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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 March 2015 (12.03.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/033303 A1

(51) International Patent Classification:
A61K 31/38 (2006.01) *C07D 273/00* (2006.01)
A61K 31/395 (2006.01) *C07D 285/00* (2006.01)

(21) International Application Number:
PCT/IB2014/064283

(22) International Filing Date:
5 September 2014 (05.09.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
4010/CHE/2013 6 September 2013 (06.09.2013) IN

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

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

WO 2015/033303 A1

(54) **Title**: CYCLIC PEPTIDOMIMETIC COMPOUNDS AS IMMUNOMODULATORS

(57) **Abstract**: The present invention relates to cyclic peptidomimetic compounds as therapeutic agents capable of inhibiting the programmed cell death 1 (PD1) signalling pathway. The invention also relates to derivatives of the therapeutic agents. The invention also encompasses the use of the said therapeutic agents and derivatives for treatment of disorders via immunopotentiation comprising inhibition of immunosuppressive signal induced due to PD-1, PD-L1, or PD-L2 and therapies using them.

CYCLIC PEPTIDOMIMETIC COMPOUNDS AS IMMUNOMODULATORS

This application claims the benefit of Indian provisional application number 4010/CHE/2013, filed on September 06, 2013; which hereby incorporated by reference.

TECHNICAL FIELD

The present invention relates to cyclic peptidomimetic compounds therapeutically useful as immune modulators. The invention also relates to pharmaceutical compositions comprising the said cyclic peptidomimetic compounds as therapeutic agents.

BACKGROUND OF THE INVENTION

Programmed cell death-1 (PD-1) is a member of the CD28 superfamily that delivers negative signals upon interaction with its two ligands, PD-L1 or PD-L2. PD-1 and its ligands are broadly expressed and exert a wider range of immunoregulatory roles in T cells activation and tolerance compared with other CD28 members. PD-1 and its ligands are involved in attenuating infectious immunity and tumor immunity, and facilitating chronic infection and tumor progression. The biological significance of PD-1 and its ligand suggests the therapeutic potential of manipulation of PD-1 pathway against various human diseases (Ariel Pedoeem et al., Curr Top Microbiol Immunol. (2011); 350:17-37).

T-cell activation and dysfunction relies on direct and modulated receptors. Based on their functional outcome, co-signaling molecules can be divided as co-stimulators and co-inhibitors, which positively and negatively control the priming, growth, differentiation and functional maturation of a T-cell response (Li Shi, et al., Journal of Hematology & Oncology 2013, 6:74).

Therapeutic antibodies that block the programmed cell death protein-1 (PD-1) immune checkpoint pathway prevent T-cell down regulation and promote immune responses against cancer. Several PD-1 pathway inhibitors have shown robust activity in various phases of on-going clinical trials (RD Harvey, Clinical Pharmacology & Therapeutics (2014); 96 2, 214–223).

Programmed death-1 (PD-1) is a co-receptor that is expressed predominantly by T cells. The binding of PD-1 to its ligands, PD-L1 or PD-L2, is vital for the physiological regulation of the immune system. A major functional role of the PD-1 signaling pathway is the inhibition of self-reactive T cells, which serve to protect against autoimmune diseases. Elimination of the PD-1 pathway can therefore result in the

breakdown of immune tolerance that can ultimately lead to the development of pathogenic autoimmunity. Conversely, tumor cells can at times co-opt the PD-1 pathway to escape from immunosurveillance mechanisms. Therefore, blockade of the PD-1 pathway has become an attractive target in cancer therapy. Current approaches include six agents that are either PD-1 and PD-L1 targeted neutralizing antibodies or fusion proteins. More than forty clinical trials are underway to better define the role of PD-1 blockade in variety of tumor types (Hyun-Tak Jin et al., Clinical Immunology (Amsterdam, Netherlands) (2014), 153(1), 145-152).

International applications WO 01/14557, WO 02/079499, WO 2002/086083, WO 03/042402, WO 2004/004771, WO 2004/056875, WO2006121168, WO2008156712, WO2010077634, WO2011066389, WO2014055897, WO2014059173, WO2014100079 and US patent US08735553 report PD-1 or PD-L1 inhibitory antibodies or fusion proteins.

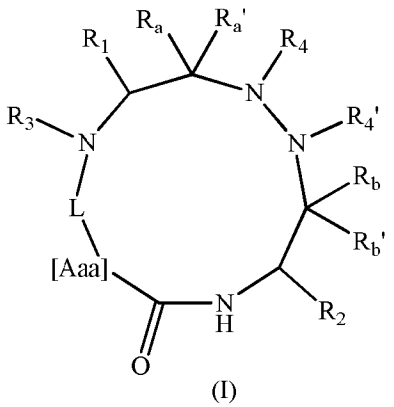
Further, International applications, WO2011161699, WO2012/168944, WO2013144704 and WO2013132317 report peptides or peptidomimetic compounds which are capable of suppressing and/or inhibiting the programmed cell death 1 (PD1) signaling pathway.

Still there is a need for more potent, better and/or selective immune modulators of PD-1 pathway. The present invention provides, cyclic peptidomimetic compounds which are capable of suppressing and/or inhibiting the programmed cell death 1 (PD1) signaling pathway.

SUMMARY OF INVENTION

In accordance with the present invention, cyclic peptidomimetic compounds or a stereoisomer thereof or a pharmaceutically acceptable salt thereof, provided which are capable of suppressing and/or inhibiting the programmed cell death 1 (PD1) signalling pathway.

In one aspect, the present invention provides cyclic peptidomimetic compounds of formula (I):



(I)

or a pharmaceutically acceptable salt or a stereoisomer thereof;

wherein,

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr;

R_3 is hydrogen or alkyl;

each of R_4 and R_4' independently represents hydrogen or alkyl;

both R_a and R_a' represent hydrogen; or together represent an oxo (=O) group;

both R_b and R_b' represent hydrogen; or together represent an oxo (=O) group;

L is $-C(O)-(CH_2)_m-(X-\underset{\displaystyle R_5}{\underset{|}{C}}H-CH_2)_n-NH-$;

X is selected from CH_2, O or S;

R_5 is hydrogen or alkyl;

m is an integer selected from 1 to 3;

n is an integer selected from 2 to 20.

In a further aspect of the present invention, it relates to the pharmaceutical composition comprising a compound of formula (I) or a pharmaceutically acceptable salt or a stereoisomer and processes for preparing thereof.

