R3', R4', R8, R10, Ra, Rb, Rb', U, W, B, E, j', j'', i and n are as defined in claim 1; wherein k and m are each independently and at each occurrence selected from an integer in the range from 0 to 4, preferably k is 0 and m is 0; wherein p4 is an integer in the range from 0 to 6, preferably p4 is an integer in the range from 0 to 3, more preferably p4 is 0;
15 and wherein R'' is independently selected from hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅

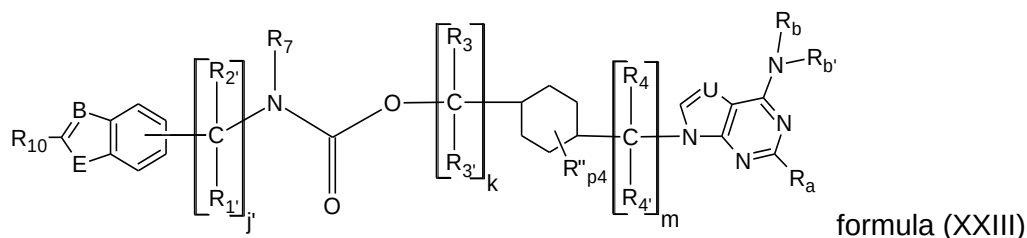
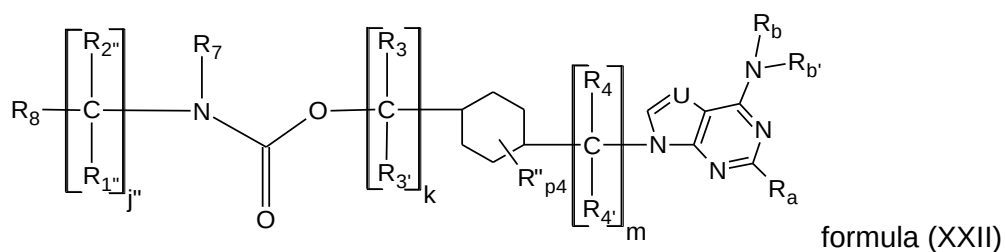
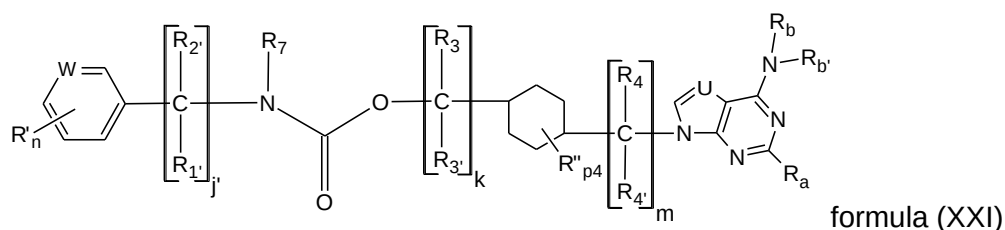
alkenyl, C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group, preferably R'' is independently selected from hydrogen, C₁₋₄ alkyl such as methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl.

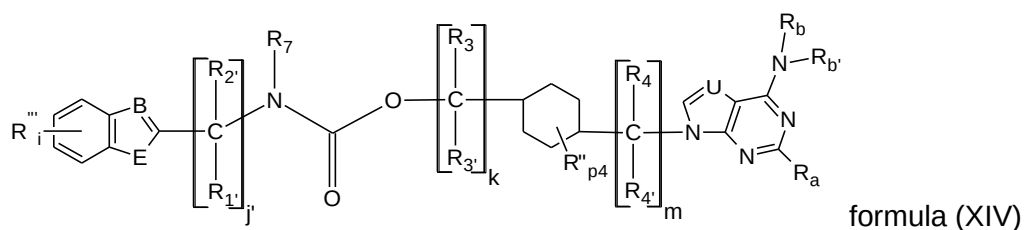
5. A compound (C) or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein said compound (C) is chosen among those of formulae (XVII) to (XX) [compounds (C) of class (V), herein after]:



wherein R', R'', R₁', R₂', R₁'', R₂'', R₃, R₄, R₃', R₄', R₈, R₁₀, R_a, R_b, R_b', U, W, B, E, j', j'', i and n are as defined in claim 1; wherein the dash bond represents at least one double bond; wherein k and m are each independently and at each occurrence selected from an integer in the range from 0 to 4, preferably k is 1 and m is 0; wherein p5 is an integer in the range from 0 to 4; preferably p5 is an integer in the range from 0 to 2, more preferably p5 is 0; and wherein R'' is independently selected from hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group, preferably R'' is independently selected from hydrogen, C₁₋₄ alkyl such as methyl, ethyl, propyl, isopropyl, butyl, tert-butyl, isobutyl and the like.

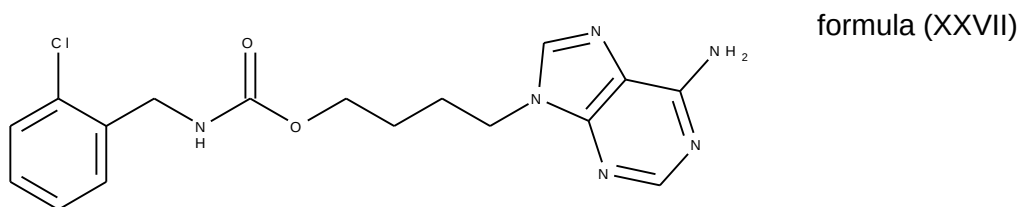
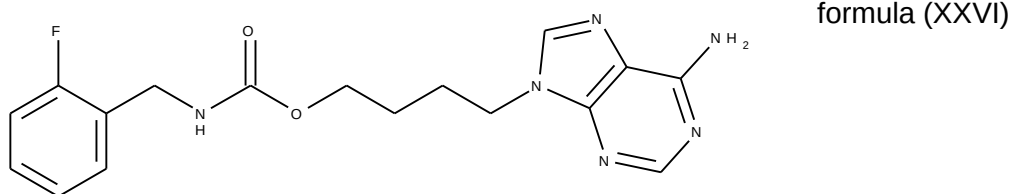
6. A compound (C) or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein said compound (C) is chosen among those of formulae (XXI) to (XXIV) [compounds (C) of class (VI), herein after]:

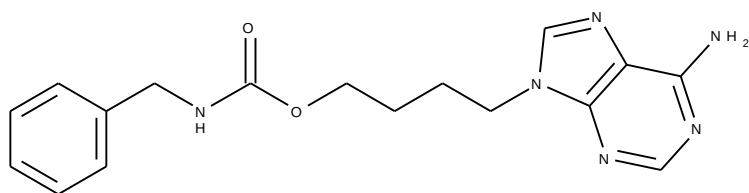




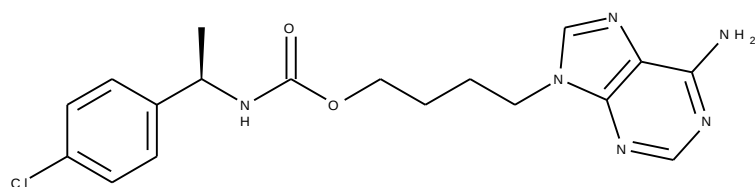
wherein R', R'', R₁', R₂', R₁'', R₂'', R₃, R₄, R₃', R₄', R₈, R₁₀, R_a, R_b, R_b', U, W, B, E, j', j'', i and n are as defined in claim 1; wherein k and m are each independently and at each occurrence selected from an integer in the range from 0 to 4, preferably k is 1 and m is 0; wherein p₄ is an integer in the range from 0 to 6; preferably p₄ is an integer in the range from 0 to 3, more preferably p₄ is 0; and wherein R'' is independently selected from hydrogen, C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl, wherein said C₁₋₁₅ alkyl, C₂₋₁₅ alkenyl, C₂₋₁₅ alkynyl are optionally substituted with a halogen atom, an aryl group or an aralkyl group, preferably R'' is independently selected from hydrogen, C₁₋₄ alkyl such as methyl, ethyl, propyl, isopropyl, butyl, *tert*-butyl, isobutyl and the like.

7. A compound (C) according to claim 1, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein compound of formula (II) is a compound chosen among those of formulae (XXVI) to (LIX); (LXIV) to (CXIII) or (CLVIII) to herein below:

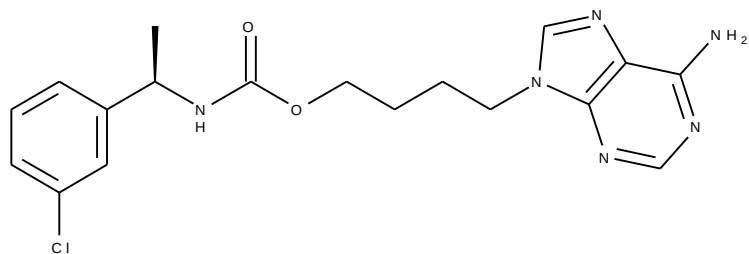




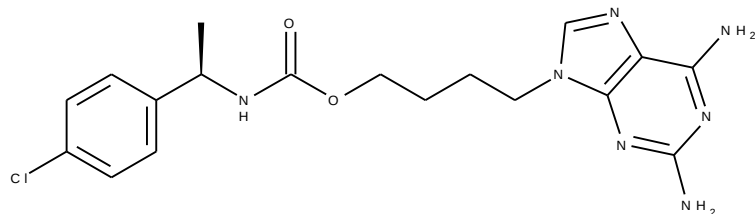
formula (XXVIII)



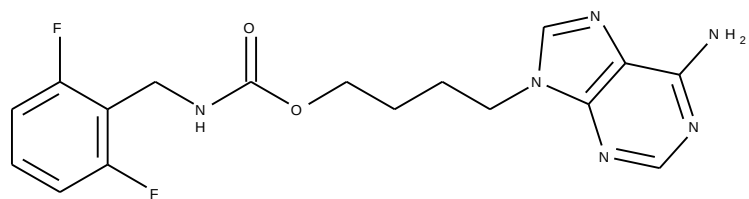
formula (XXIX)



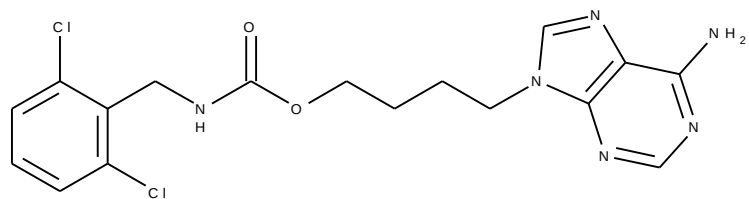
formula (XXX)



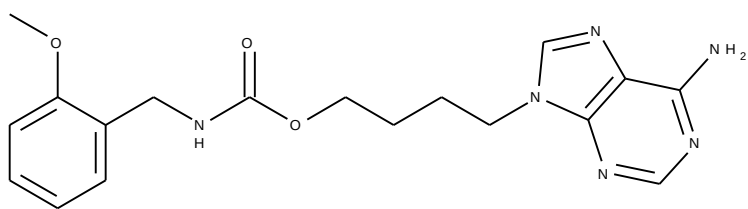
formula (XXXI)



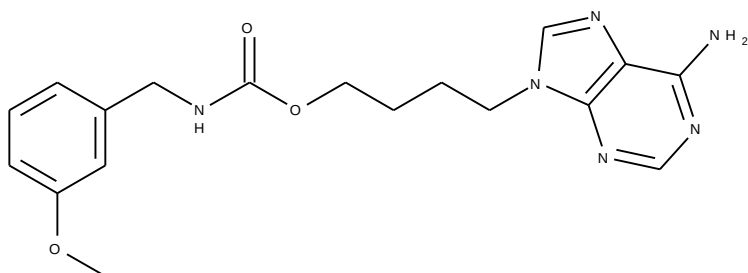
formula (XXXII)



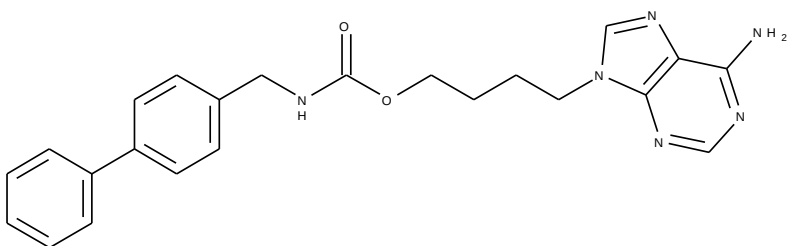
formula (XXXIII)



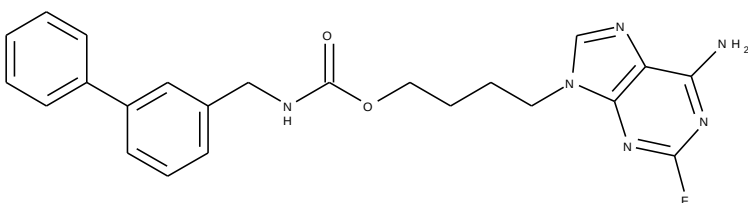
formula (XXXIV)



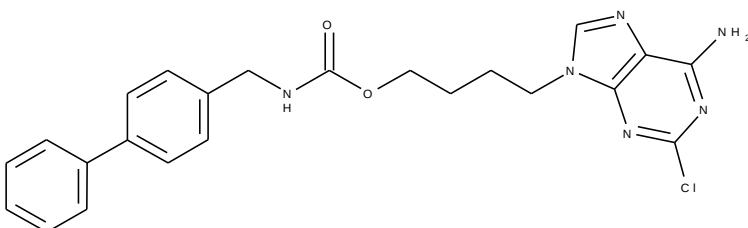
formula (XXXV)



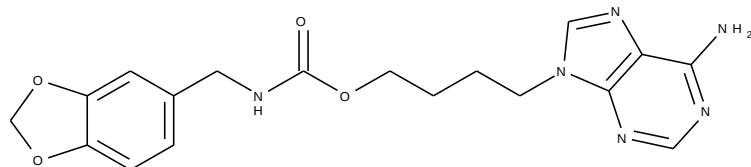
formula (XXXVI)



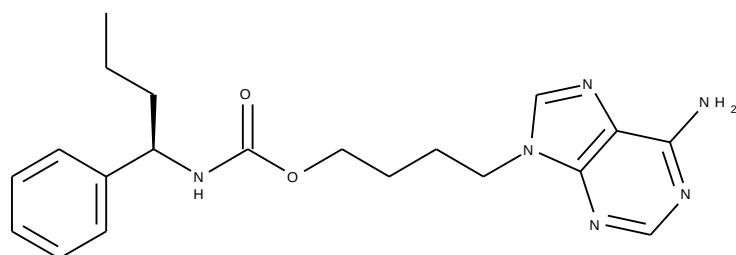
formula (XXXVI - 1)



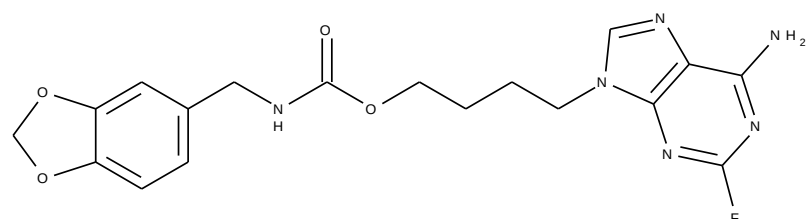
formula (XXXVI - 2)



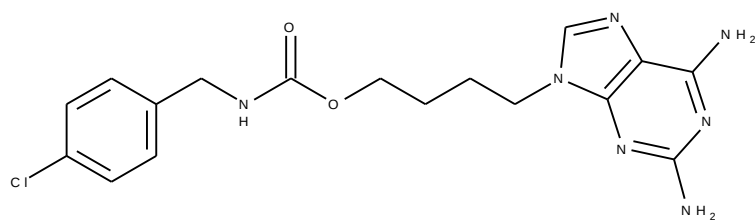
formula (XXXVII)



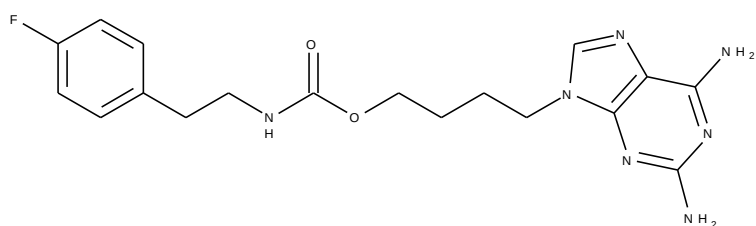
formula (XXXVIII)



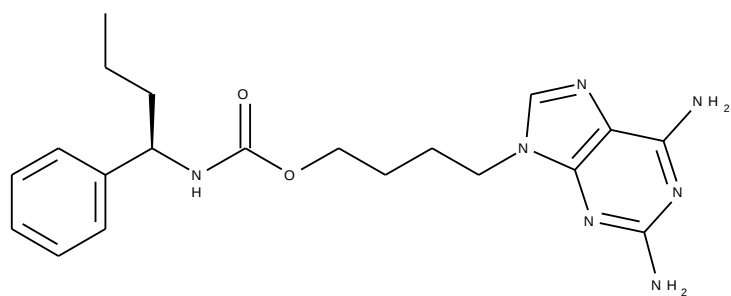
formula (XXXIX)



formula (XL)

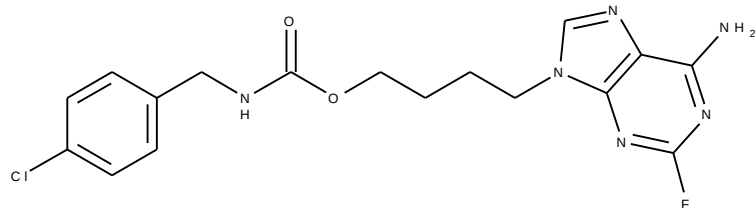


formula (XLI)

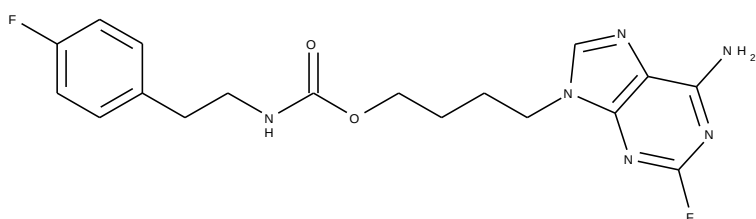


formula (XLII)

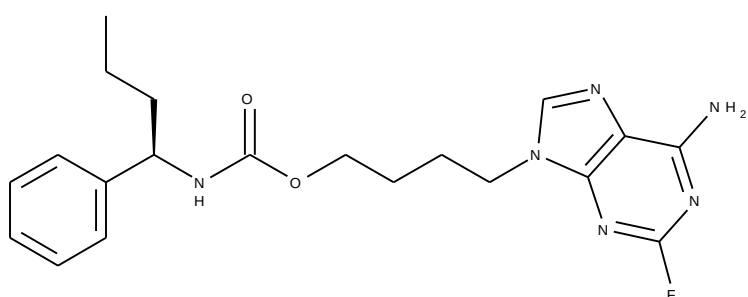
-191-



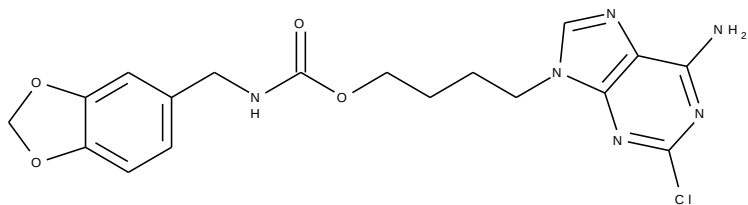
formula (XLIII)



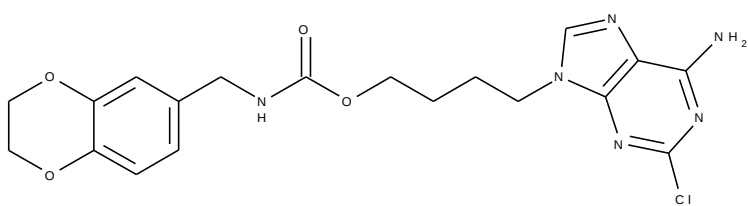
formula (XLIV)



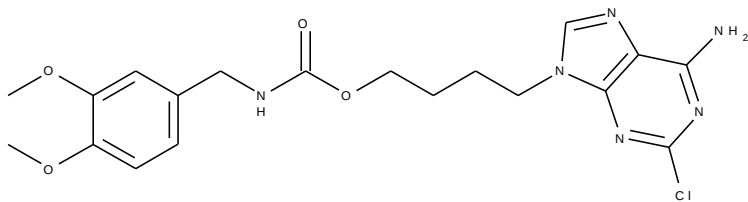
formula (XLV)



formula (XLVI)

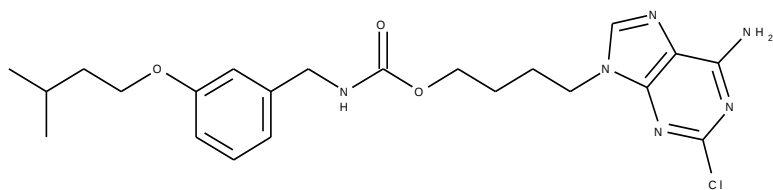


formula (XLVI - 1)

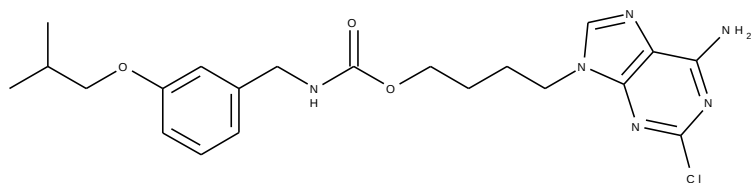


formula (XLVI - 2)