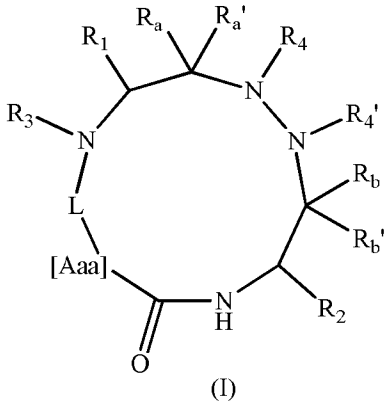
In yet another aspect of the present invention, it provides use of cyclic peptidomimetic compounds of formula (I) and their salts and stereoisomers thereof, which are capable of suppressing and/or inhibiting the programmed cell death 1 (PD1) signaling pathway.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides cyclic peptidomimetic compounds as therapeutic agents useful for treatment of disorders via immunopotentiation comprising inhibition of immunosuppressive signal induced due to PD-1, PD-L1, or PD-L2 and therapies using them.

Each embodiment is provided by way of explanation of the invention, and not by way of limitation of the invention. In fact, it will be apparent to those skilled in the art that various modification and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used on another embodiment to yield a still further embodiment. Thus it is intended that the present invention cover such modifications and variations as come within the scope of the appended claims and their equivalents. Other objects, features, and aspects of the present invention are disclosed in, or are obvious from, the following detailed description. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not to be construed as limiting the broader aspects of the present invention.

In one embodiment, the present invention relates to compounds of formula (I)



(I)

or a stereoisomer or a pharmaceutically acceptable salt thereof;

wherein;

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

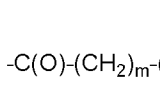
[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr;

R_3 is hydrogen or alkyl;

each of R_4 and R_4' independently represents hydrogen or alkyl;

both R_a and R_a' represent hydrogen; or together represent an oxo (=O) group;

both R_b and R_b' represent hydrogen; or together represent an oxo (=O) group;

L is ;

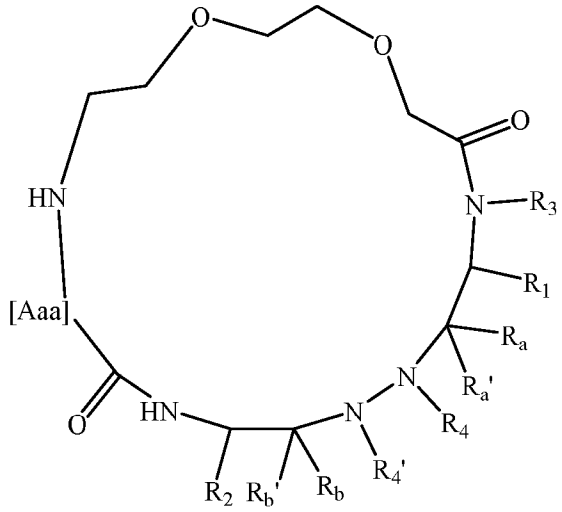
X is selected from CH_2, O or S;

R_5 is hydrogen or alkyl;

m is an integer selected from 1 to 3;

n is an integer selected from 2 to 20.

In a particular embodiment of the compounds of formula (I), the invention comprises a particular series of compounds of formula (IA):



(IA)

wherein,

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr;

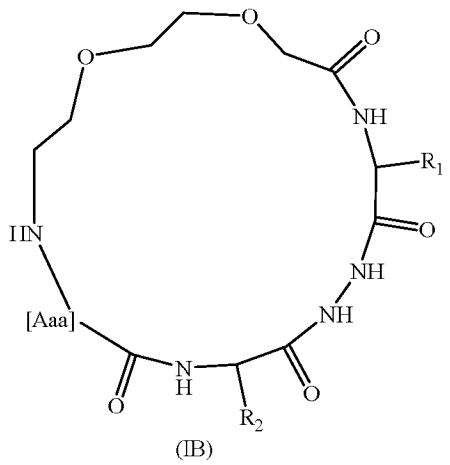
R_3 is hydrogen or alkyl;

each of R_4 and R_4' independently represents hydrogen or alkyl;

both R_a and R_a' represent hydrogen; or together represent an oxo (=O) group;

both R_b and R_b' represent hydrogen; or together represent an oxo (=O) group.

In a particular embodiment of the compounds of formula (I), the invention comprises a particular series of compounds of formula (IB):



(IB)

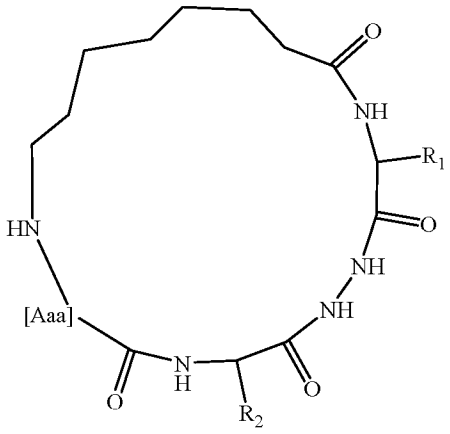
wherein,

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr.

In yet another embodiment of the compounds of formula (I), the invention comprises a particular series of compounds of formula (IC):



(IC)

wherein,

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr.

In yet another embodiment, the present invention provides compounds of formula (I), wherein,

R_1 is side chain of Ser or Thr;

R_2 is side chain of Asp, Asn or Glu;

[Aaa] is an amino acid residue selected from Ser or Thr;

R_3, R_4 and R_4' independently are hydrogen;

both R_a and R_a' together represent an oxo (=O) group;

both R_b and R_b' together represent an oxo (=O) group;

L is $-C(O)-(CH_2)_m-(X-CH_2-CH_2)_n-NH-$;

X is CH_2 or O;

m is an integer selected from 1 to 3;

n is an integer selected from 2 to 20;

or a pharmaceutically acceptable salt or a stereoisomer thereof.

The embodiments below are illustrative of the present invention and are not intended to limit the claims to the specific embodiments exemplified.

In one embodiment, specifically provided are compounds of the formula (I), in which L is $-C(O)-CH_2-(X-\underset{\displaystyle R_5}{\underset{|}{C}}H-CH_2)_n-NH-$; wherein X, n and R_5 are same as defined in formula (I).