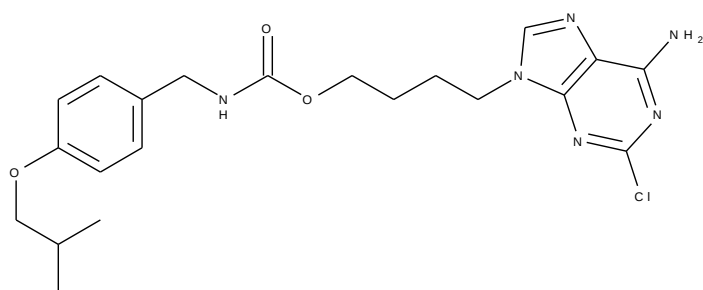
-192-



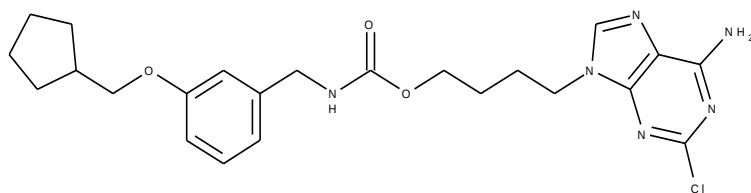
formula (XLVI - 3)



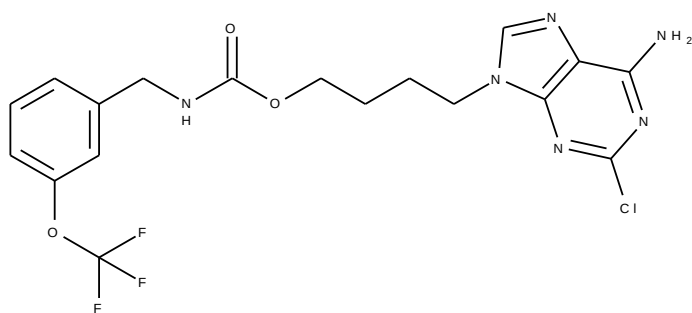
formula (XLVI - 4)



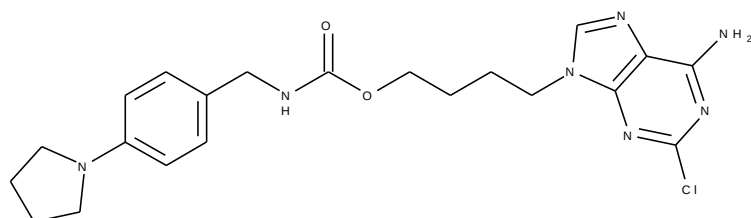
formula (XLVI - 5)



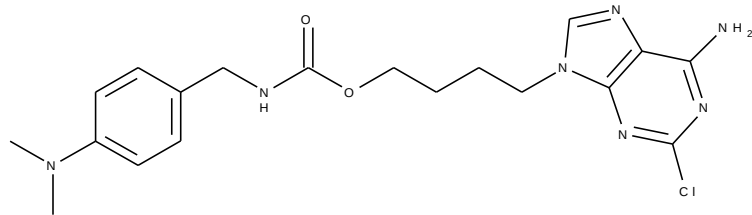
formula (XLVI - 6)



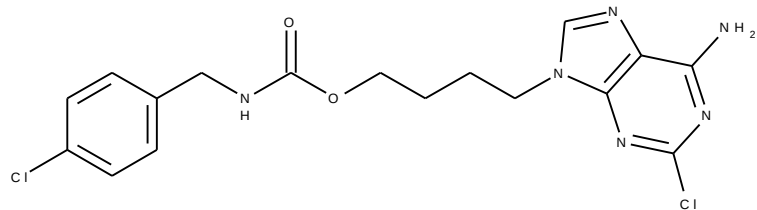
formula (XLVI - 7)



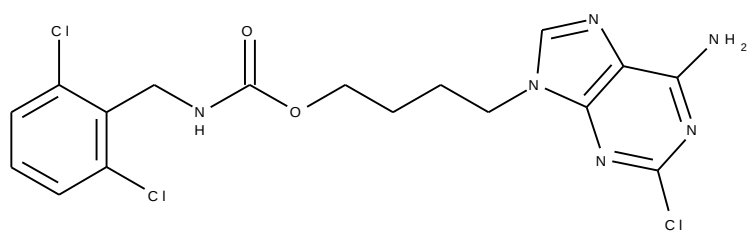
formula (XLVI - 8)



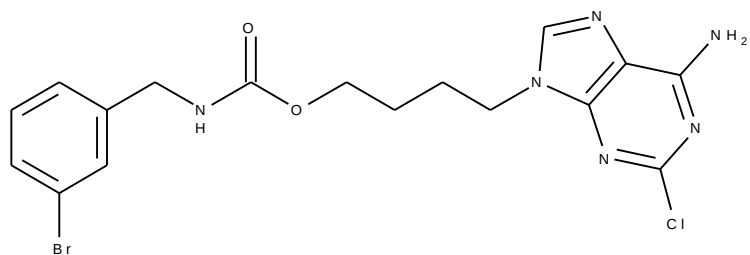
formula (XLVI - 9)



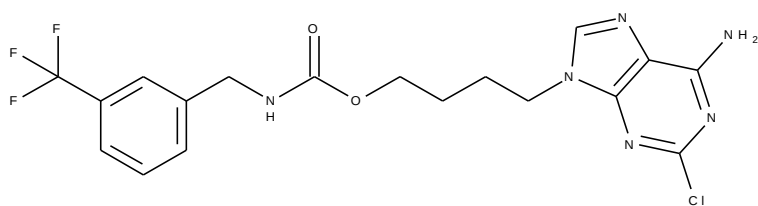
formula (XLVII)



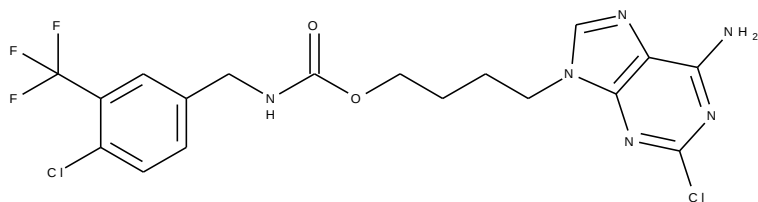
formula (XLVII - 1)



formula (XLVIII)

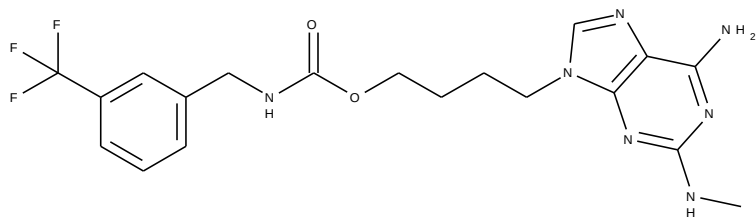


formula (XLIX)

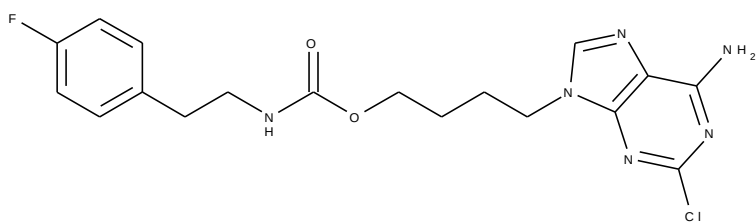


formula (XLIX - 1)

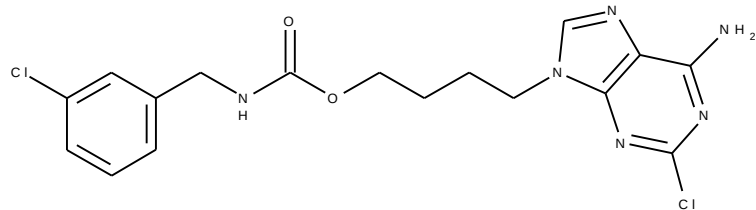
-194-



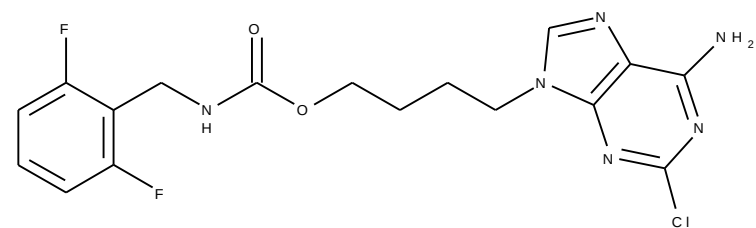
formula (L)



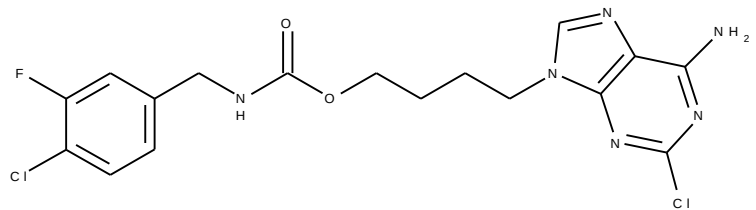
formula (LI)



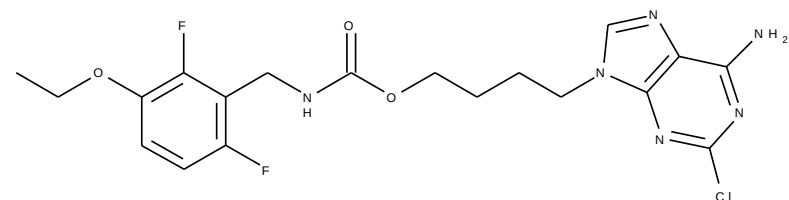
formula (LI - 1)



formula (LI - 2)

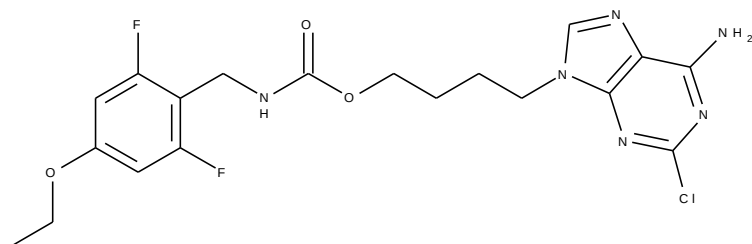


formula (LI - 3)

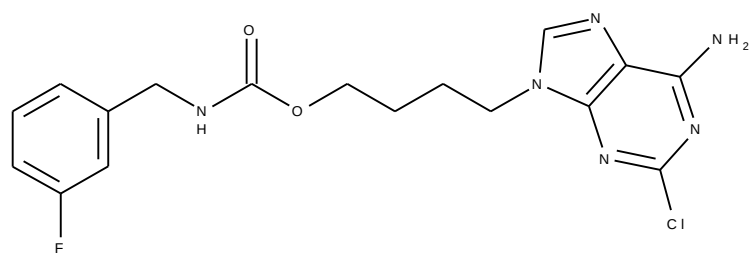


formula (LI - 4)

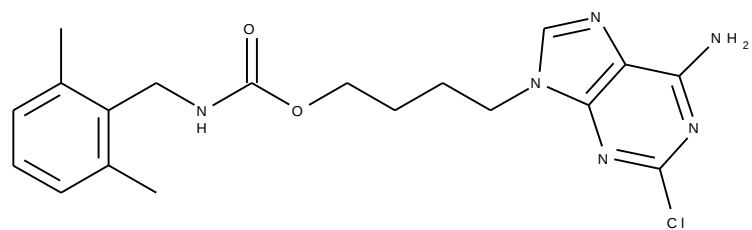
-195-



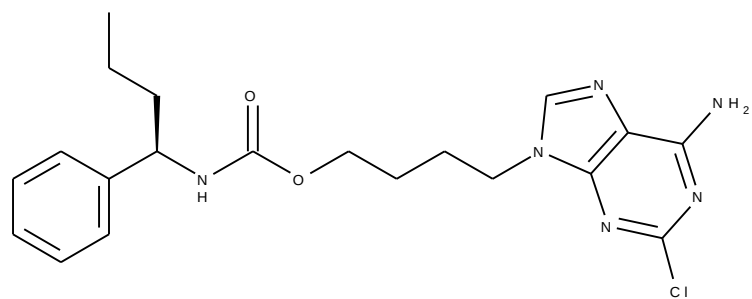
formula (LI - 5)



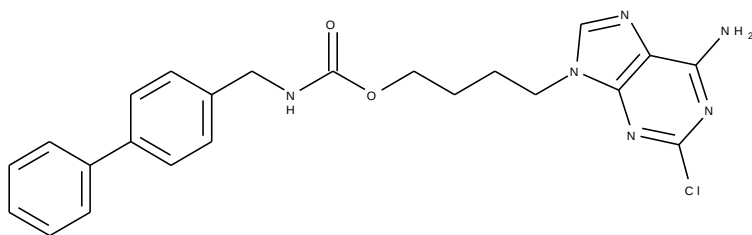
formula (LI - 6)



formula (LI - 7)



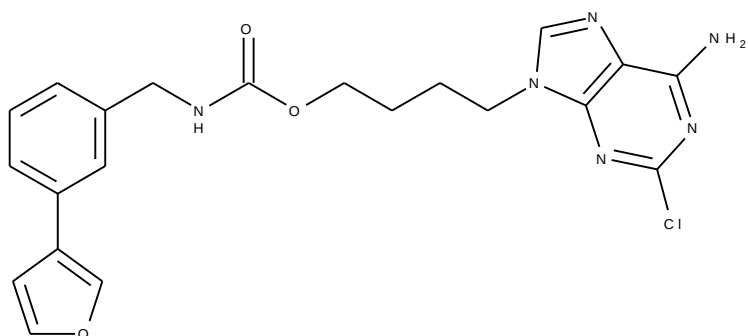
formula (LII)



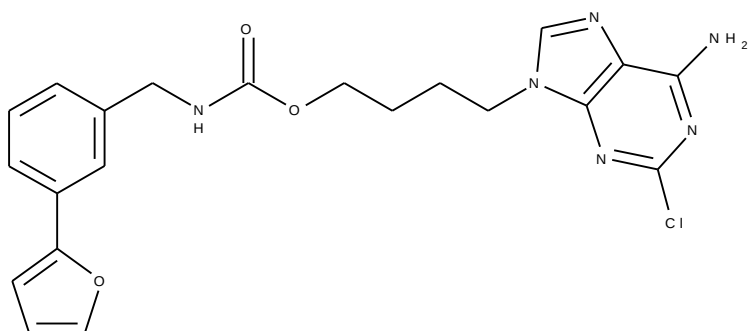
formula (LIII)

-196-

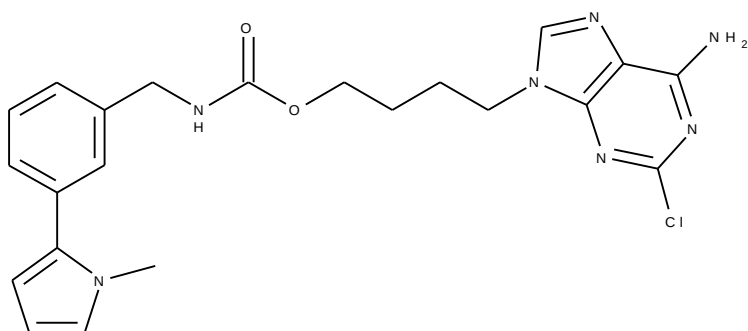
formula (LIII - 1)



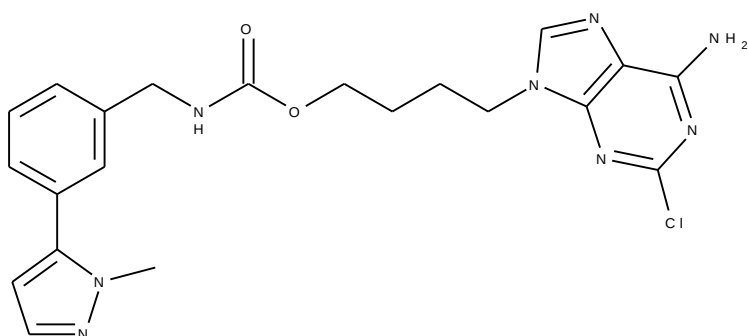
formula (LIII - 2)



formula (LIII - 3)

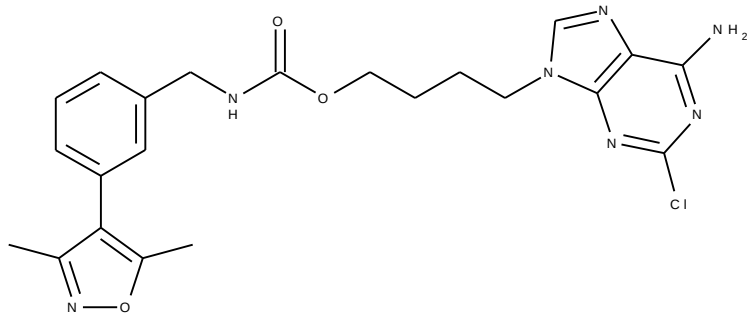


formula (LIII - 4)

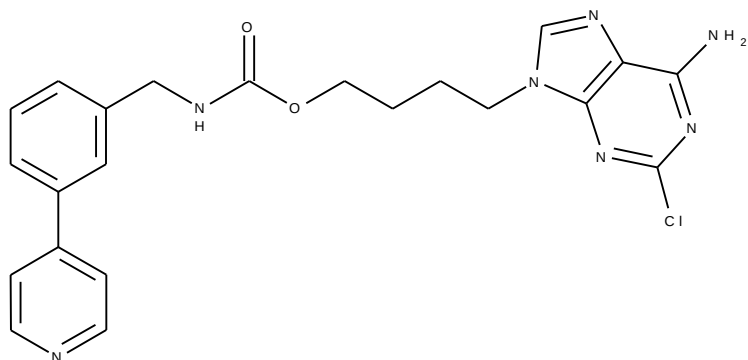


-197-

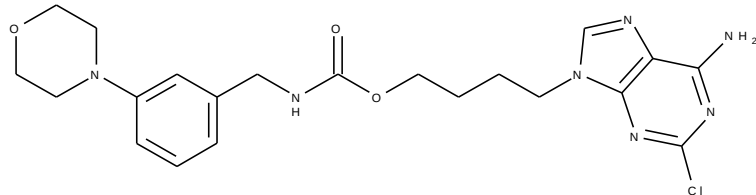
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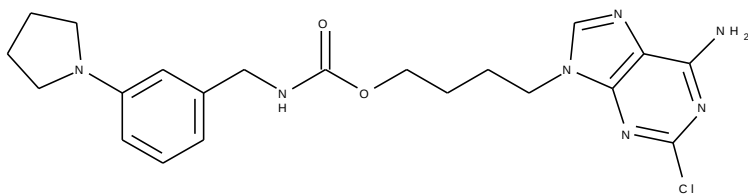
formula (LIII - 6)



formula (LIII - 7)

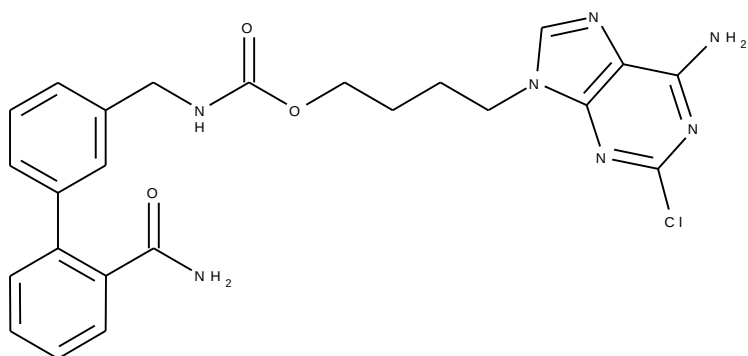


formula (LIII - 8)

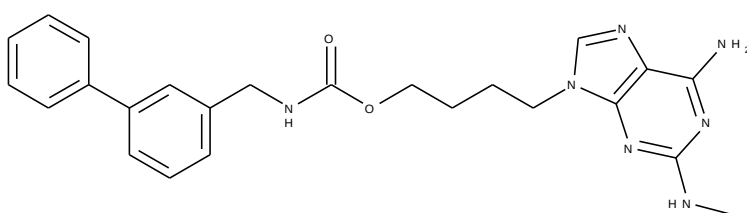


-198-

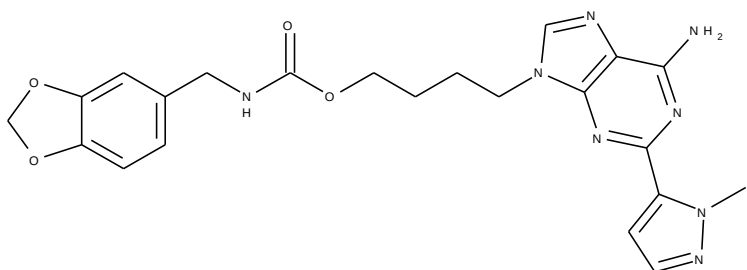
formula (LIII - 9)



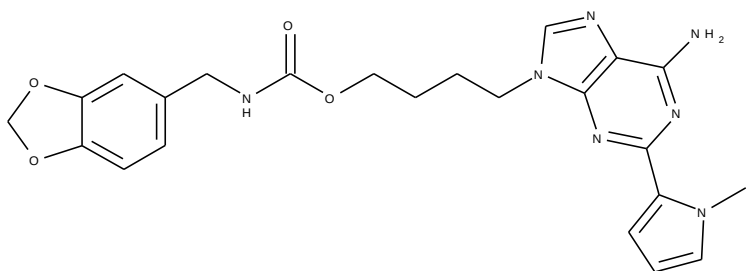
formula (LIV)



formula (LV)