In another embodiment, specifically provided are compounds of the formula (I), in which L is $-C(O)-(CH_2)_m-(O-\underset{\displaystyle R_5}{\underset{|}{C}}H-CH_2)_n-NH-$; wherein m, n and R_5 are same as defined in formula (I).

In yet another embodiment, specifically provided are compounds of the formula (I), in which L is $-C(O)-(CH_2)_m-(X-CH_2-CH_2)_n-NH-$; wherein m, n and X are same as defined in formula (I).

In yet another embodiment, specifically provided are compounds of the formula (I), in which L is $-C(O)-(CH_2)_m-(X-\underset{\displaystyle R_5}{\underset{|}{C}}H-CH_2)_2-NH-$; wherein m, X and R_5 are same as defined in formula (I).

In yet another embodiment, specifically provided are compounds of the formula (I), in which L is –C(O)-CH_2-$(OCH_2CH_2)_2$–NH-.

In another embodiment, specifically provided are compounds of the formula (I), (IA), (IB) and (IC), in which R_1 is side chain of Ser.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA), (IB) and (IC) in which R_1 is side chain of Thr.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA) and (IB), in which R_2 is side chain of Asp.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA), (IB) and (IC) in which R_2 is side chain of Asn.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA), (IB) and (IC) in which R_2 is side chain of Glu.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA), (IB) and (IC) in which [Aaa] is Ser.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA), (IB) and (IC) in which [Aaa] is Thr.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA) and (IB) in which [Aaa] is Asp.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA) and (IB) in which [Aaa] is Lys or Ile.

In yet another embodiment, specifically provided are compounds of the formula (I), (IA) and (IB), in which one, more or all amino acid/s is/are D amino acid/s.

In yet another embodiment, specifically provided are compounds of the formula (I) and (IA), in which R_4' is C_{1-5} alkyl such as methyl.

In yet another embodiment, specifically provided are compounds of the formula (I) and (IA), in which R_4 is C_{1-5} alkyl such as methyl.

In yet another embodiment, specifically provided are compounds of the formula (I) and (IA), in which both R_a and R_a' are hydrogen.

In yet another embodiment, specifically provided are compounds of the formula (I) and (IA), in which both R_b and R_b' are hydrogen.

In yet another embodiment, specifically provided are compounds of the formula (I) and (IA), in which both R_a and R_a' together represent an oxo (=O) group.

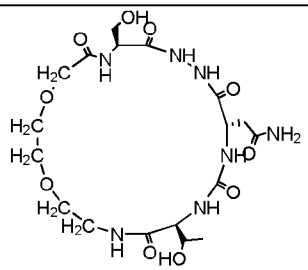
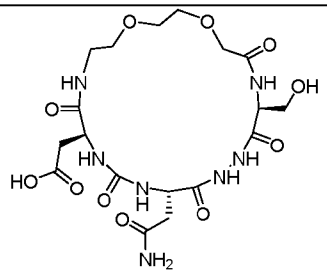
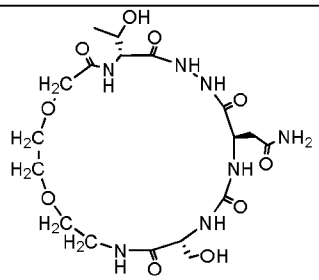
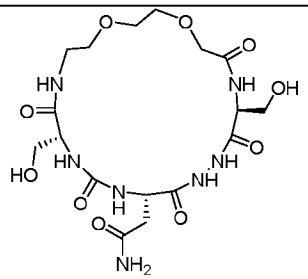
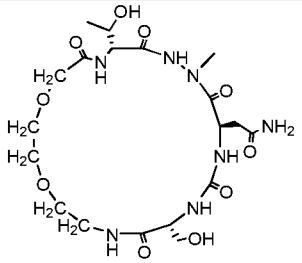
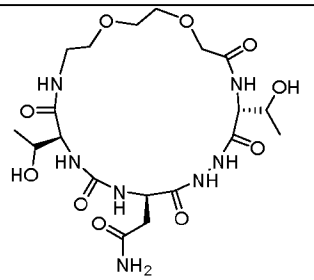
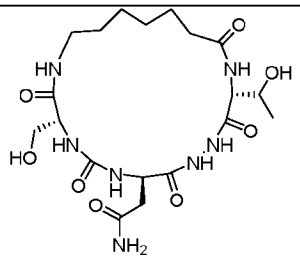
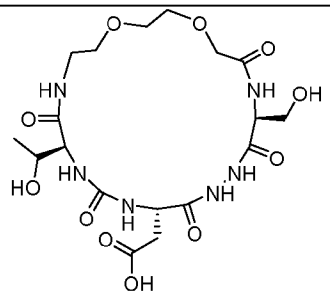
In yet another embodiment, specifically provided are compounds of the formula (I) and (IA), in which both R_b and R_b' together represent an oxo (=O) group.

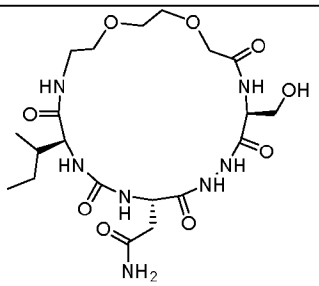
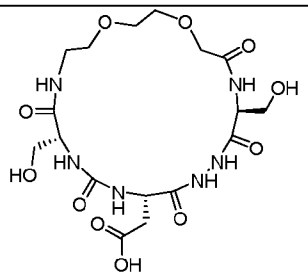
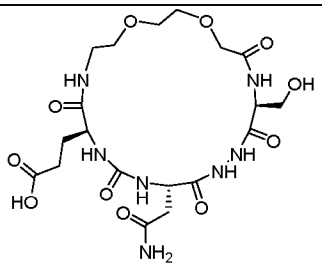
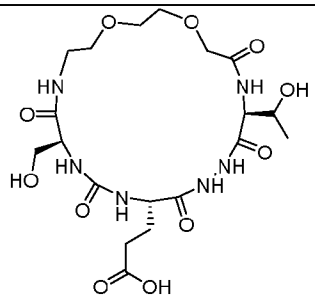
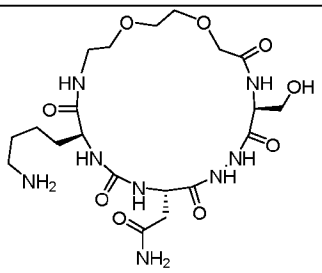
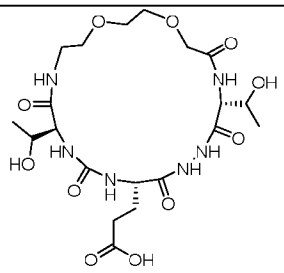
In yet another embodiment, specifically provided are compounds of the formula (I) and (IA), in which both R_4 and R_4' are hydrogen.

In yet another embodiment, specifically provided are compounds of the formula (I) and (IA), in which R_3 is hydrogen.

In an embodiment, specific compounds of formula (I) without any limitation are enumerated in Table (1):

Table 1

Compound No.	Structure	Compound No	Structure
1.		8.	
2.		9.	
3.		10.	
4.		11.	

5.		12.	
6.		13.	 and
7.		14.	

or a pharmaceutically acceptable salt or a stereoisomer thereof thereof.

The compounds as disclosed in the present invention are formulated for pharmaceutical administration.

In one embodiment, the present invention provides a pharmaceutical composition comprising at least one compound according to any one of claims 1 to 8 or a pharmaceutically acceptable salt or a stereoisomer thereof, and a pharmaceutically acceptable carrier or excipient.

In one embodiment, the said pharmaceutical composition further comprising at least one of an anticancer agent, chemotherapy agent, or antiproliferative compound.

In one embodiment, the present invention provides the compounds as disclosed in the present invention for use as a medicament.

In one embodiment, the present invention provides the compounds as disclosed in the present invention for use as a medicament for the treatment of cancer.

In one embodiment, the present invention provides the compounds as disclosed in the present invention for use as a medicament for the treatment of bacterial infectious disease, a viral infectious disease or a fungal infectious disease.

In one embodiment, the present invention provides the compounds as disclosed in the present invention for use in the preparation of a medicament for the treatment of breast cancer, colon cancer, lung cancer, melanoma, prostate cancer and renal cancer, bone cancer, cancer of the head or neck, pancreatic cancer, skin cancer, cutaneous or intraocular malignant melanoma, uterine cancer, ovarian cancer, rectal cancer, cancer of the anal region, stomach cancer, testicular cancer, uterine cancer, carcinoma of the fallopian tubes, carcinoma of the endometrium, carcinoma of the cervix, carcinoma of the vagina, carcinoma of the vulva, Hodgkin's Disease, non-Hodgkin's lymphoma, cancer of the esophagus, cancer of the small intestine, cancer of the endocrine system, cancer of the thyroid gland, cancer of the parathyroid gland, cancer of the adrenal gland, sarcoma of soft tissue, cancer of the urethra, cancer of the penis, chronic or acute leukemias including acute myeloid leukemia, chronic myeloid leukemia, acute lymphoblastic leukemia, chronic lymphocytic leukemia, solid tumours of childhood, lymphocytic lymphoma, cancer of the bladder, cancer of the kidney or ureter, carcinoma of the renal pelvis, neoplasm of the central nervous system (CNS), primary CNS lymphoma, tumour angiogenesis, spinal axis tumour, brain stem glioma, pituitary adenoma, Kaposi's sarcoma, epidermoid cancer, squamous cell cancer, T-cell lymphoma, environmentally induced cancers including those induced by asbestos, and combinations of said cancers.

In one embodiment, the present invention provides the compounds as disclosed in the present invention for use in the treatment of cancer.

In one embodiment, the present invention provides the compounds as disclosed in the present invention for use in the treatment of bacterial infectious disease, a viral infectious disease or a fungal infectious disease.

In one embodiment, the present invention provides a method of treatment of cancer, wherein the method comprises administration of an effective amount of the compound of the present invention to the subject in need thereof.

In one embodiment, the present invention provides a method for inhibiting growth of tumour cells and/or metastasis by administering an effective amount of the compound of the present invention to the subject in need thereof.

The said tumour cells include cancer such as but not limited to melanoma, renal cancer, prostate cancer, breast cancer, colon cancer and lung cancer, bone cancer, pancreatic cancer, skin cancer, cancer of the head or neck, cutaneous or intraocular malignant melanoma, uterine cancer, ovarian cancer, rectal cancer, cancer of the anal region, stomach cancer, testicular cancer, carcinoma of the fallopian tubes, carcinoma of the endometrium, carcinoma of the cervix, carcinoma of the vagina, carcinoma of the vulva, Hodgkin's Disease, non-Hodgkin's lymphoma, cancer of the esophagus, cancer of the small intestine, cancer of the endocrine system, cancer of the thyroid gland, cancer of the parathyroid gland, cancer of the adrenal gland, sarcoma of soft tissue, cancer of the urethra, cancer of the penis, chronic or acute leukemias including acute myeloid leukemia, chronic myeloid leukemia, acute lymphoblastic leukemia, chronic lymphocytic leukemia, solid tumours of childhood, lymphocytic lymphoma, cancer of the bladder, cancer of the kidney or ureter, carcinoma of the renal pelvis, neoplasm of the central nervous system (CNS), primary CNS lymphoma, tumour angiogenesis, spinal axis tumour, brain stem glioma, pituitary adenoma, Kaposi's sarcoma, epidermoid cancer, squamous cell cancer, T-cell lymphoma, environmentally induced cancers including those induced by asbestos, and combinations of said cancers.

Still yet another embodiment of the present invention provides a method of treatment of infection via immunopotentiation caused by inhibition of immunosuppressive signal induced by PD-1, PD-L1, or PD-L2, wherein the method comprises administration of an effective amount of the compound of the present invention to the subject in need thereof.