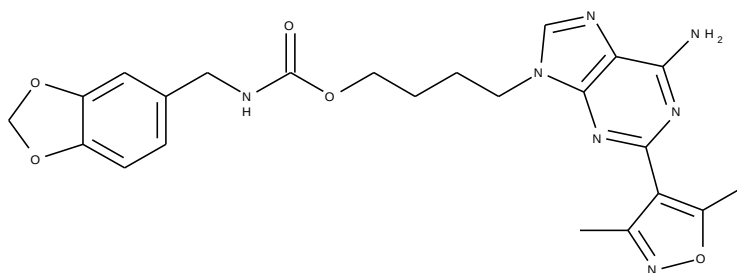


formula (LV-1)

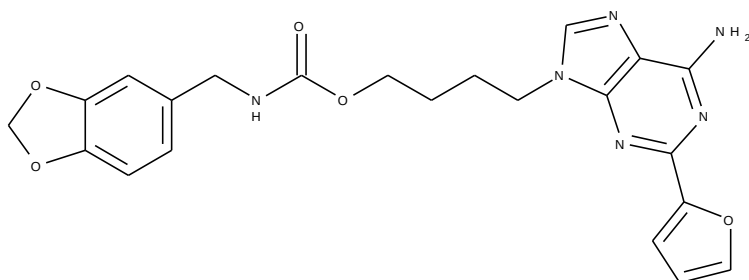


-199-

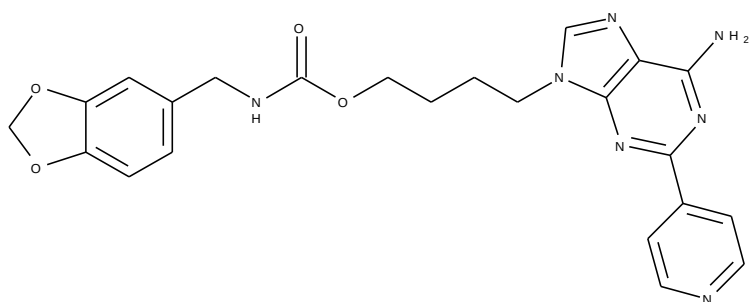
formula (LV-2)



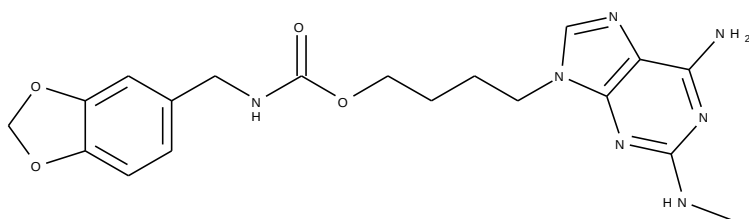
formula (LVI)

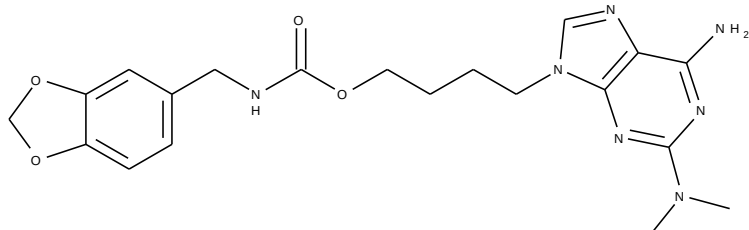


formula (LIX)

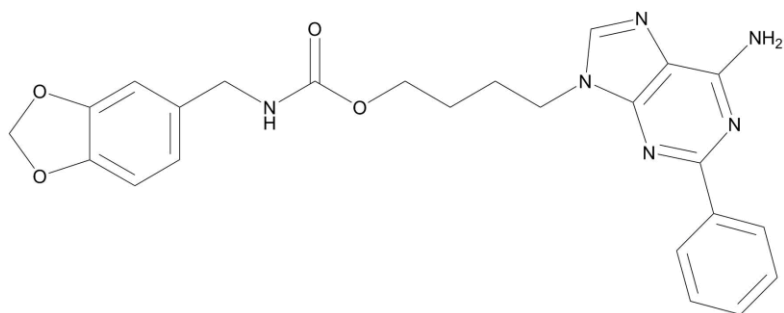


formula (LVIII)

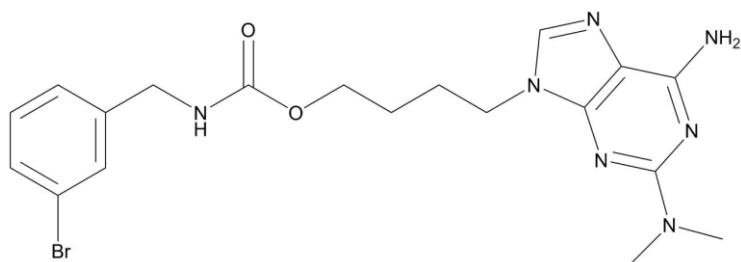




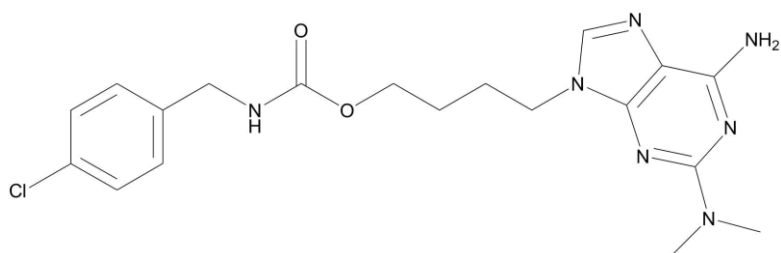
formula (LVIII - 1)



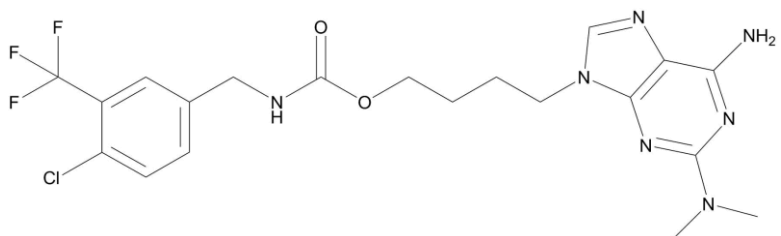
formula (CLVIII)



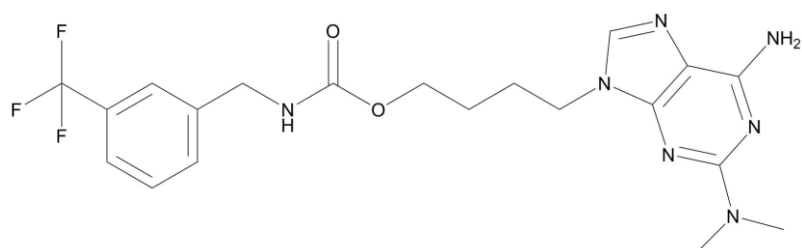
formula (LXIV)



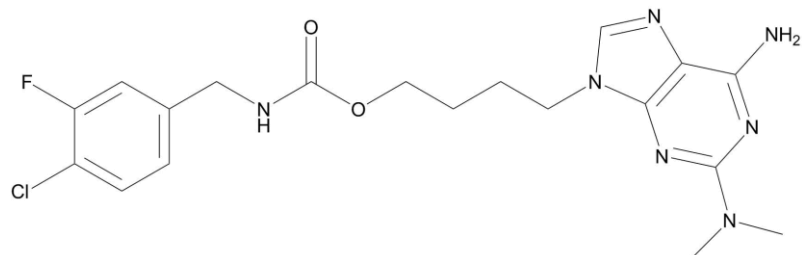
formula (LXV)



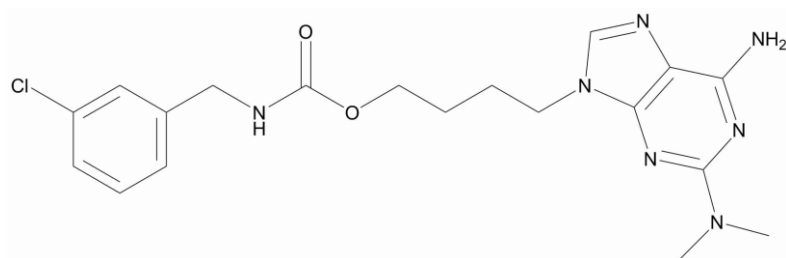
formula (LXVI)



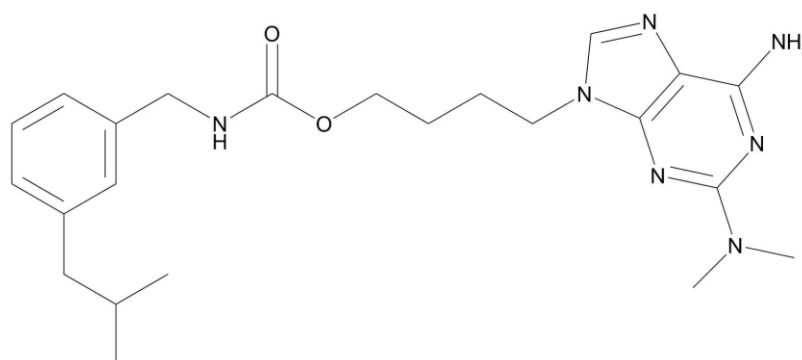
formula (LXVII)



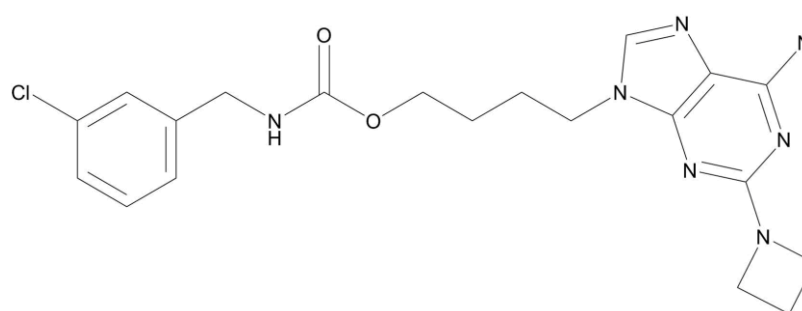
formula (LXVIII)



formula (LXIX)

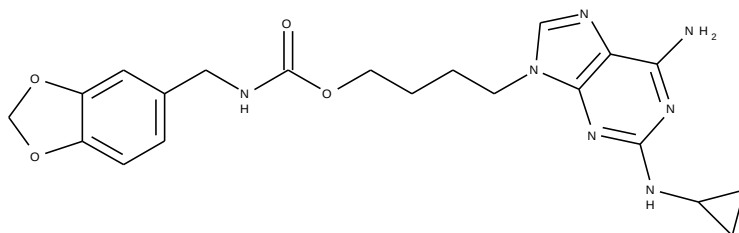


formula (LXX)

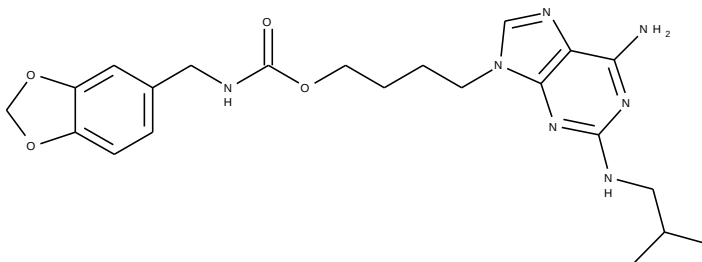


formula (LXXI)

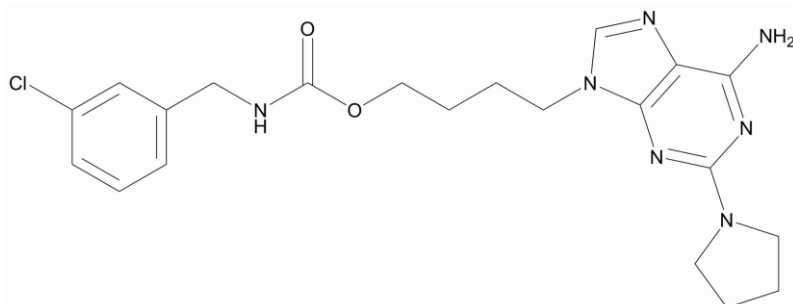
formula (LXXI - 1)



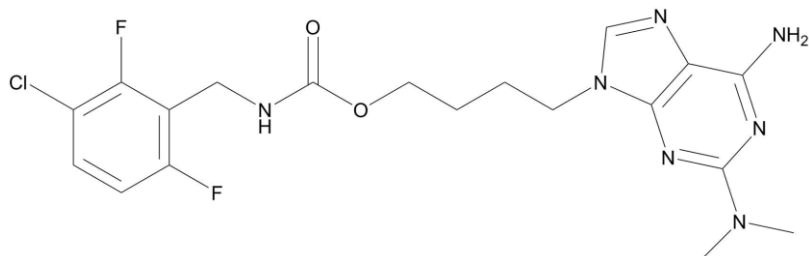
formula (LXXI - 2)



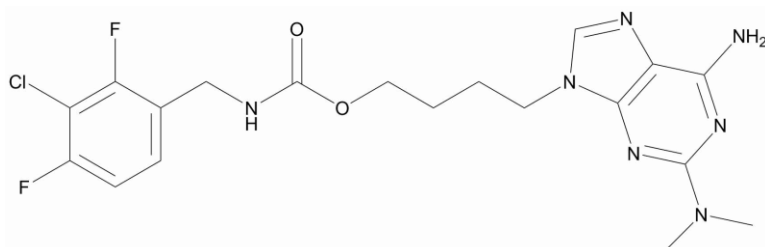
formula (LXXII)

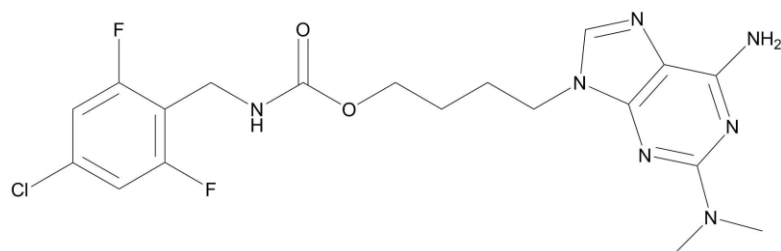


formula (LXXIII)

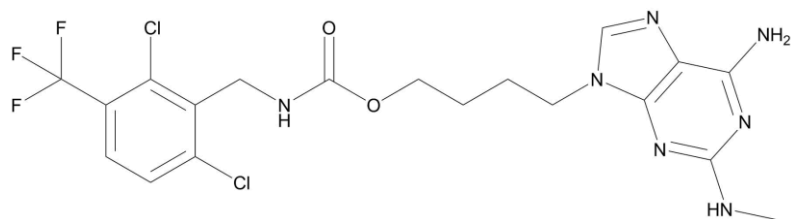


formula (LXXIV)

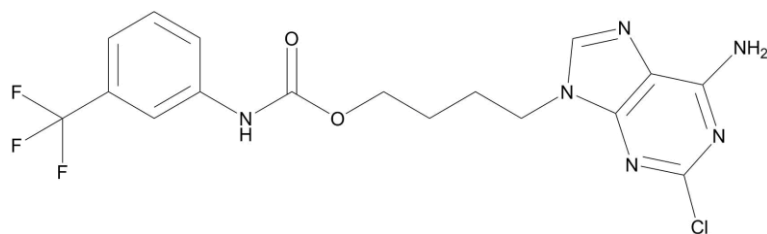




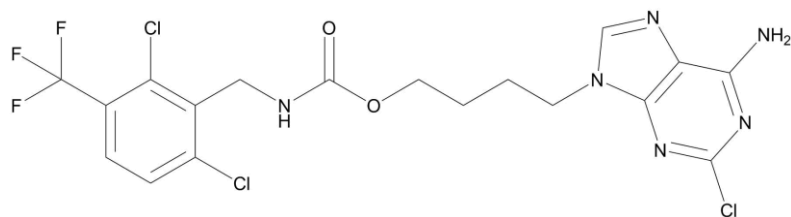
formula (LXXV)



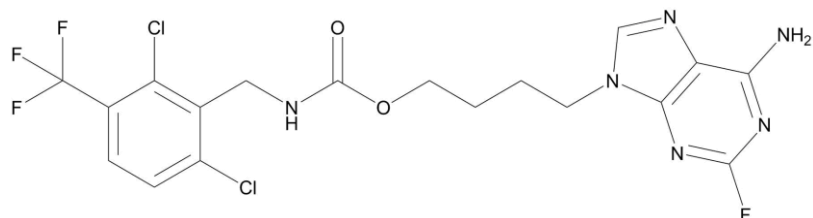
formula (LXXVI)



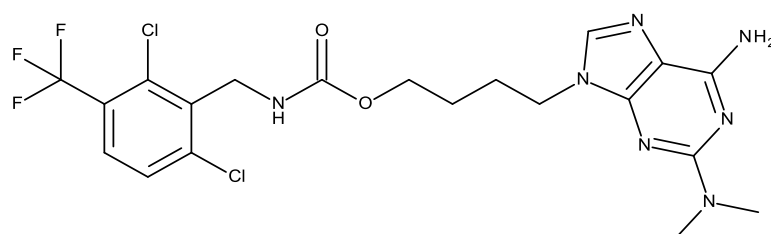
formula (LXXVII)



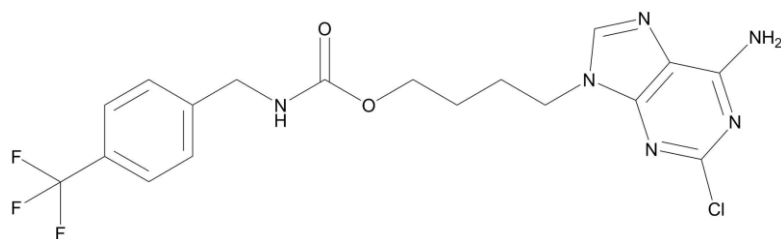
formula (LXXVIII)



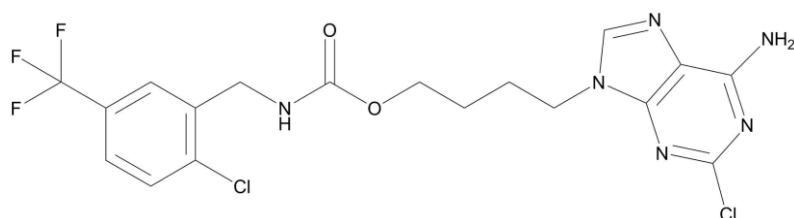
formula (LXXIX)



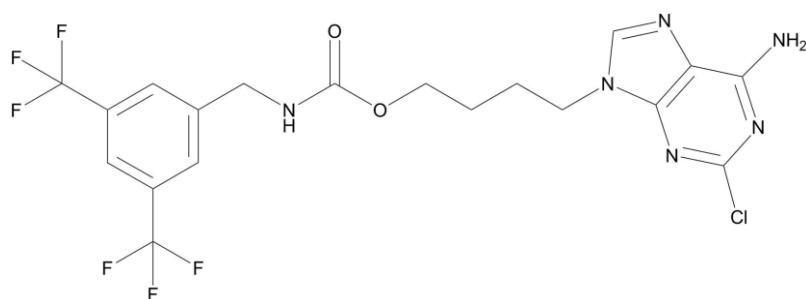
formula (LXXX)



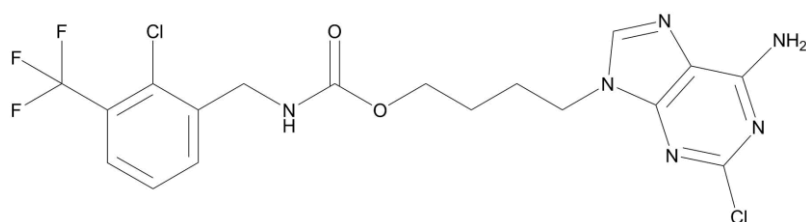
formula (LXXXI)



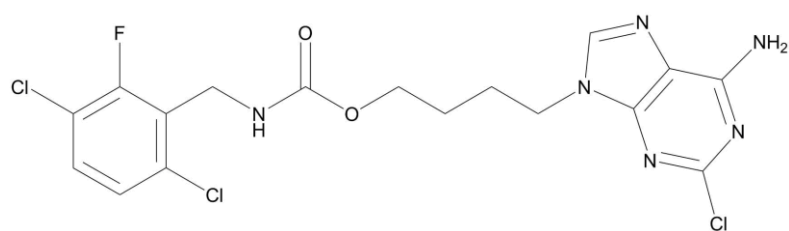
formula (LXXXII)



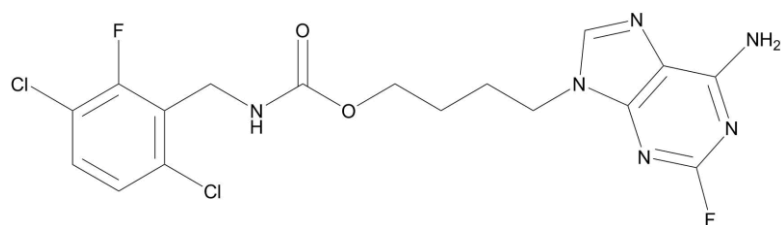
formula (LXXXIII)



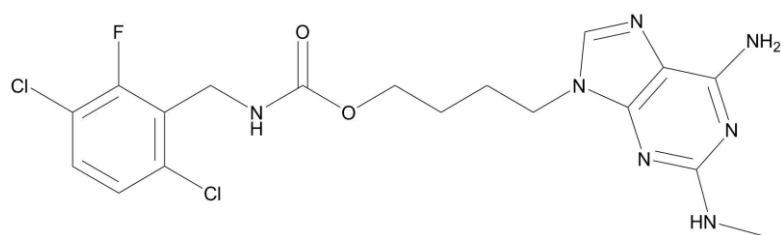
formula (LXXXIV)



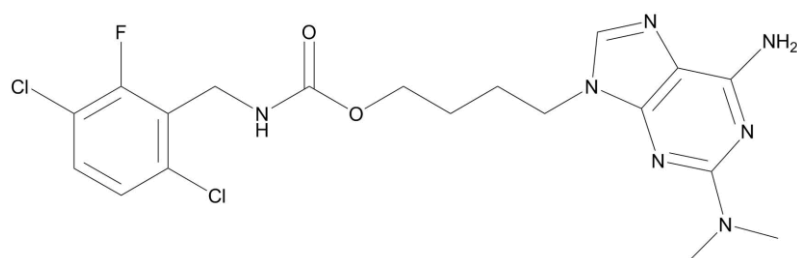
formula (LXXXV)



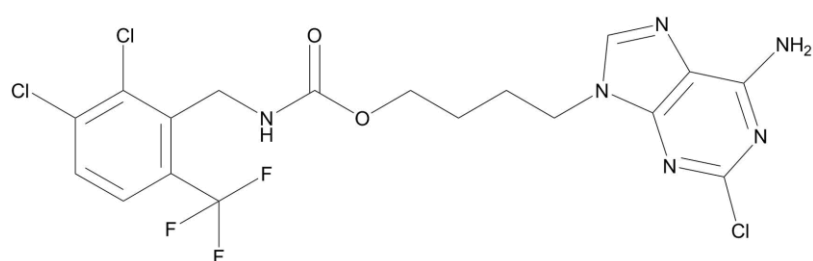
formula (LXXXVI)



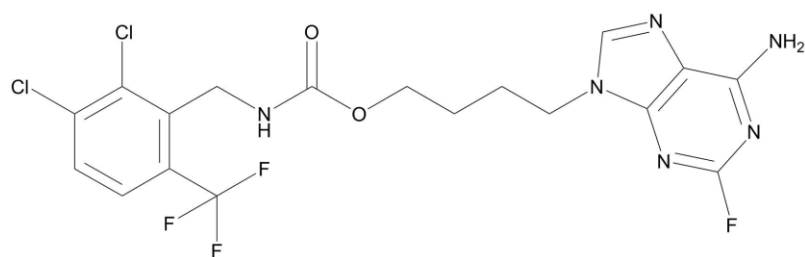
formula (LXXXVII)



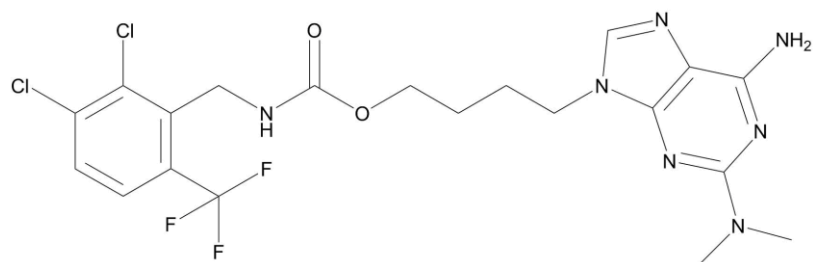
formula (LXXXVIII)



formula (LXXXIX)

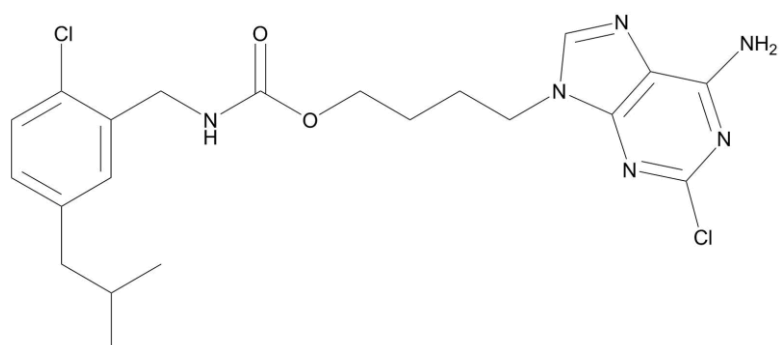


formula (XC)

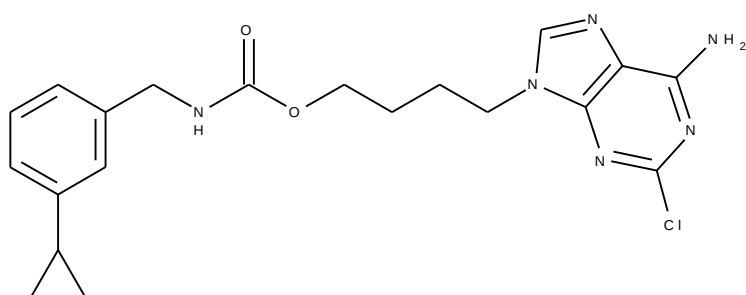


formula (XCI)

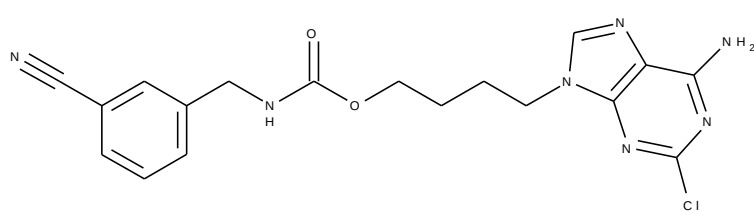
-206-



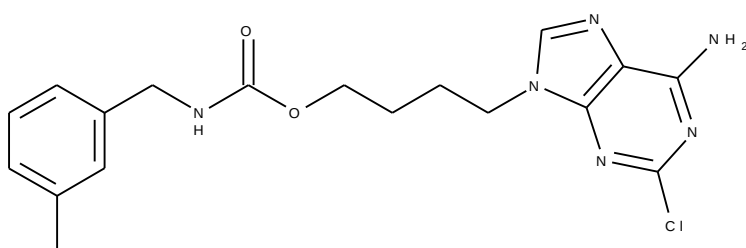
formula (XCII)



formula (XCII -1)



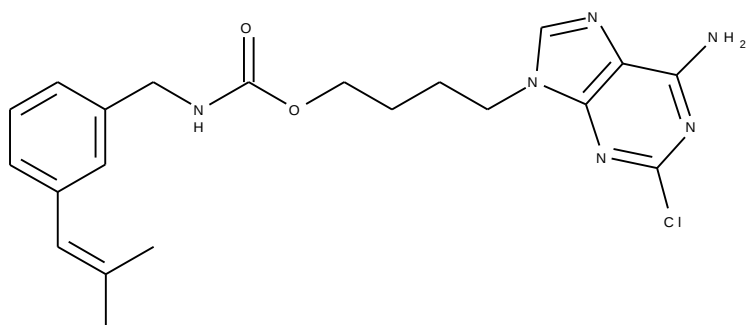
formula (XCII -2)



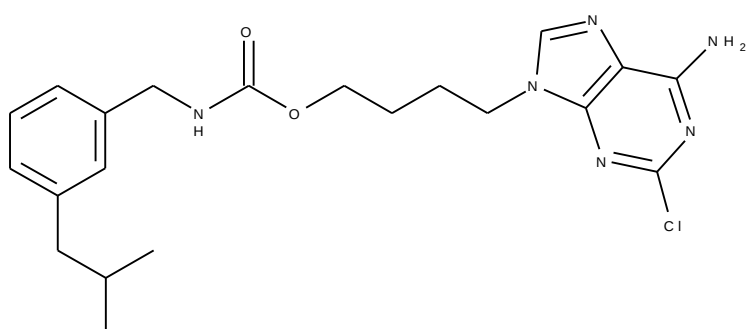
formula (XCII -3)

-207-

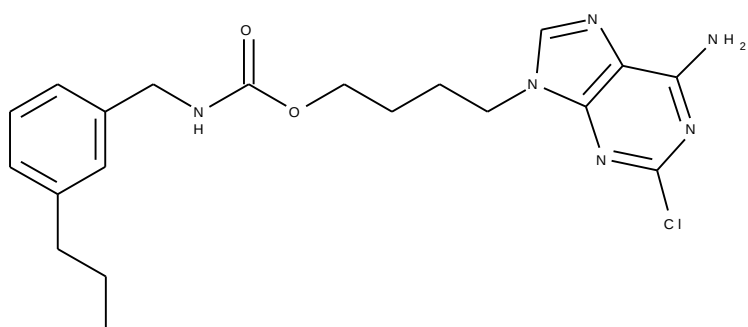
formula (XCII - 4)



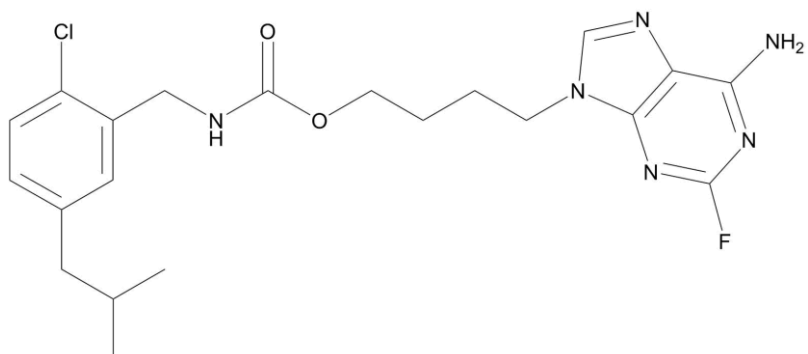
formula (XCII - 5)

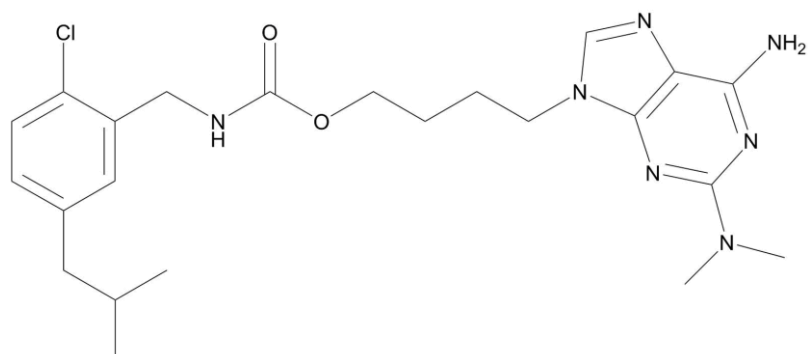


formula (XCII - 6)

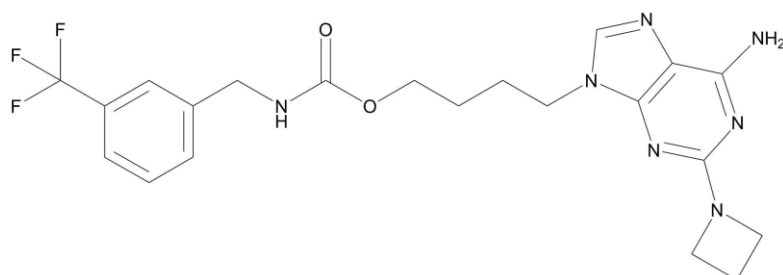


formula (XCII - 7)

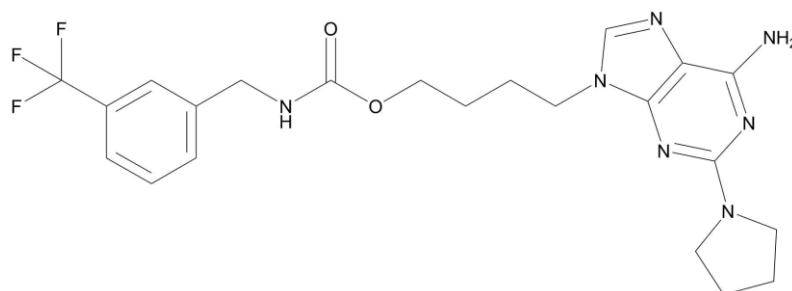




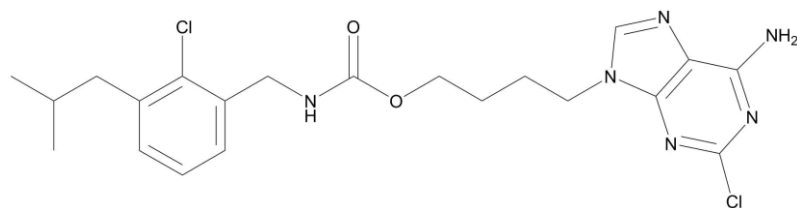
formula (XCIV)



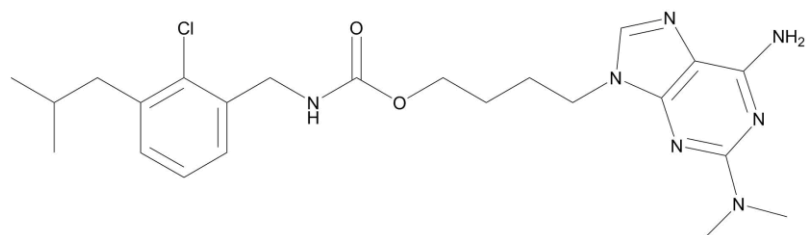
formula (XCV)



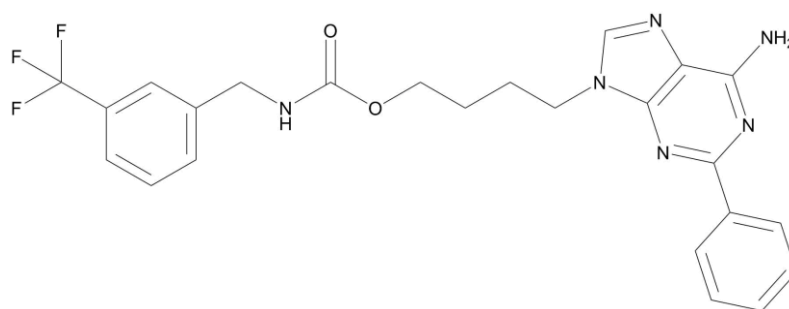
formula (XCVI)



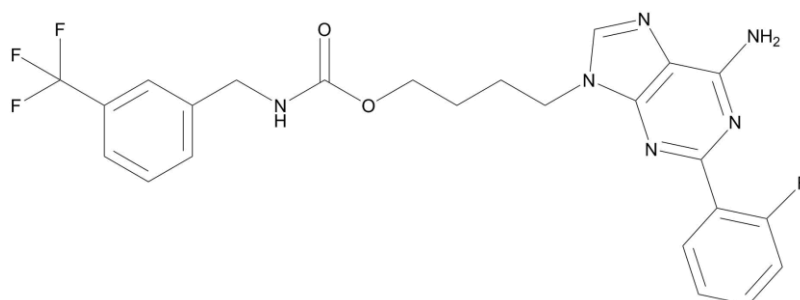
formula (XCVII)



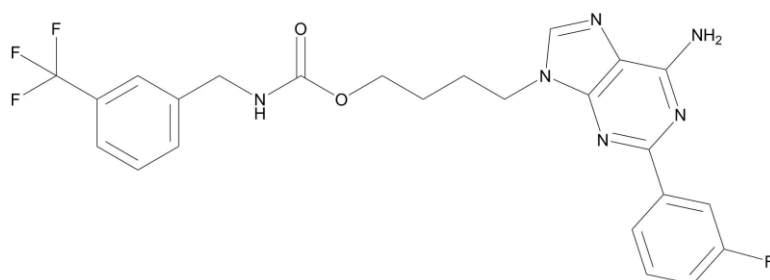
formula (XCVIII)



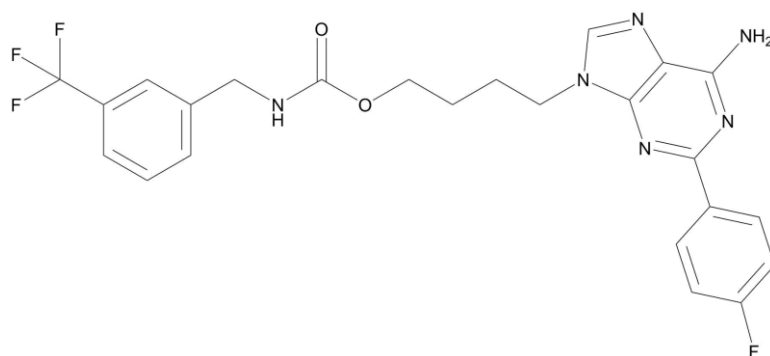
formula (XCIX)



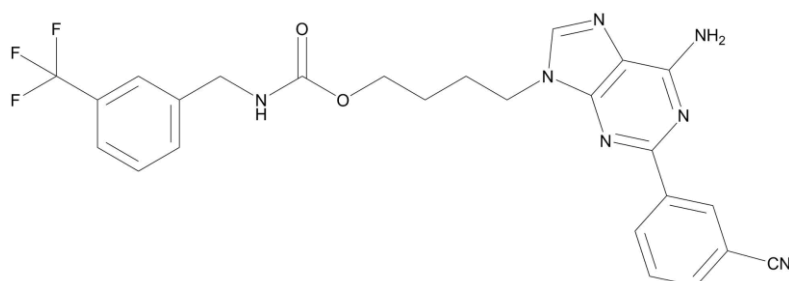
formula (C)



formula (CI)

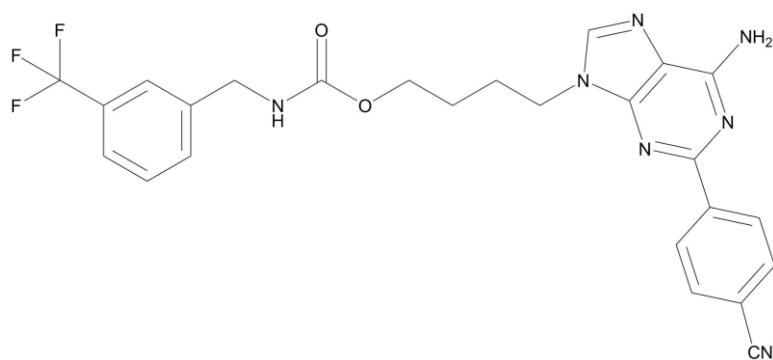


formula (CII)

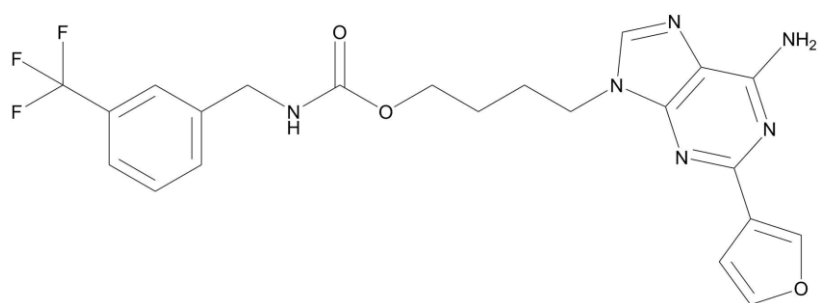


formula (CIII)

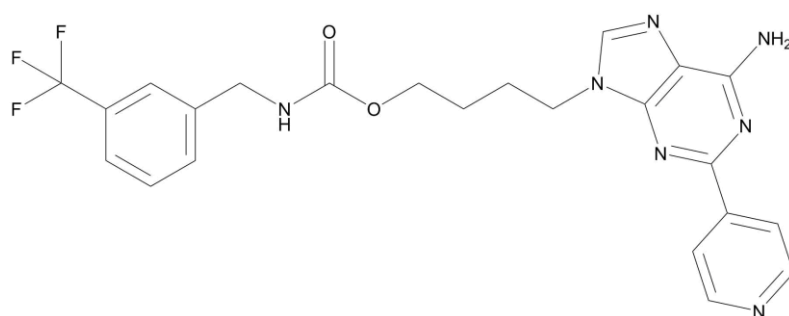
-210-



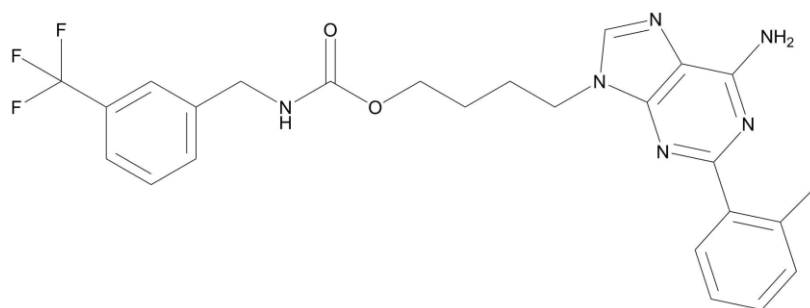
formula (CIV)



formula (CV)