The infectious disease includes but not limited to HIV, Influenza, Herpes, Giardia, Malaria, Leishmania, the pathogenic infection by the virus Hepatitis (A, B, & C), herpes virus (e.g., VZV, HSV-I, HAV-6, HSV-II, and CMV, Epstein Barr virus), adenovirus, influenza virus, flaviviruses, echovirus, rhinovirus, coxsackie virus, cornovirus, respiratory syncytial virus, mumps virus, rotavirus, measles virus, rubella virus, parvovirus, vaccinia virus, HTLV virus, dengue virus, papillomavirus, molluscum virus, poliovirus, rabies virus, JC virus and arboviral encephalitis virus, pathogenic infection by the bacteria chlamydia, rickettsial bacteria, mycobacteria, staphylococci, streptococci, pneumonococci, meningococci and conococci, klebsiella, proteus, serratia, pseudomonas, E. coli, legionella, diphtheria, salmonella, bacilli, cholera, tetanus, botulism, anthrax, plague, leptospirosis, and Lyme's disease bacteria, pathogenic

infection by the fungi Candida (albicans, krusei, glabrata, tropicalis, etc.), Cryptococcus neoformans, Aspergillus (fumigatus, niger, etc.), Genus Mucorales (mucor, absidia, rhizophus), Sporothrix schenkii, Blastomyces dermatitidis, Paracoccidioides brasiliensis, Coccidioides immitis and Histoplasma capsulatum, and pathogenic infection by the parasites Entamoeba histolytica, Balantidium coli, Naegleriafowleri, Acanthamoeba sp., Giardia lambia, Cryptosporidium sp., Pneumocystis carinii, Plasmodium vivax, Babesia microti, Trypanosoma brucei, Trypanosoma cruzi, Leishmania donovani, Toxoplasma gondi, Nippostrongylus brasiliensis.

The compounds of the present invention may be used as single drugs or as a pharmaceutical composition in which the compound is mixed with various pharmacologically acceptable materials.

The pharmaceutical composition is usually administered by oral or inhalation routes, but can be administered by parenteral administration route. In the practice of this invention, compositions can be administered, for example, by orally, intravenous infusion, topically, intraperitoneally, intravesically or intrathecally. Examples of the parenteral administration includes but not limited to intraarticular (in the joints), intravenous, intramuscular, intradermal, intraperitoneal, and subcutaneous routes, include aqueous and non-aqueous, isotonic sterile injection solutions, which can contain antioxidants, buffers, bacteriostats, and solutes that render the formulation isotonic with the blood of the intended recipient, and aqueous and non-aqueous sterile suspensions that can include suspending agents, solubilizers, thickening agents, stabilizers, and preservatives. Oral administration, parenteral administration, subcutaneous administration and intravenous administration are the preferred methods of administration.

The dosage of the compounds of the present invention varies depending on age, weight, symptom, therapeutic efficacy, dosing regimen and/or treatment time. Generally, they may be administered by oral or inhalation routes, in an amount of 1 mg to 100 mg per time, from once a couple of days, once 3 days, once 2 days, once a day to a couple of times a day, in the case of an adult, or continuously administered by oral or inhalation routes from 1 to 24 hours a day. Since the dosage is affected by various conditions, an amount less than the above dosage may sometimes work well enough, or higher dosage may be required in some cases.

The compounds of the present invention may be administered in combination with other drugs for (1) complementation and/or enhancement of prevention and/or therapeutic efficacy of the preventive and/or therapeutic drug of the present invention, (2) dynamics, absorption improvement, dosage reduction of the preventive and/or therapeutic drug of the present invention, and/or (3) reduction of the side effects of the preventive and/or therapeutic drug of the present invention.

A concomitant medicine comprising the compounds of the present invention and other drug may be administered as a combination preparation in which both components are contained in a single formulation, or administered as separate formulations. The administration by separate formulations includes simultaneous administration and administration with some time intervals. In the case of the administration with some time intervals, the compound of the present invention can be administered first, followed by another drug or another drug can be administered first, followed by the compound of the present invention. The administration method of the respective drugs may be the same or different.

The dosage of the other drug can be properly selected, based on a dosage that has been clinically used. The compounding ratio of the compound of the present invention and the other drug can be properly selected according to age and weight of a subject to be administered, administration method, administration time, disorder to be treated, symptom and combination thereof. For example, the other drug may be used in an amount of 0.01 to 100 parts by mass, based on 1 part by mass of the compound of the present invention. The other drug may be a combination of two or more kind of arbitrary drugs in a proper proportion. The other drug that complements and/or enhances the preventive and/or therapeutic efficacy of the compound of the present invention includes not only those that have already been discovered, but those that will be discovered in future, based on the above mechanism.

Diseases on which this concomitant use exerts a preventive and/or therapeutic effect are not particularly limited. The concomitant medicine can be used for any diseases, as long as it complements and/or enhances the preventive and/or therapeutic efficacy of the compound of the present invention.

The compound of the present invention can be used with an existing chemotherapeutic concomitantly or in a mixture form. Examples of the chemotherapeutic include an alkylation agent, nitrosourea agent, antimetabolite, anticancer antibiotics,

vegetable-origin alkaloid, topoisomerase inhibitor, hormone drug, hormone antagonist, aromatase inhibitor, P-glycoprotein inhibitor, platinum complex derivative, other immunotherapeutic drugs and other anticancer drugs. Further, it can be used with a cancer treatment adjunct, such as a leucopenia (neutropenia) treatment drug, thrombocytopenia treatment drug, antiemetic and cancer pain intervention drug, concomitantly or in a mixture form.

In one embodiment, the compound(s) of the present invention can be used with other immunomodulators and/or a potentiating agent concomitantly or in a mixture form. Examples of the immunomodulator include various cytokines, vaccines and adjuvants. Examples of these cytokines, vaccines and adjuvants that stimulates immune responses include but not limited to GM-CSF, M-CSF, G-CSF, interferon-α, β, or γ, IL-1, IL-2, IL-3 , IL-12, Poly (I:C) and C_pG.

In another embodiment, the potentiating agents includes cyclophosphamide and analogs of cyclophosphamide, anti-TGFβ and Imatinib (Gleevac), a mitosis inhibitor, such as paclitaxel, Sunitinib (Sutent) or other antiangiogenic agents, an aromatase inhibitor, such as letrozole, an A2a adenosine receptor (A2AR) antagonist, an angiogenesis inhibitor, anthracyclines, oxaliplatin, doxorubicin, TLR4 antagonists, and IL-18 antagonists.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as is commonly understood by one of skill in art to which the subject matter herein belongs. As used herein, the following definitions are supplied in order to facilitate the understanding of the present invention.

As used herein the term "alkyl" refers to a hydrocarbon chain radical that includes solely carbon and hydrogen atoms in the backbone, containing no unsaturation, having from one to twenty carbon atoms (i.e., C_{1-20} alkyl) or one to ten carbon atoms (i.e., C_{1-10} alkyl) or one to five carbon atoms (i.e., C_{1-5} alkyl) and which is attached to the rest of the molecule by a single bond, e.g., including but not limited to methyl, ethyl, propyl, butyl, isobutyl, sec-butyl, tert-butyl, isopentyl or neopentyl. Unless set forth or recited to the contrary, all alkyl groups described or claimed herein may be straight chain or branched, substituted or unsubstituted.