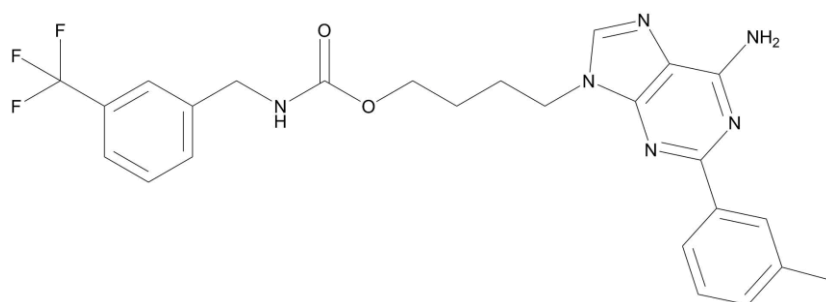


formula (CVI)

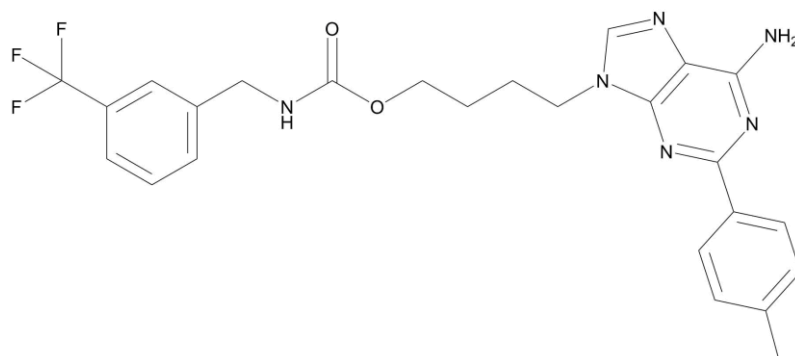


formula (CVII)

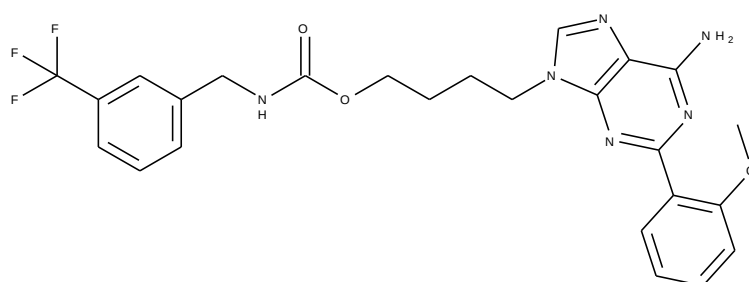
-211-



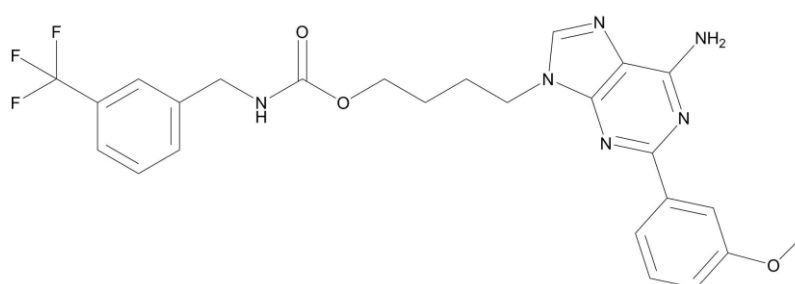
formula (CVIII)



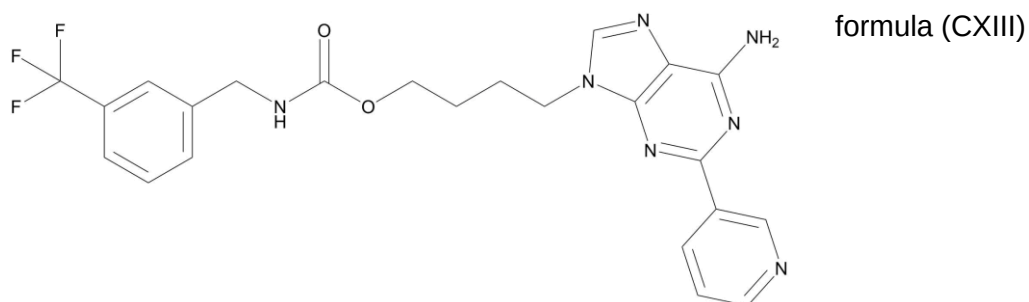
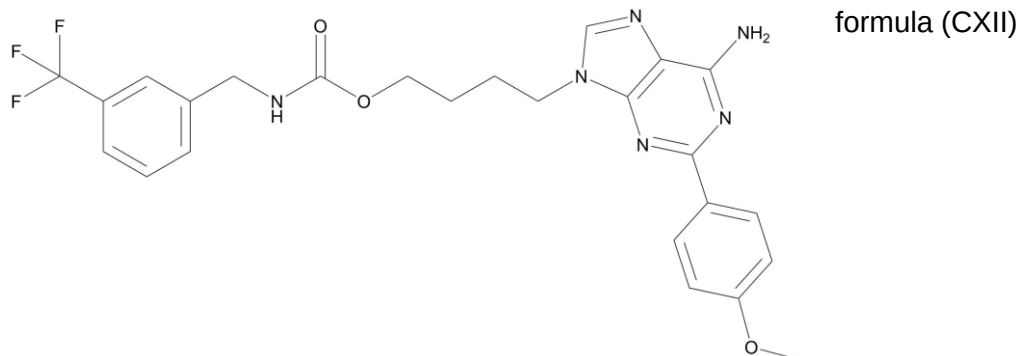
formula (CIX)



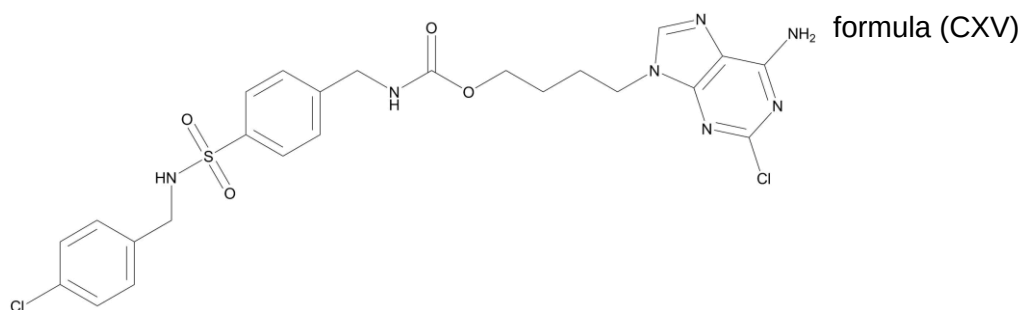
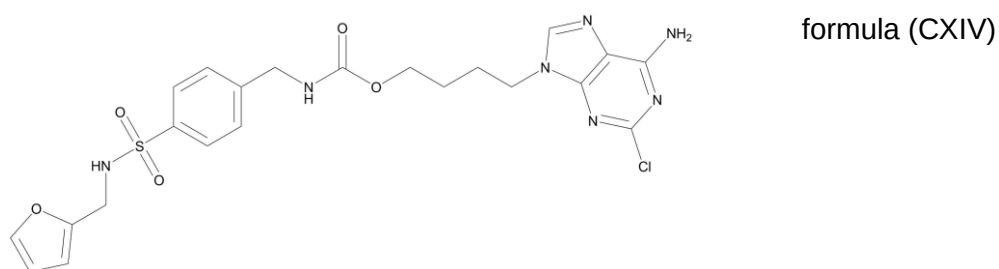
formula (CX)

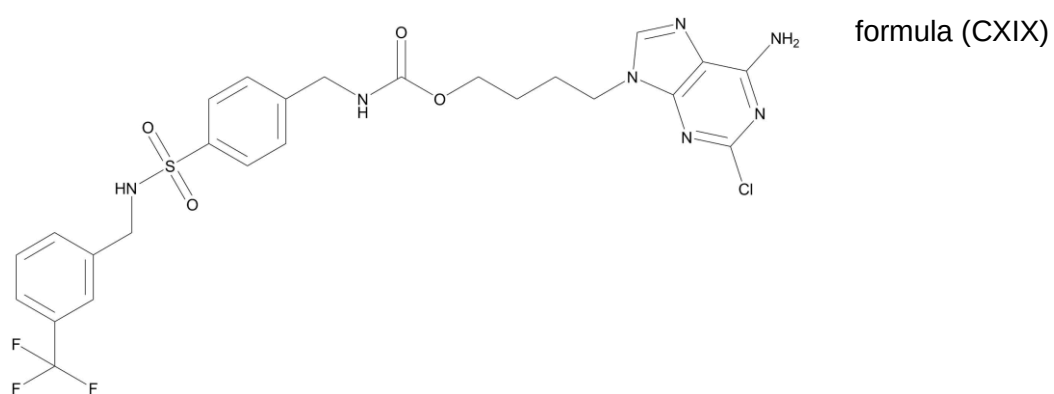
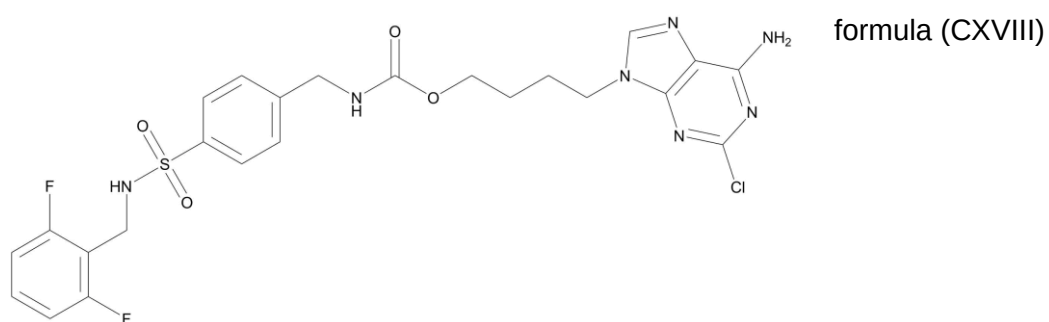
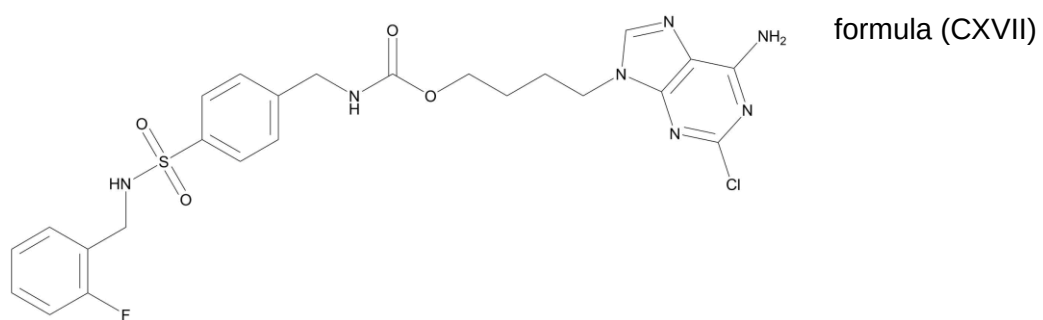
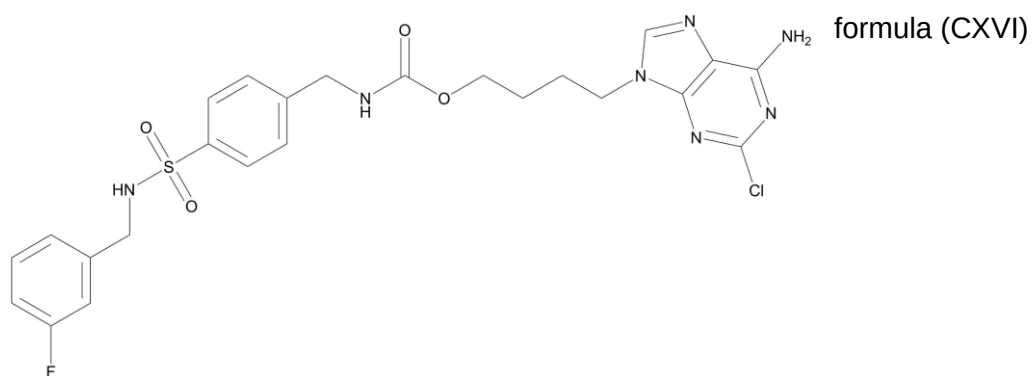


formula (CXI)

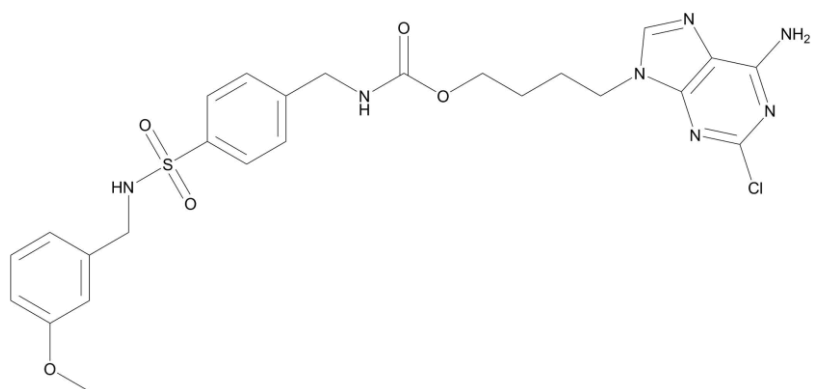


8. The compound (C) according to claim 1, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein compound of formula (II) is a compound chosen among those of formulae (CXIV) to (CXLVII) herein below

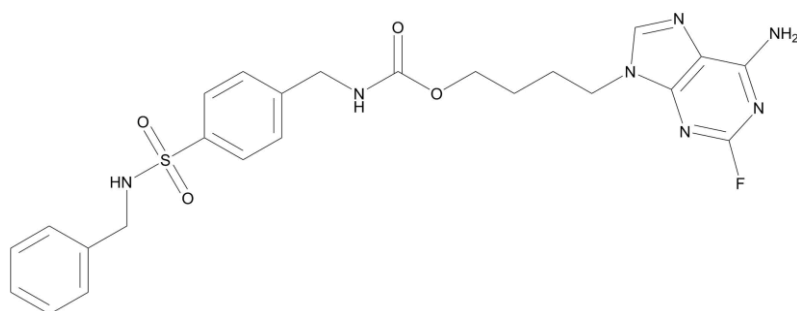




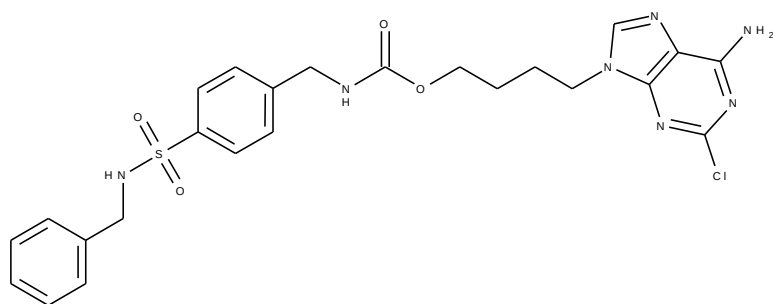
-214-



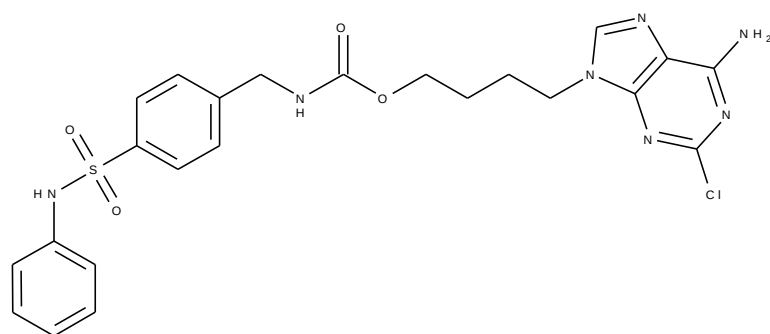
formula (CXX)



formula (CXXI)

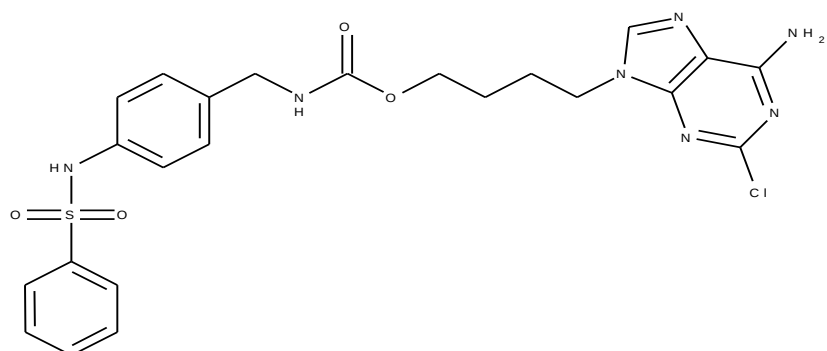


formula (CXXI - 1)

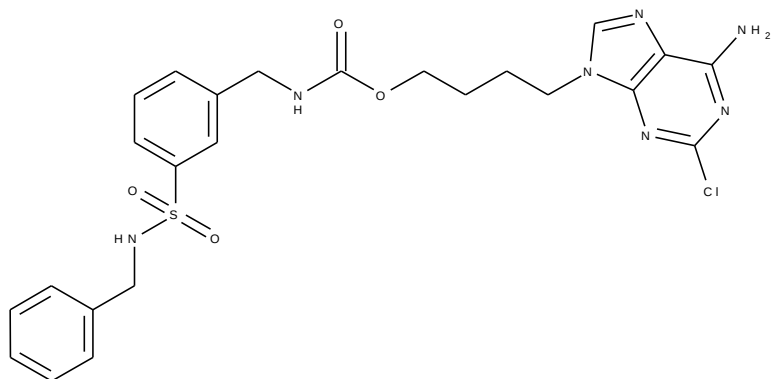


formula (CXXI - 2)

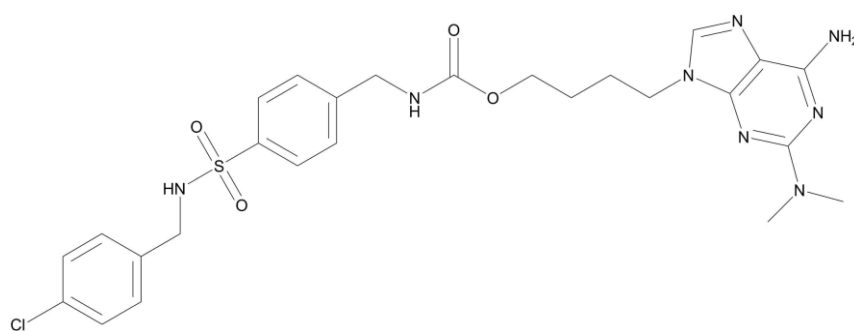
-215-



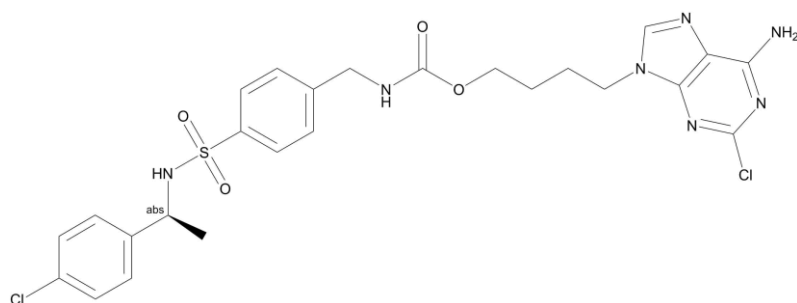
formula (CXXI - 3)



formula (CXXI - 4)

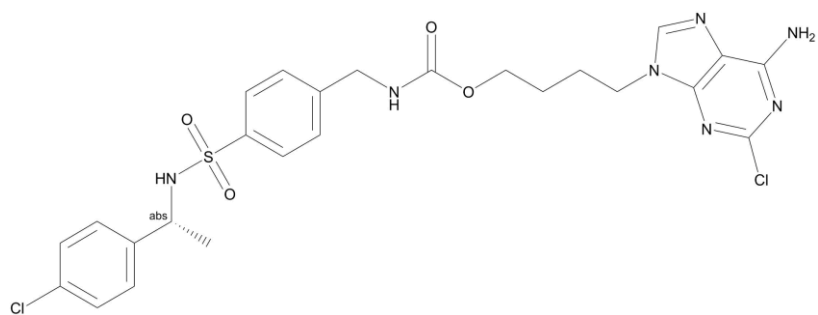


formula (CXXII)

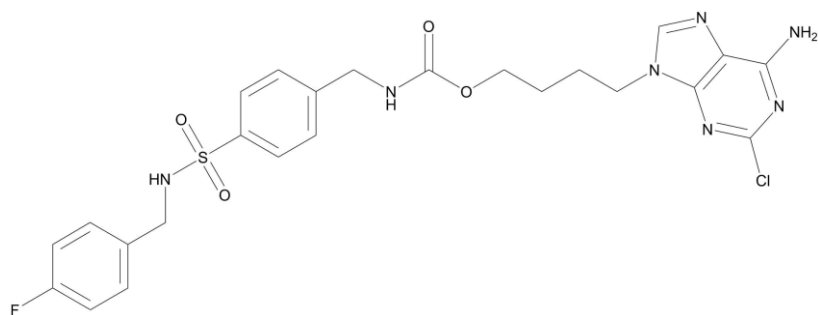


Formula (CXXIII)

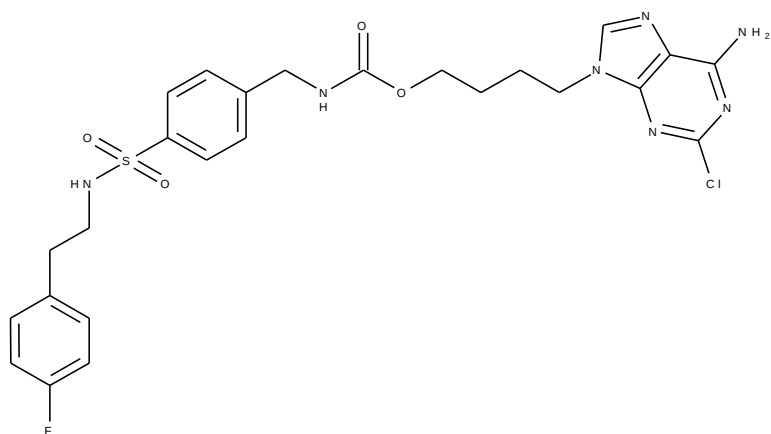
-216-



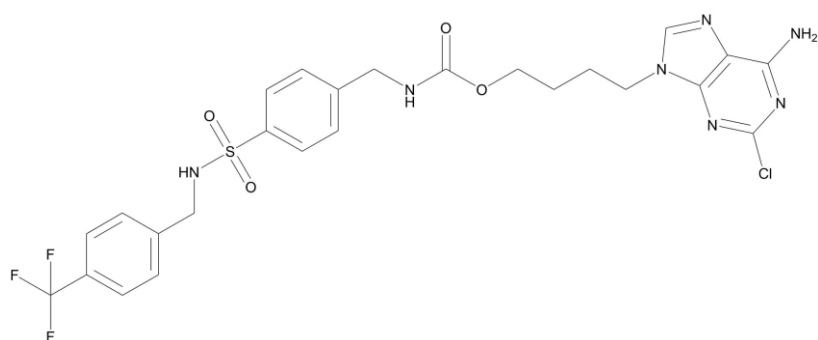
formula (CXXIV)



formula (CXXV)

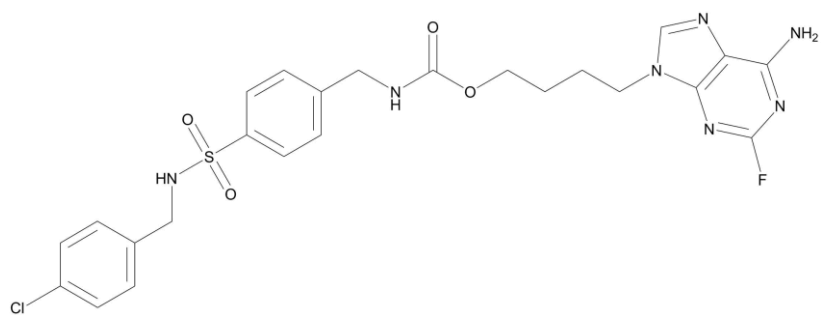


formula (CXXV - 1)

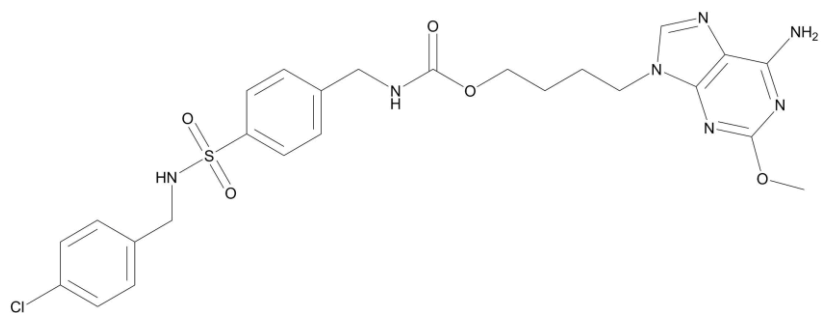


formula (CXXVI)

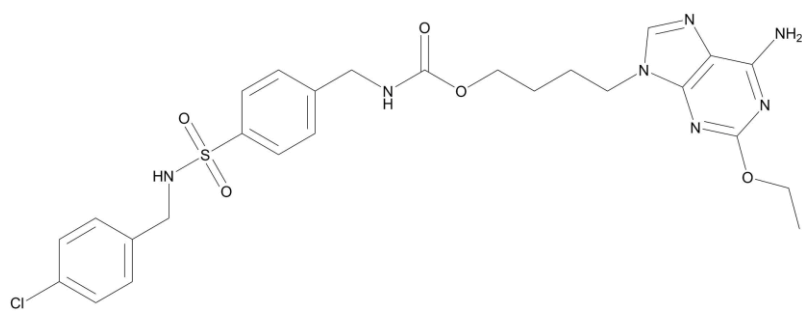
-217-



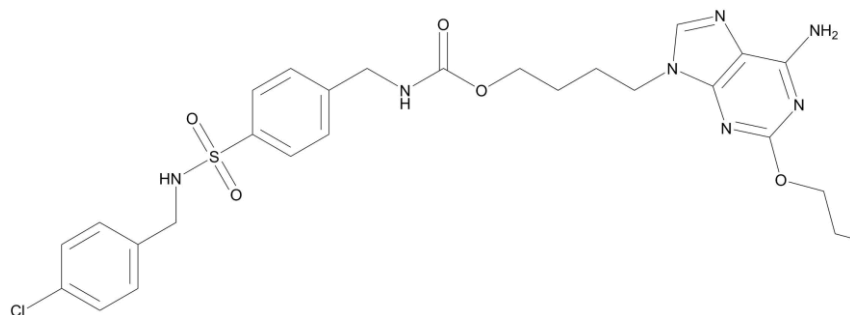
formula (CXXVII)



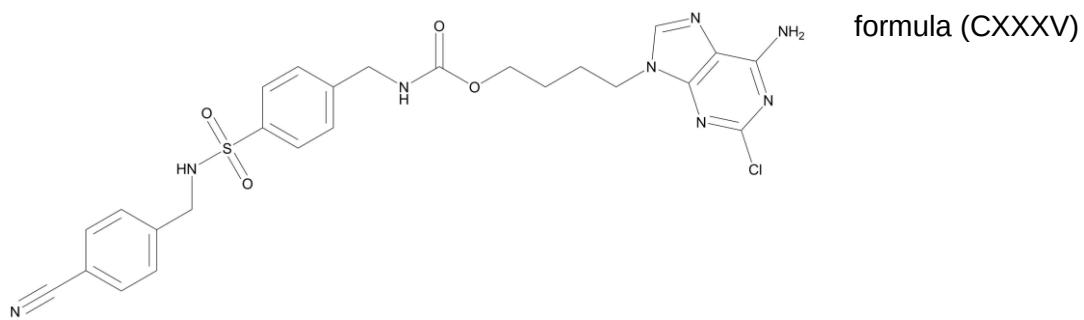
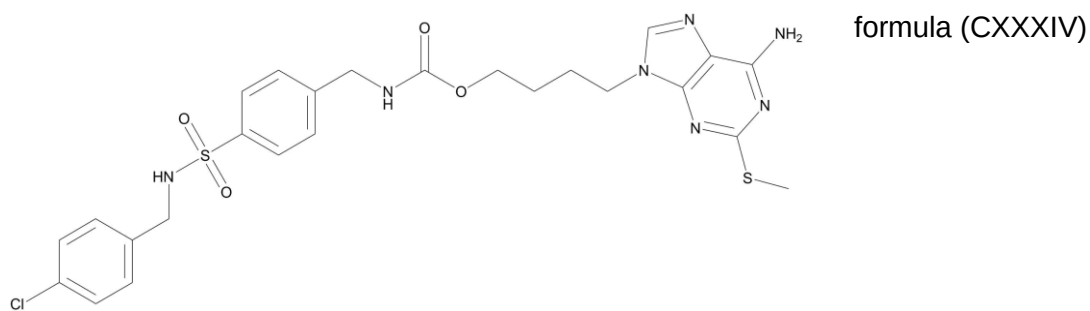
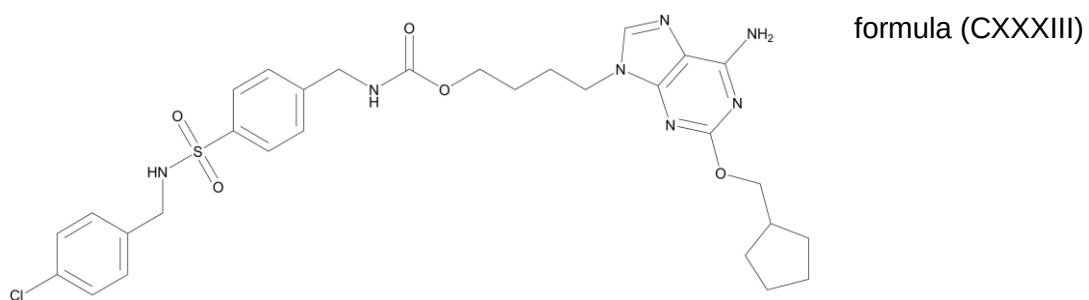
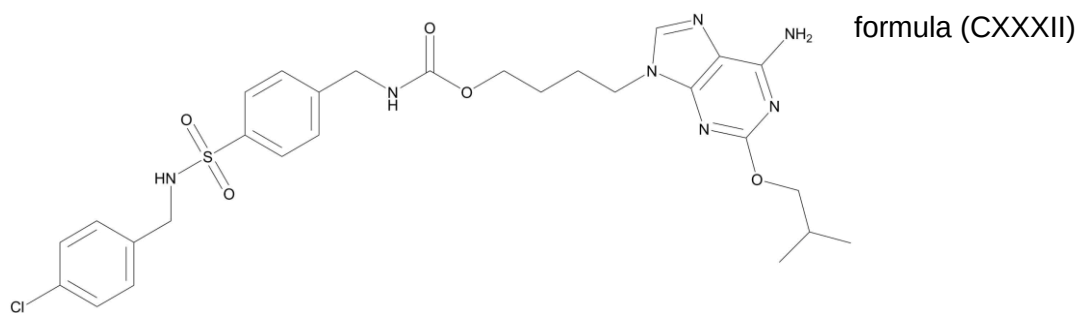
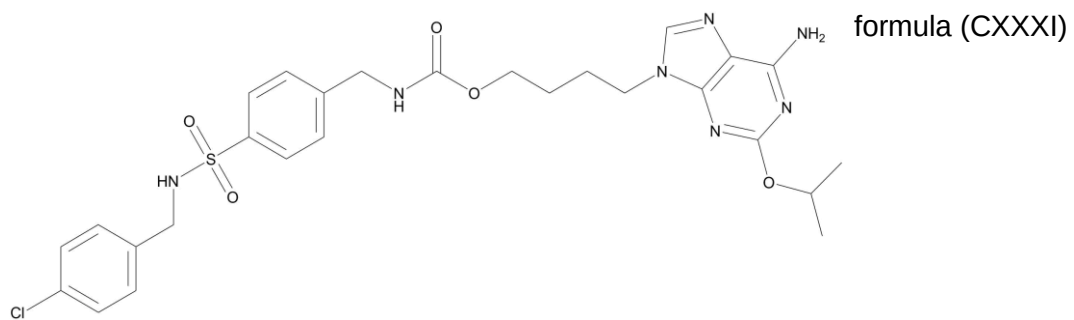
formula (CXXVIII)

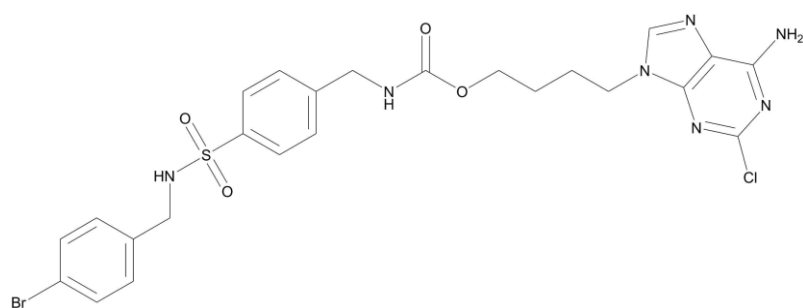


formula (CXXIX)

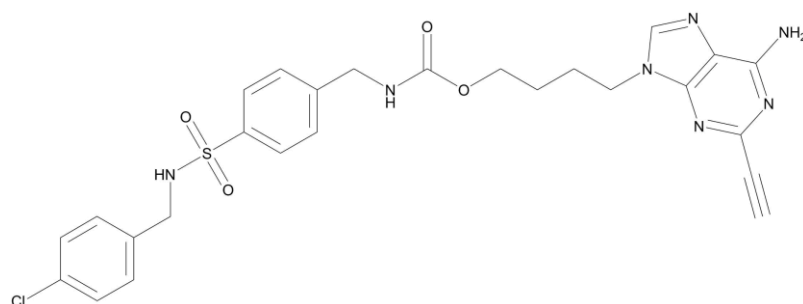


formula (CXXX)

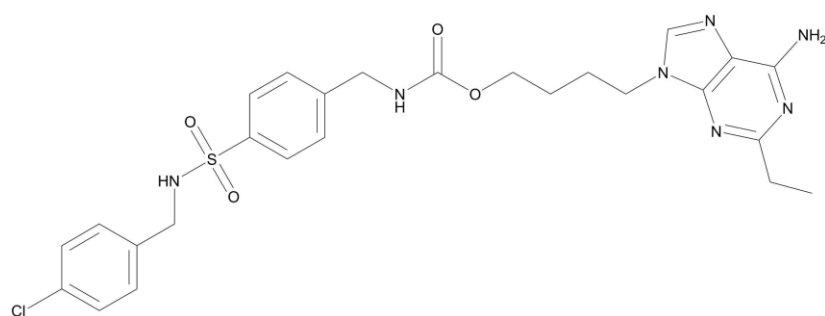




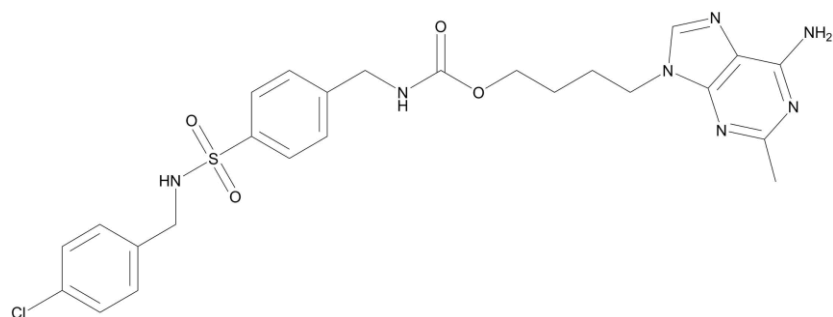
formula (CXXXVI)



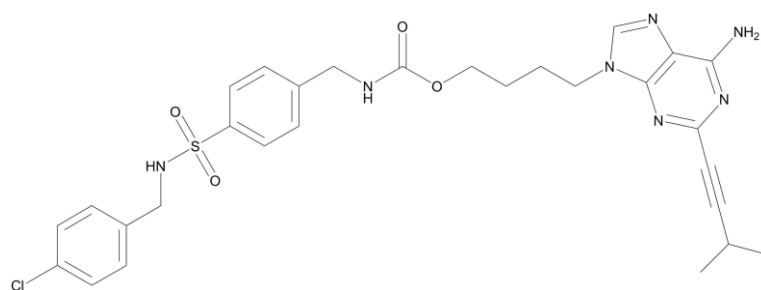
formula (CXXXVII)



formula (CXXXVIII)

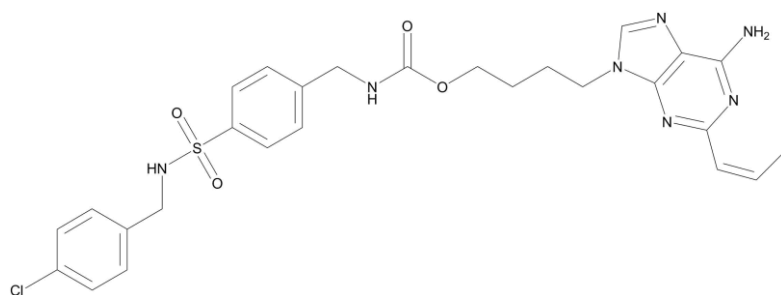


formula (CXXXIX)

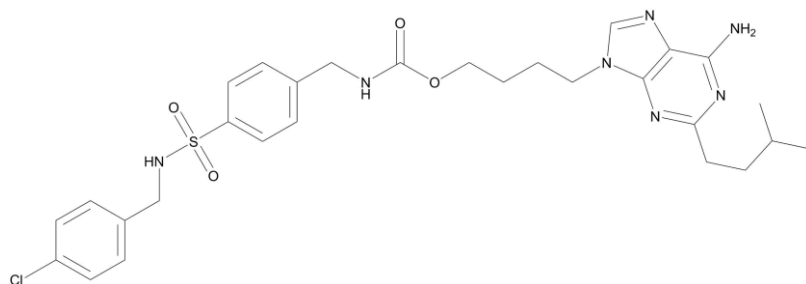


formula (CXL)

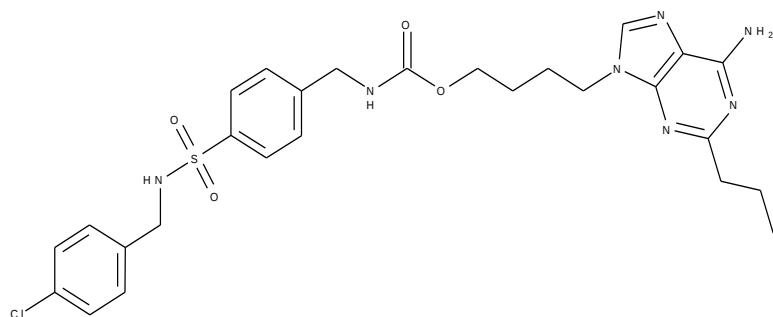
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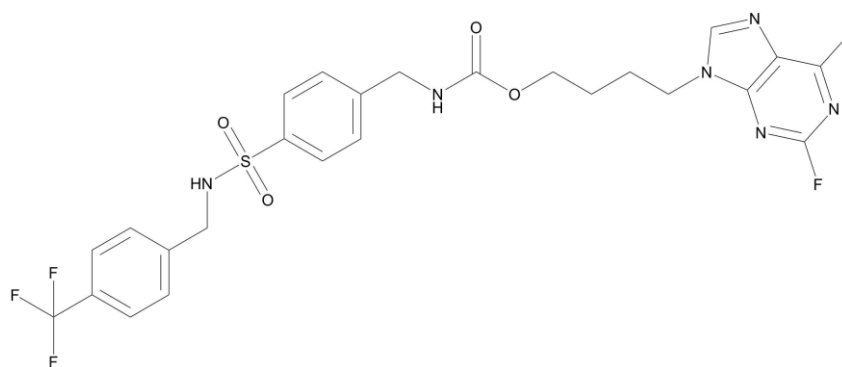
formula (CXLI)



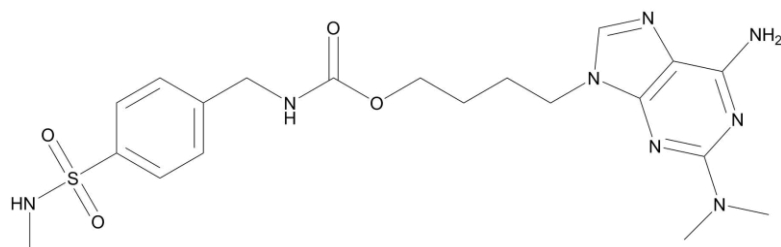
formula (CXLII)



formula (CXLIII)

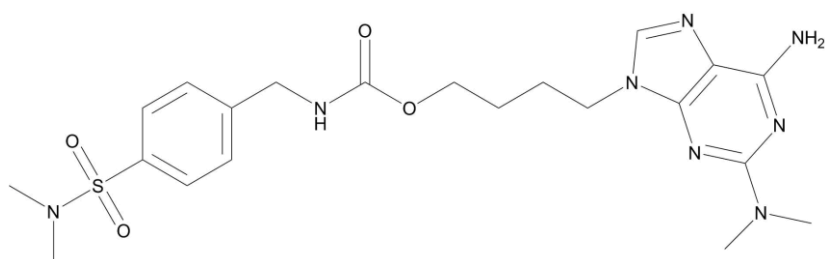


formula (CXLIV)

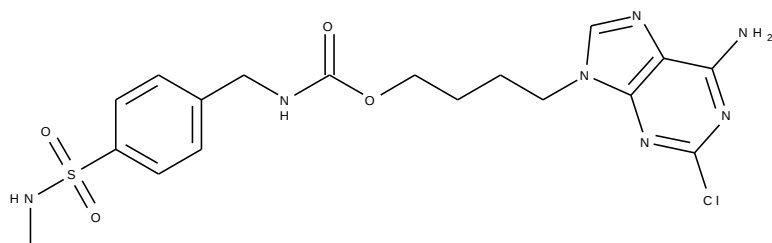


formula (CXLV)