As used herein, the term “amino acid” refers to amino acids having L or D stereochemistry at the alpha carbon.

As used herein, the term 'compound(s)' refers to the compounds disclosed in the present invention.

As used herein, the term "comprise" or "comprising" is generally used in the sense of include, that is to say permitting the presence of one or more features or components.

As used herein, the term "including" as well as other forms, such as "include", "includes," and "included," is not limiting.

"Pharmaceutically acceptable salt" is taken to mean an active ingredient, which comprises a compound of the formula (I) in the form of one of its salts, in particular if this salt form imparts improved pharmacokinetic properties on the active ingredient compared with the free form of the active ingredient or any other salt form of the active ingredient used earlier. The pharmaceutically acceptable salt form of the active ingredient can also provide this active ingredient for the first time with a desired pharmacokinetic property which it did not have earlier and can even have a positive influence on the pharmacodynamics of this active ingredient with respect to its therapeutic efficacy in the body.

"Pharmaceutically acceptable" means that which is useful in preparing a pharmaceutical composition that is generally safe, non-toxic, and neither biologically nor otherwise undesirable and includes that which is acceptable for veterinary as well as human pharmaceutical use.

The term "stereoisomer" refers to any enantiomers, diastereomers, or geometrical isomers of the compounds of formula (I), wherever they are chiral or when they bear one or more double bond. When the compounds of the formula (I) and related formulae are chiral, they can exist in racemic or in optically active form. Since the pharmaceutical activity of the racemates or stereoisomers of the compounds according to the invention may differ, it may be desirable to use the enantiomers. In these cases, the end product or even the intermediates can be separated into enantiomeric compounds by chemical or physical measures known to the person skilled in the art or even employed as such in the synthesis. In the case of racemic amines, diastereomers are formed from the mixture by reaction with an optically active resolving agent. Examples of suitable resolving agents are optically active acids such as the R and S forms of tartaric acid, diacetyltartaric acid, dibenzoyltartaric acid, mandelic acid, malic acid, lactic acid, suitable N-protected amino acids (for example N-benzoylproline or N-benzenesulfonylproline), or the various

optically active camphorsulfonic acids. Also advantageous is chromatographic enantiomer resolution with the aid of an optically active resolving agent (for example dinitrobenzoylphenylglycine, cellulose triacetate or other derivatives of carbohydrates or chirally derivatised methacrylate polymers immobilised on silica gel).

The term "subject" includes mammals (especially humans) and other animals, such as domestic animals (e.g., household pets including cats and dogs) and non-domestic animals (such as wildlife).

“Therapeutically effective amount” or “efficient amount” refers to sufficient amount of the compound(s) of the present invention that (i) treats or prevents the particular disease, disorder or syndrome (ii) attenuates, ameliorates or eliminates one or more symptoms of the particular disease, disorder or syndrome or (iii) prevents or delays the onset of one or more symptoms of the particular disease, disorder or syndrome described herein. In the case of cancer, the therapeutically effective amount of the drug may decrease the number of cancer cells; decrease the cancer size; inhibit (i.e., slow to some extent and alternatively stop) cancer cell infiltration into peripheral organs; suppress (i.e., slow to some extent and alternatively stop) tumor metastasis; inhibit, to some extent, tumor growth; and/or relieve to some extent one or more of the symptoms associated with the cancer. In the case of infectious disease states, the therapeutic effective amount is an amount sufficient to decrease or alleviate an infectious diseases, the symptoms of an infections caused by bacterial, viral and fungal.

Naturally-occurring amino acids are identified throughout the specification by the conventional three-letter abbreviations indicated in the below table 2:

Table 2

Name	3-letter code	Name	3-letter code
Alanine	Ala	Leucine	Leu
Asparagine	Asn	Lysine	Lys
Aspartic acid	Asp	Phenylalanine	Phe
Glutamic acid	Glu	Serine	Ser
Glutamine	Gln	Threonine	Thr
Isoleucine	Ile	Tryptophan	Trp

The **abbreviations** used in the entire specification may be summarized herein below with their particular meaning.

^{o}C (degree Celsius); δ (delta); % (percentage); brine (NaCl solution); bs or brs (Broad singlet); Bzl (Benzyl); Cbz (Carboxybenzyl); Cbz-Cl (Benzyl chloroformate); CH_2Cl_2/DCM (Dichloromethane); Cs_2CO_3 (Cesium carbonate); DMF (Dimethyl formamide); DMSO (Dimethyl sulfoxide); DIPEA/DIEA (N, N- Diisopropyl ethylamine); DMSO-d_6 (Deuterated DMSO); d (Doublet); EtOAc (Ethyl acetate); Et_2NH (Diethylamine); Fmoc (Fluorenylmethyloxycarbonyl); Fmoc-Cl (Fluorenylmethyloxycarbonyl chloride) g or gr (gram); H or H_2 (Hydrogen); H_2O (Water); HOBt/HOBT (1-Hydroxy benzotriazole); HCl (Hydrochloric acid); h or hr (Hours); HATU (2-(1H-7-Azabenzotriazol-1-yl)-1,1,3,3-tetramethyl uranium hexafluoro phosphate methanaminium); Hz (Hertz); HPLC (High-performance liquid chromatography); LCMS (Liquid chromatography mass spectroscopy); MeOH/CH_3OH (Methanol); mmol (Millimoles); M (Molar); µl/ µL (Microlitre); mL (Millilitre); mg (Milligram); min (minutes); m (Multiplet); mm (Millimeter); MHz (Megahertz); MS (ES) (Mass spectroscopy-electro spray); min (Minutes); Na (Sodium); $NaOBu^t$ (Sodium *tert*-butoxide); $NH_2NH_2.H_2O$ (Hydrazine hydrate); Na_2SO_4 (Sodium sulphate); N_2 (Nitrogen); NMR (Nuclear magnetic resonance spectroscopy); $NaHCO_3$ (Sodium bicarbonate); Pd-C (Palladiun on carbon); 10% Pd/C (10% palladium activated carbon); $Pd(OH)_2$ (palladium hydroxide); PD-L1 (Programmed death-ligand 1); PD-L2 (Programmed cell death 1 ligand 2); prep HPLC/prep-HPLC (Preparative High-performance liquid chromatography); PyBOP (Benzotriazol-1-yloxy)tripyrrolidinophosphonium hexafluorophosphate); RT/rt (room temperature); S (Singlet); ^{t}Bu/tBu (Tertiary butyl) TEA/Et_3N (Triethyl amine); TFA (Trifluoroaceticacid); TLC (Thin Layer Chromatography); THF (Tetrahydrofuran); TFA/CF_3COOH (Trifluoro acetic acid); t (Triplet); t_{R} = (Retention time), etc.