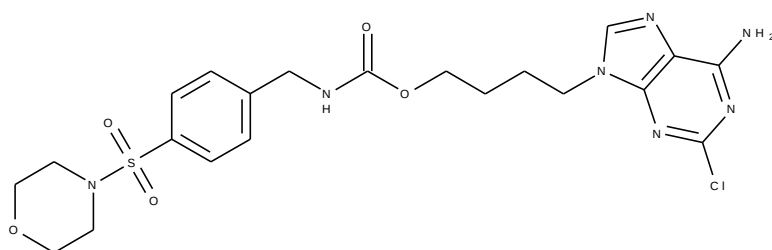
-221-



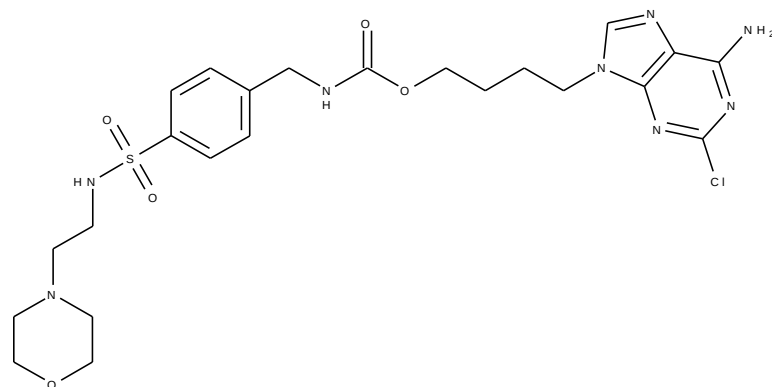
formula (CXLVI)



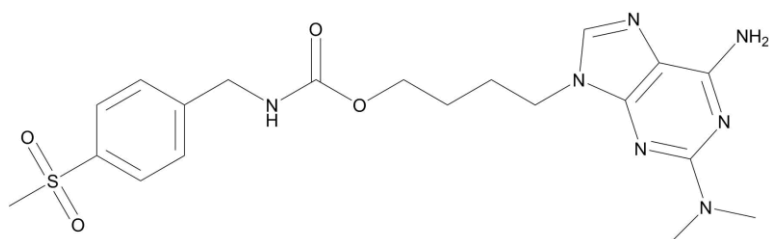
formula (CXLVI - 1)



formula (CXLVI - 2)



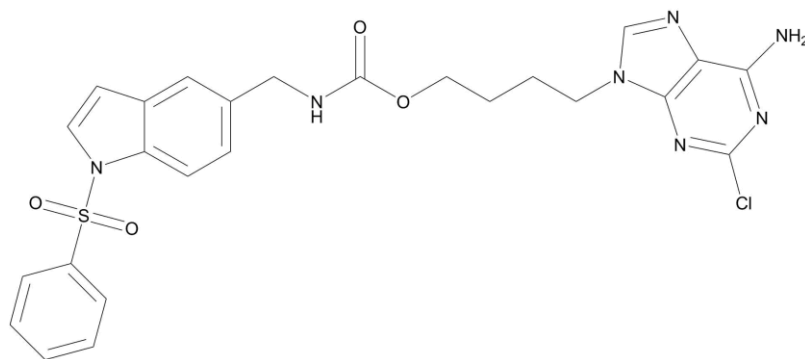
formula (CXLVI - 3)



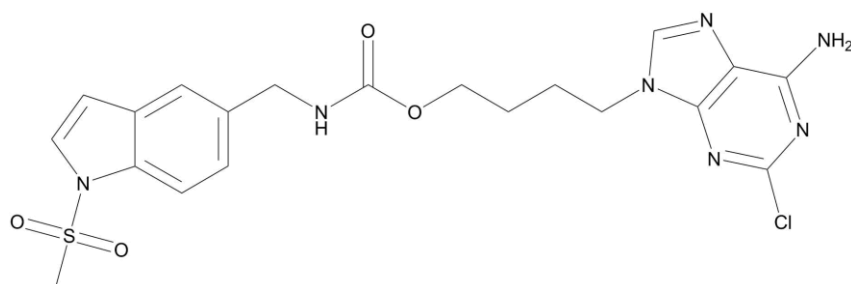
formula (CXLVII)

9. The compound (C) according to claim 1, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or

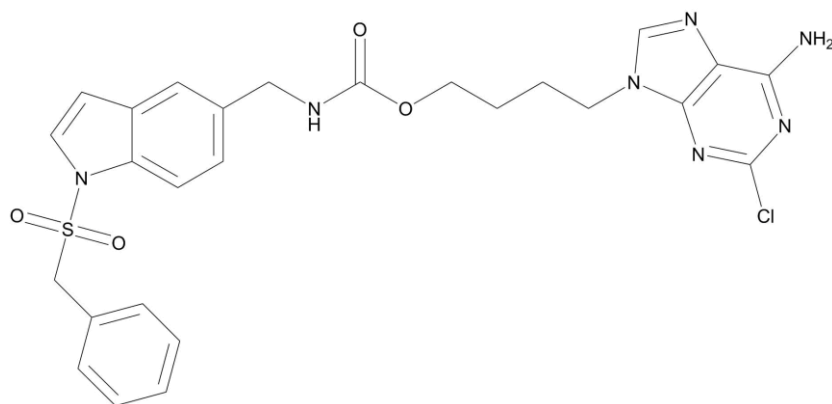
stereoisomer thereof, wherein compound of formula (IV) is a compound chosen among those of formulae (CXLVIII) to (CLVII), (CLIX) to (CLXX) or (XXV) to (XXV - 13) herein below:



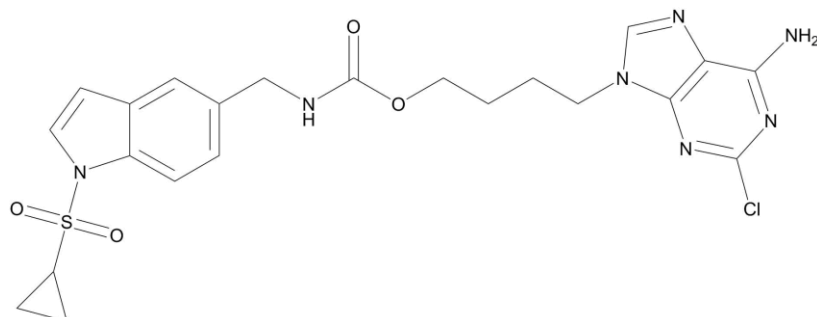
formula (CXLVIII)



formula (CXLIX)

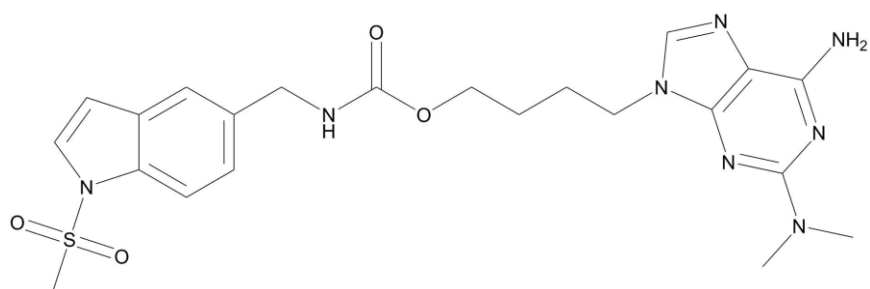


formula (CL)

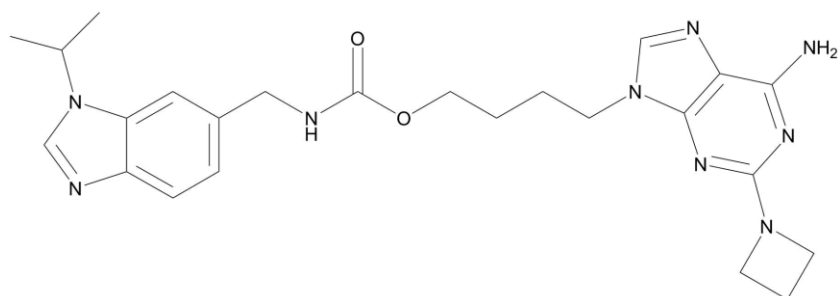


formula (CLI)

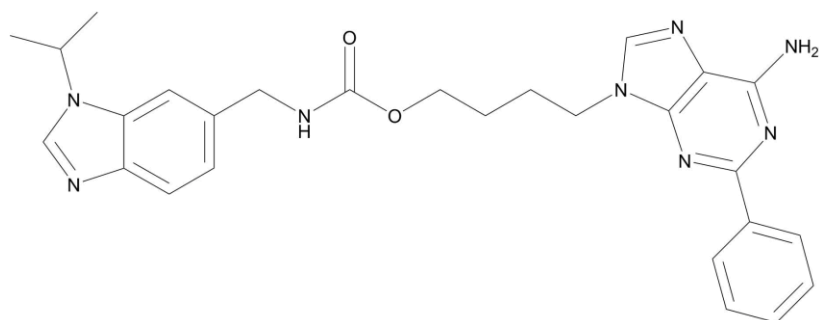
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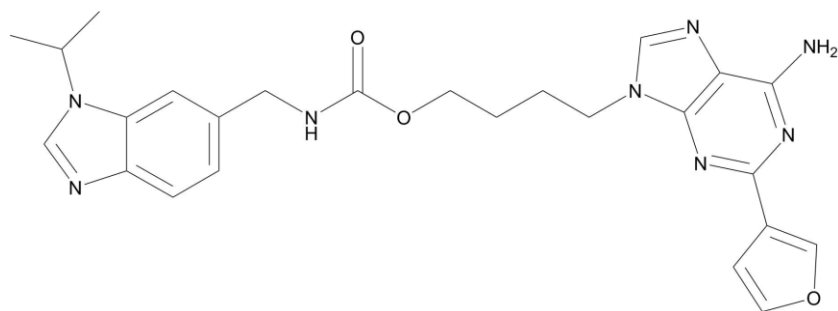
formula (CLII)



formula (CLIII)

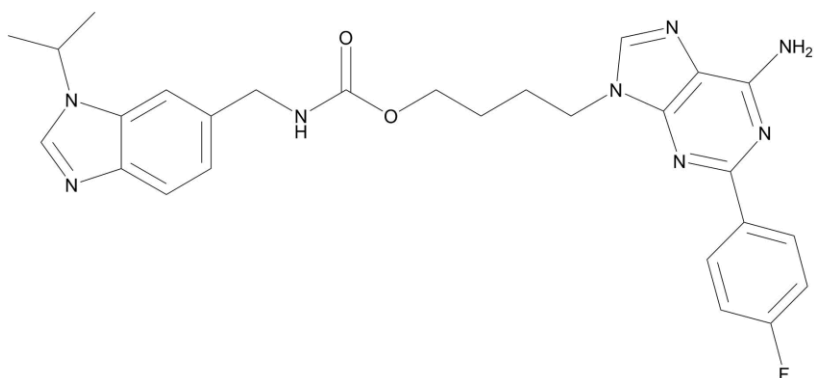


formula (CLIV)

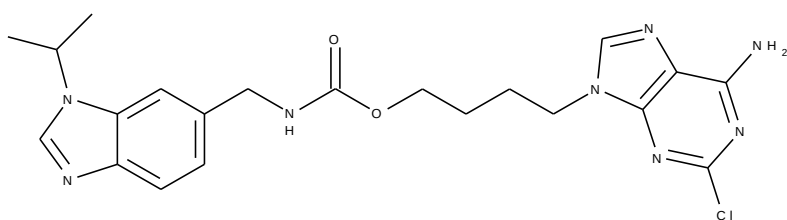


formula (CLV)

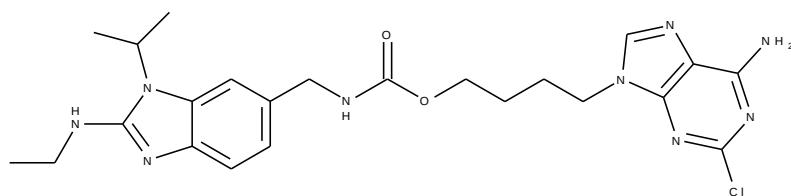
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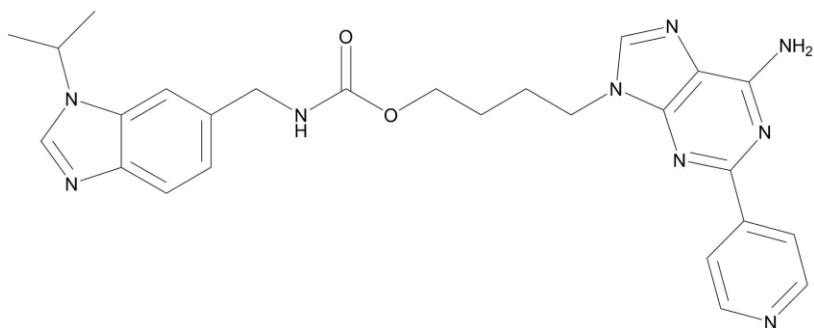
formula (CLVI)



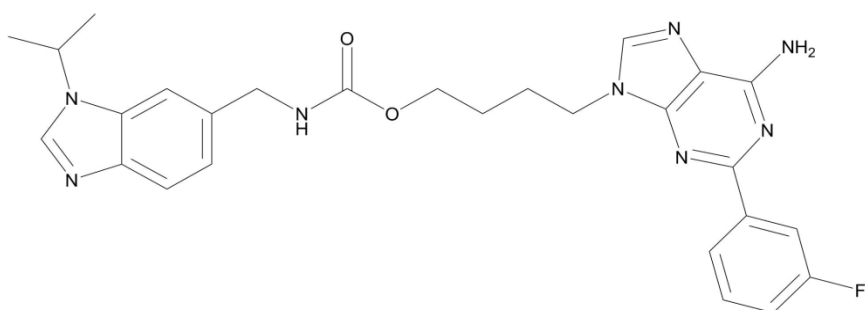
formula (CLVI - 1)



formula (CLVI - 2)

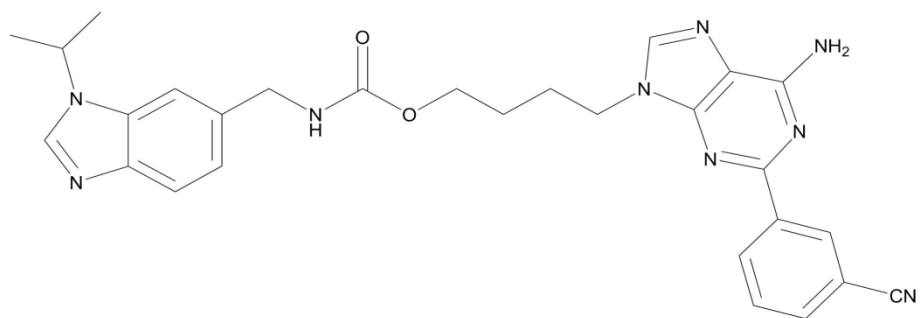


formula (CLVII)

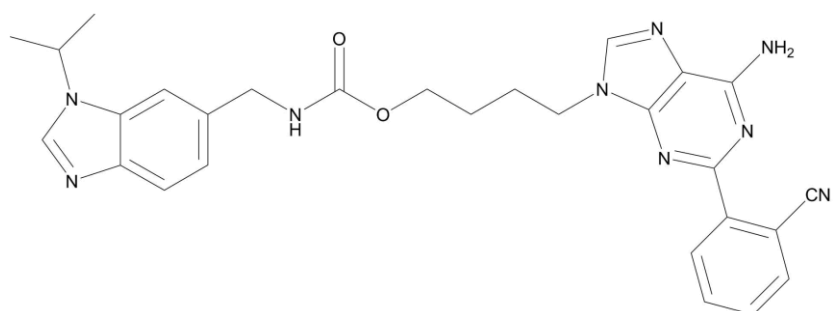


formula (CLIX)

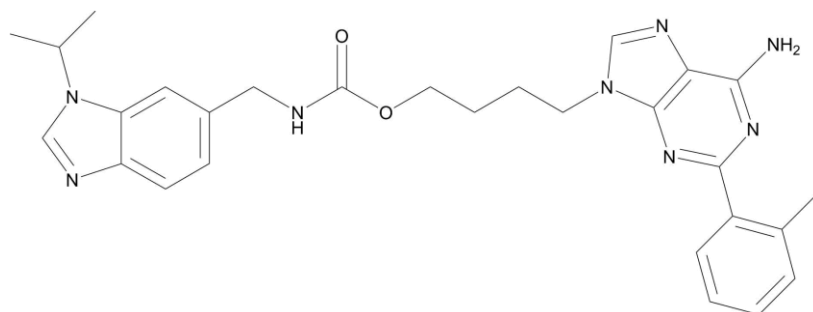
-225-



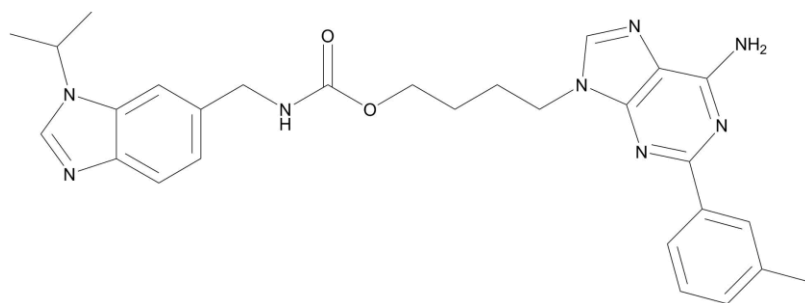
formula (CLX)



formula (CLXII)

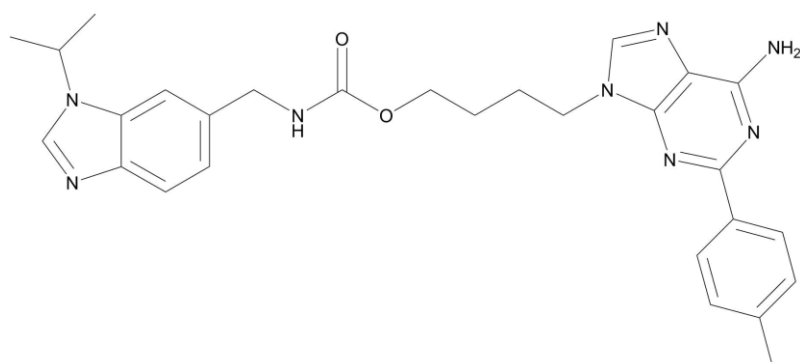


formula (CLXIII)

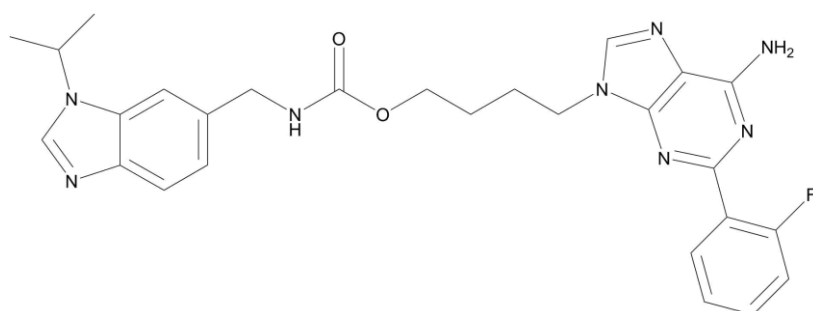


formula (CLXIV)

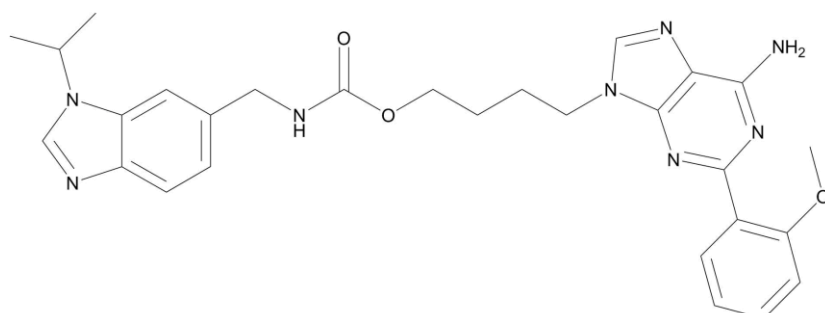
-226-



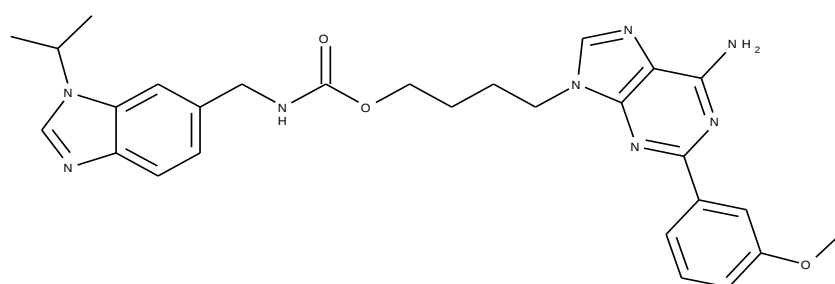
formula (CLXV)



formula (CLXVI)

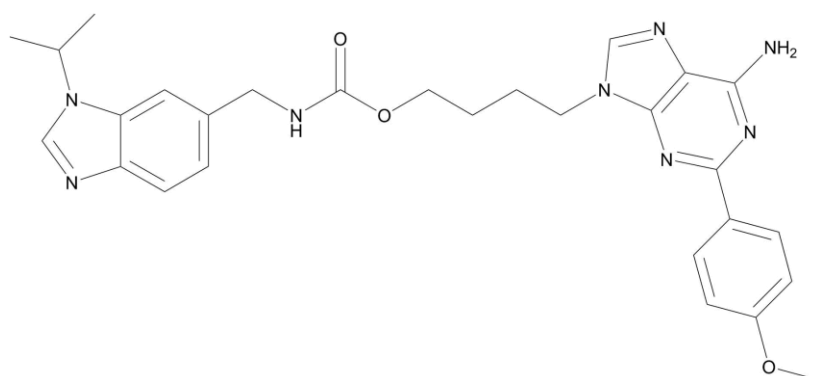


formula (CLXVII)

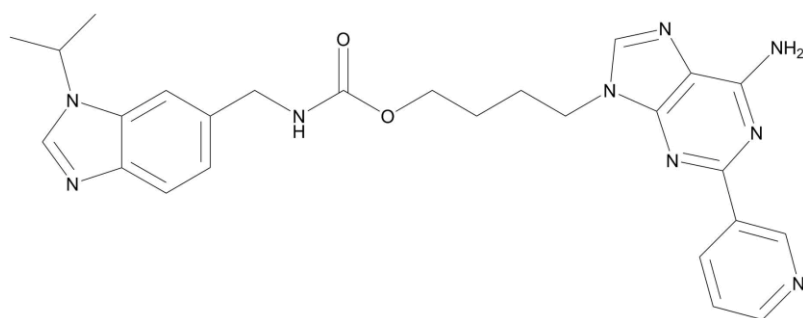


formula (CLXVIII)

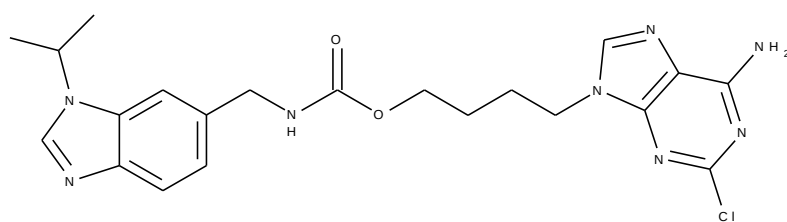
-227-



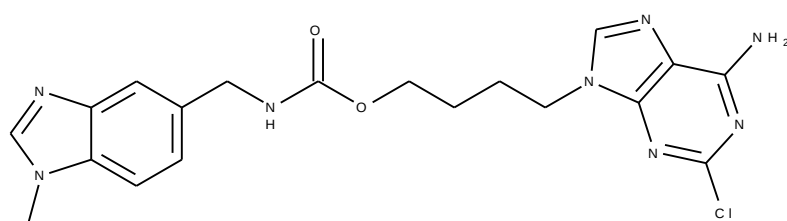
formula (CLXIX)



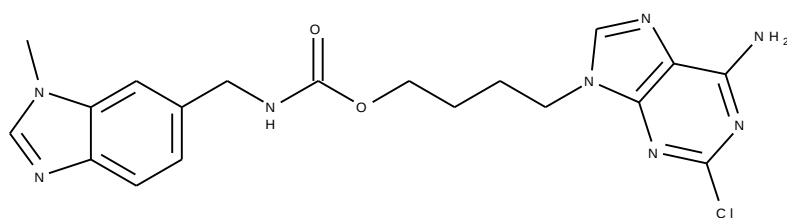
formula (CLXX)



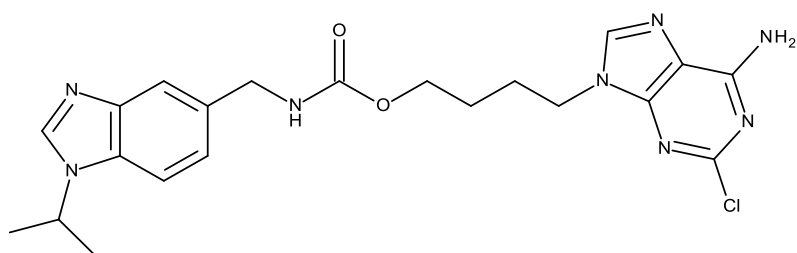
formula (XXV)



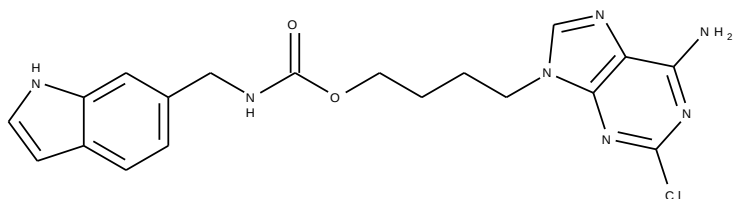
formula (XXV - 1)



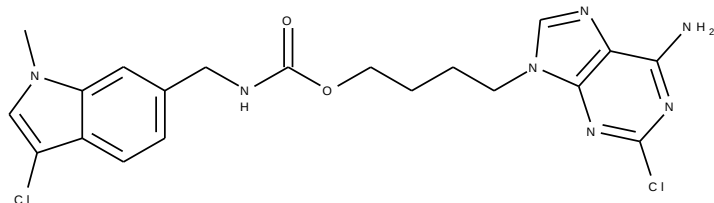
formula (XXV - 2)



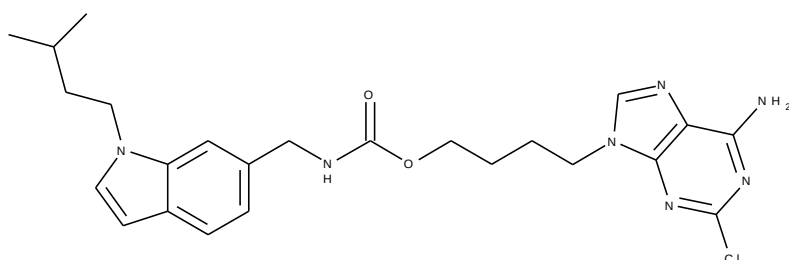
formula (XXV - 3)



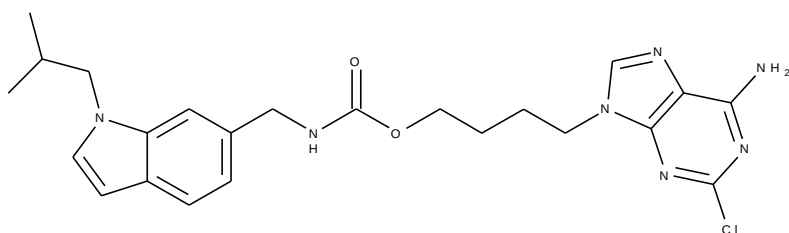
formula (XXV - 4)



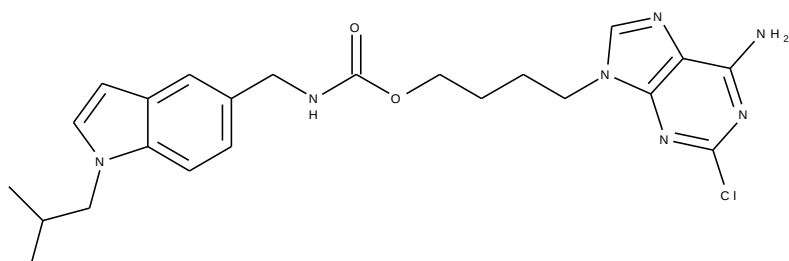
formula (XXV - 5)



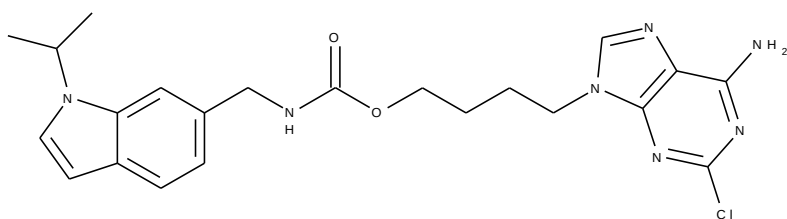
formula (XXV - 6)



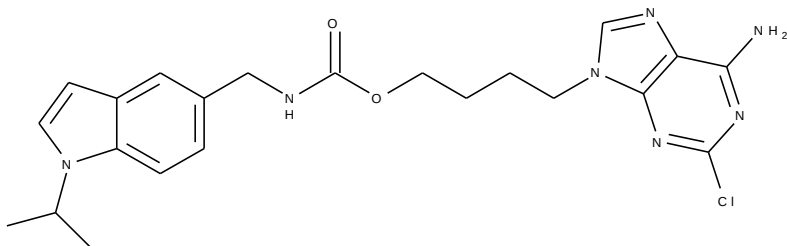
formula (XXV - 7)



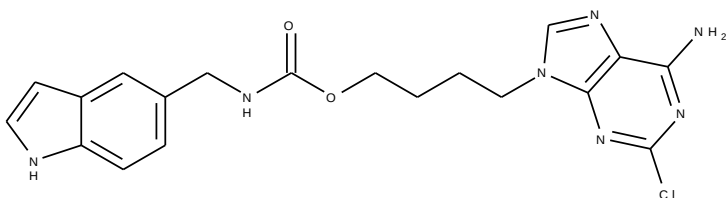
formula (XXV - 8)



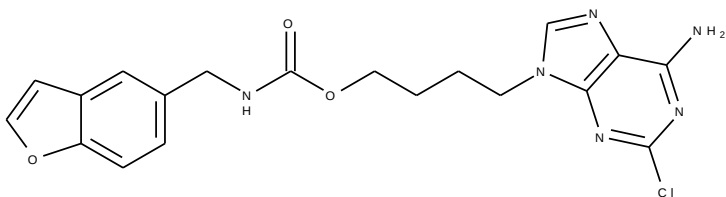
formula (XXV - 9)



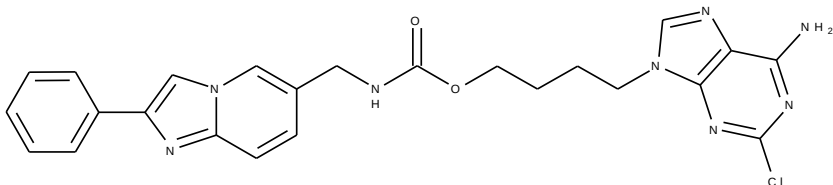
formula (XXV - 10)



formula (XXV - 11)

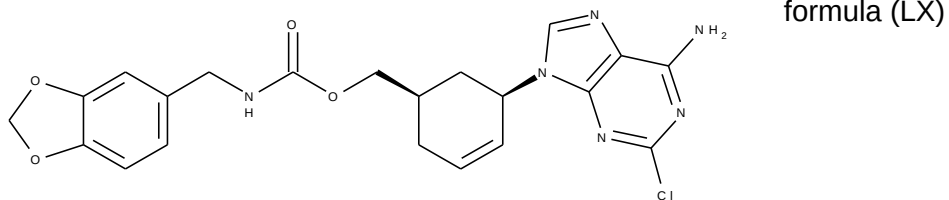


formula (XXV - 12)

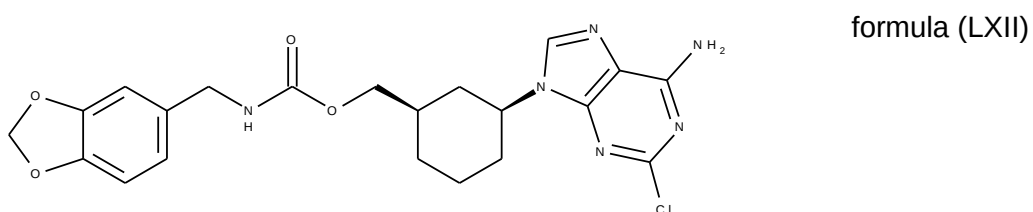
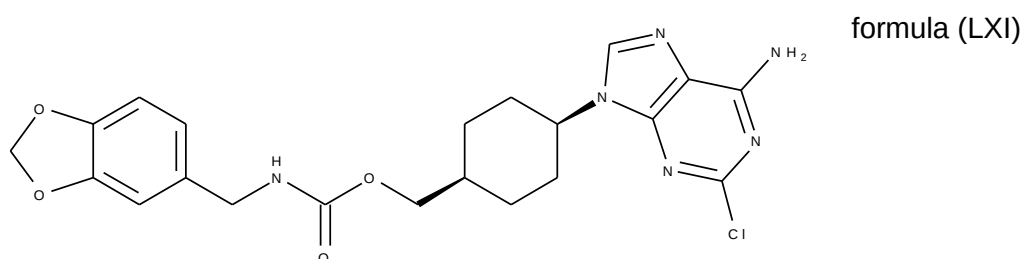


formula (XXV - 13)

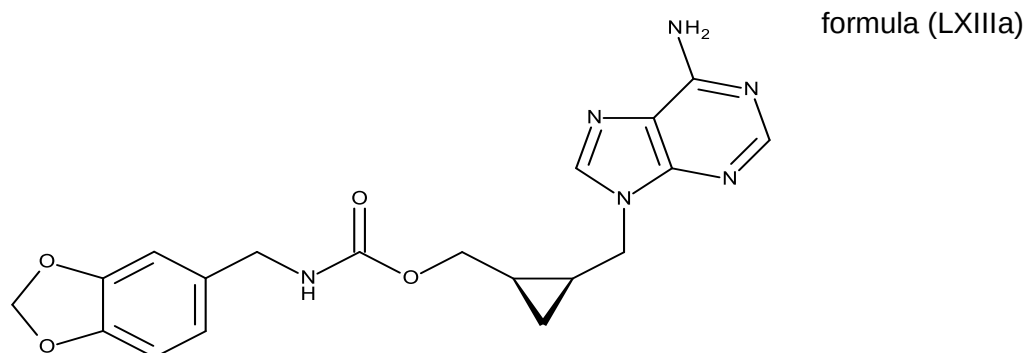
10. The compound (C) according to claim 5, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein compound of formula (XVII) is a compound of formula (LX)



11. The compound (C) according to claim 4 or claim 6, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein compound of formula (XIII) is chosen among those of formula (LXI) or (LXII) herein below:

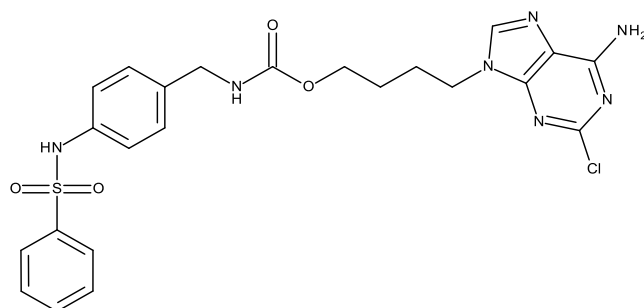
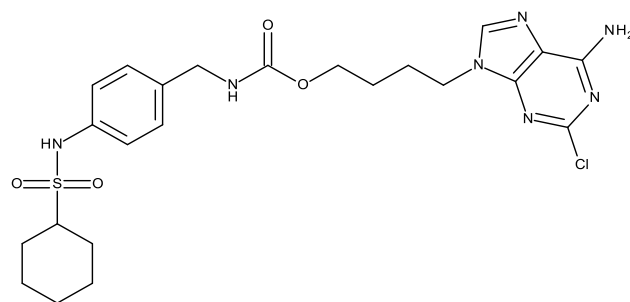
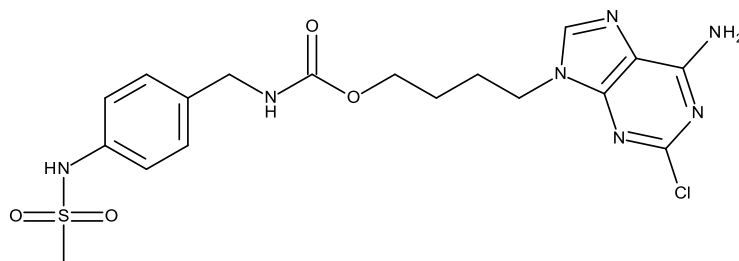
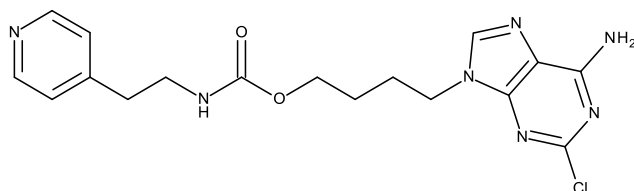


5 12. The compound (C) according to claim 3, or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein compound of formula (IX') is a compound according to formula (LXIIIa) herein below

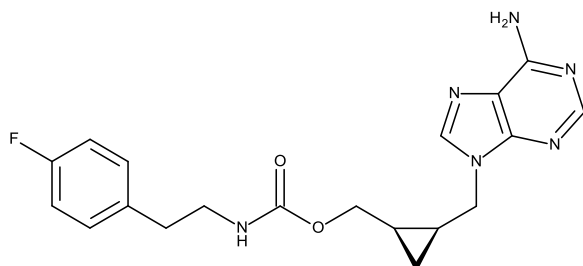
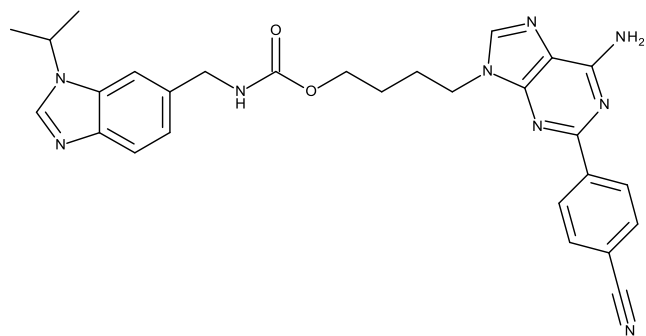
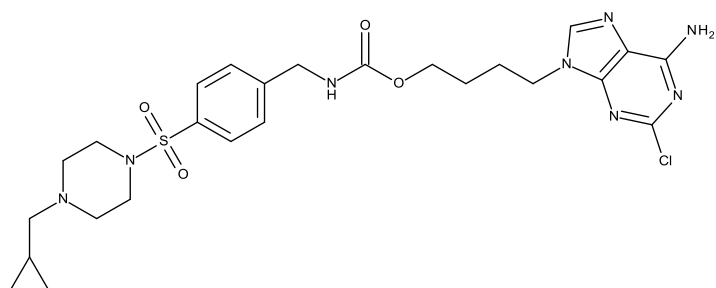
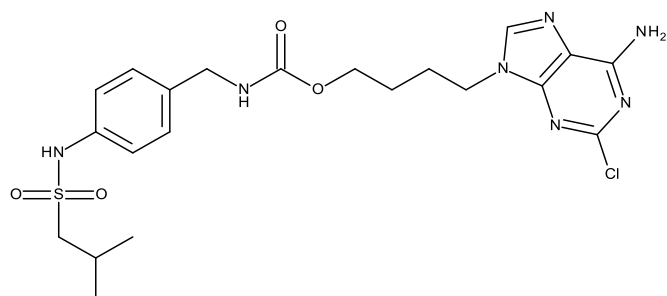
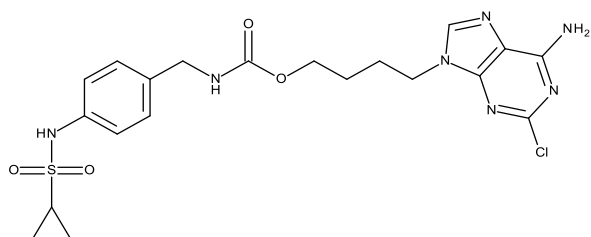


13. A compound (C) or the N-oxide, pharmaceutically acceptable salt, pharmaceutically acceptable solvate, or stereoisomer thereof, wherein compound (C) is chosen among those of following formulae herein below:

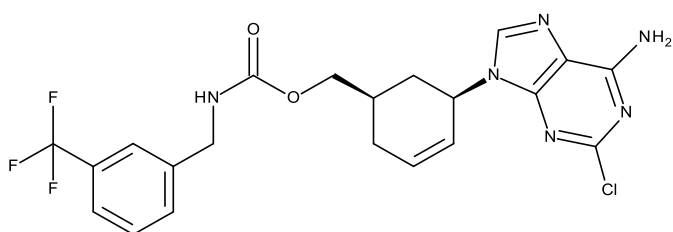
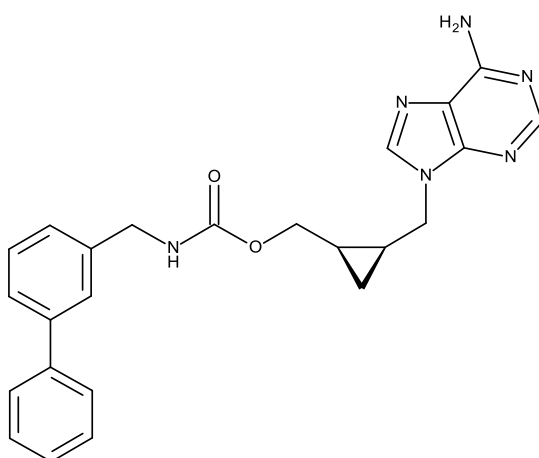
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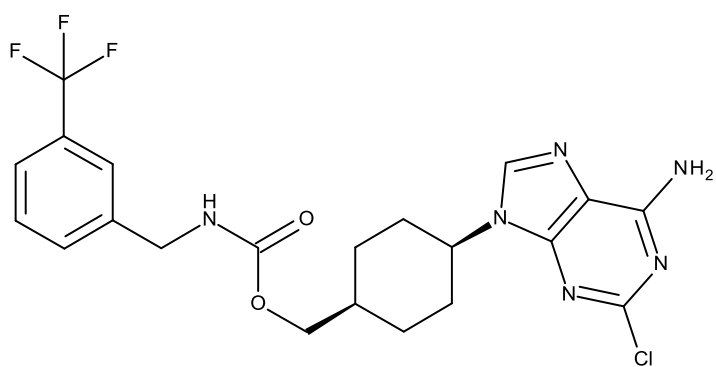
-232-



-233-



5



14. A pharmaceutical composition comprising a carrier, and as active ingredient the compound (C), as defined according to any one of claims 1 to 13
15. A compound as defined according to any one of claims 1 to 13, for use in the treatment of a disease selected from cancer, inflammatory disorders, cardiovascular diseases, viral induced diseases, circulatory diseases and fibro-proliferative diseases.
16. A compound (C), as defined according to any one of claims 1 to 13, for use as a medicament.