EXPERIMENTAL

An embodiment of the present invention provides the preparation of compounds of formula (I) according to the procedures of the following examples, using appropriate materials. Those skilled in the art will understand that known variations of the conditions and processes of the following preparative procedures can be used to prepare these compounds. Moreover, by utilizing the procedures described in detail, one of ordinary skill in the art can prepare additional compounds of the present invention.

The starting materials are generally available from commercial sources such as Sigma-Aldrich, USA or Germany; Chem-Impex USA; G.L. Biochem, China and Spectrochem, India.

Purification and characterization of compounds

Analytical HPLC method: Analytical HPLC was performed using on ZIC HILIC 200 A° column (4.6 mm × 250 mm, 5 µm), Flow rate: 1.0 mL / min. The elution conditions used are: Buffer A: 5 mmol ammonium acetate, Buffer B: Acetonitrile, Equilibration of the column with 90 % buffer B and elution by a gradient of 90 % to 40 % buffer B during 30 min.

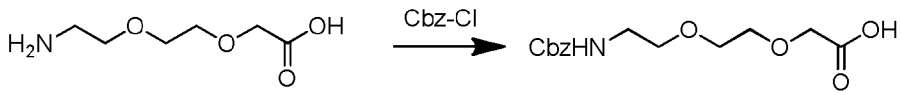
Preparative HPLC Method A: The crude material was purified by preparative HPLC using ZIC HILIC 200A° column (21.2 mm × 150 mm, 5 µm). The elution conditions used are Eluent: A: 5 mmol ammonium acetate B: Acetonitrile, Flow rate: 18 mL / min. The compound was eluted by gradient elution 0-3 min = 90 % buffer B, 3-20 min = 90-40 % buffer B with a flow rate of 20 mL/min.

Preparative HPLC Method B: Prep HPLC was performed using on ZIC HILIC 200 A° column (10 mm × 250 mm, 5 µm), Flow rate: 5.0 mL / min. The elution conditions used are: Buffer A: 5 mmol ammonium acetate, Buffer B: Acetonitrile, Equilibration of the column with 90 % buffer B and elution by a gradient of 90 % to 40 % buffer B during 20 min.

LCMS was performed on AP1 2000 LC/MS/MS triple quad (Applied biosystems) with Agilent 1100 series HPLC with G1315 B DAD, using Mercury MS column or using Agilent LC/MSD VL single quad with Agilent 1100 series HPLC with G1315 B DAD, using Mercury MS column or using Shimadzu LCMS 2020 single quad with Prominence UFLC system with SPD-20 A DAD.

Example 1: Synthesis of compound 1

Step 1a:

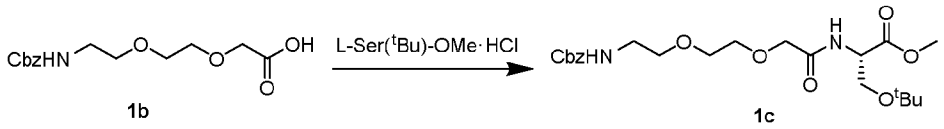


1a **1b**

Sodium hydroxide (12.2 g, 305 mmol) and Cbz-Cl (12.5 g, 73 mmol) were added to a solution of compound **1a** (10.0 g, 61 mmol) in water (100 mL) and stirred at room temperature for 3 h. The completeness of the reaction was confirmed by TLC analysis.

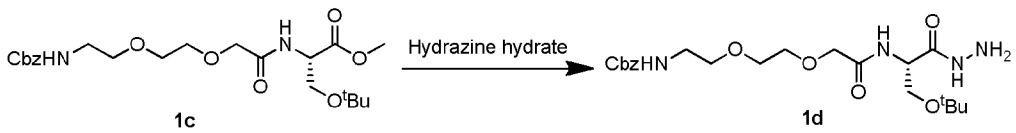
The reaction mass was partitioned between citric acid solution and ethyl acetate. Organic layer was washed with water, brine, dried over Na_2SO_4 and evaporated under reduced pressure to yield 11 g of compound **1b** (Yield: 61.1%). LCMS: 298.0$(M+H)^+$.

Step 1b:



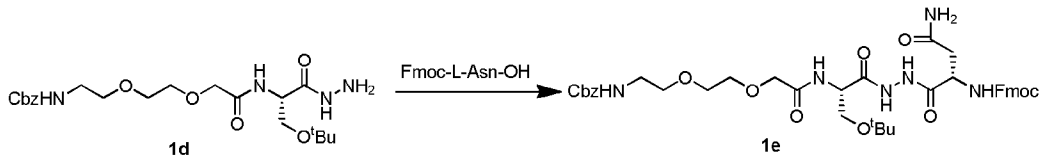
DIPEA (3.5 g, 26.8 mmol) was added slowly to a stirred solution of compound **1b** (4.0 g, 13.4 mmol) and HATU (5.6 g, 14.7 mmol) in DMF (50 mL) and was allowed to stir at room temperature for 5 more min. To the above reaction mixture L-Ser(^{t}Bu)-OMe·HCl (3.5 g, 20.1 mmol) was added slowly and stirred at room temperature for 12 h. The completeness of the reaction was confirmed by TLC analysis. The reaction mixture was quenched with ice, precipitated solid was filtered and re-crystallized with CH_2Cl_2 to yield 6 g of compound **1c,** LCMS: 454.8$(M+H)^+$.

Step 1c:



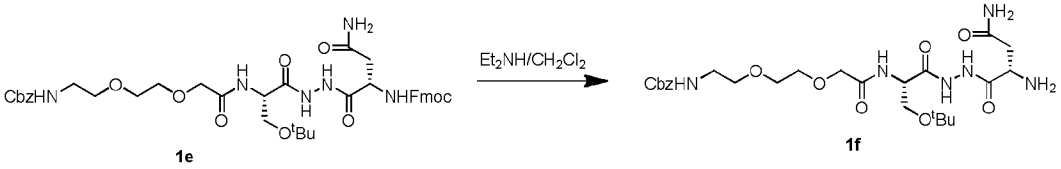
99% Hydrazine hydrate solution (10 mL) was added slowly to a stirred solution of compound **1c** (6 g) in methanol (50 mL) and stirred at room temperature for 2 h. The completion of the reaction was confirmed by TLC. The reaction mixture on evaporation under reduced pressure yielded 5.8 g of compound **1d**. LCMS: 455.0 $(M+H)^+$.

Step 1d:



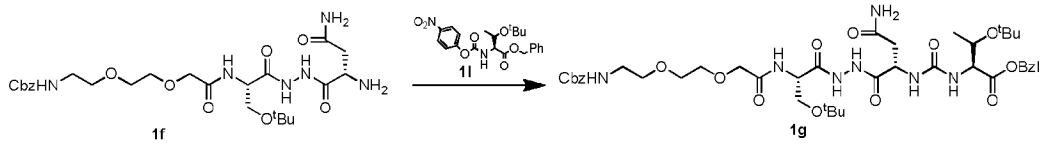
DIPEA (3.3 g, 25.4 mmol) was added slowly to a stirred solution of compound **1d** (5.8 g, 12.7 mmol) , HATU (5.8 g, 15.2 mmol) in DMF (50 mL) and was allowed to stirr at room temperature for 5 min. Fmoc-L-Asn-OH (4.9 g, 14.0 mmol) was further added to reaction mixture and stirred at room temperature for 12 h. The completeness of the reaction was confirmed by TLC analysis. The reaction mixture was then quenched with ice, precipitated solid was filtered and re-crystallized with CH_2Cl_2 to yield 5.9 g of compound **1e,** LCMS: 791.0 $(M+H)^+$.

Step 1e:



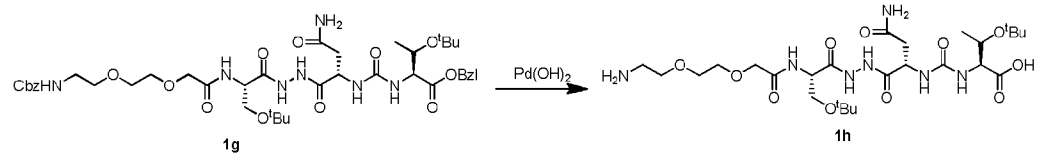
Fmoc group of compound **1e** [(5.9 g in CH_2Cl_2 (60 mL)] was deprotected using diethyl amine (60 mL) and the completion of the reaction was confirmed by TLC analysis. The reaction mixture on evaporation under reduced pressure yielded 1.6 g of compound **1f**. LCMS: 568.8 $(M+H)^+$.

Step 1f:



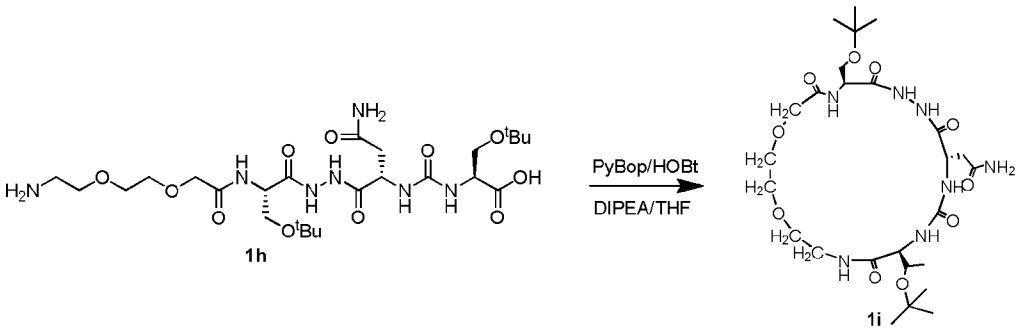
Compound **1l** (1.3 g, 3.0 mmol) and compound **1f** (1.60 g, 2.8 mmol) was dissolved in THF (10 mL) and stirred at room temperature. Coupling was initiated by the addition of triethylamine (0.57 g, 5.6 mmol) to the above reaction mixture and the reaction was allowed to stir for 12 h at room temperature. The completeness of the reaction was confirmed by TLC analysis. Organic layer was washed with $NaHCO_3$, citric acid solution, brine, dried over Na_2SO_4 and evaporated under reduced pressure to yield 0.45 g of compound **1g**.

Step 1g:



Cbz group and benzyl ester deprotection was carried out on compound **1g** (0.45 g) in methanol using palladium hydroxide (0.5 g) for 1 h at room temperature. The completeness of the reaction was confirmed by TLC analysis. Palladium hydroxide was removed by celite® bed filtration and the filtrate was evaporated under reduced pressure to yield 0.34 g of compound **1h**. LCMS: 636.0 $(M+H)^+$.

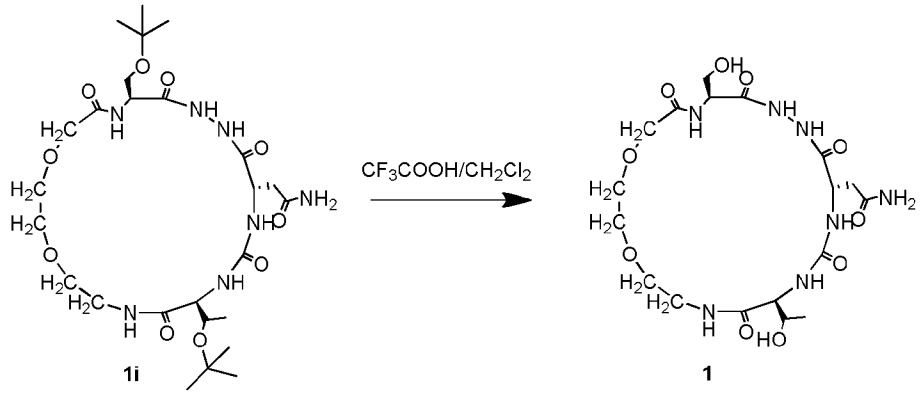
Step 1h:



1h 1i

Cyclization of compound **1h** (0.1 g, 0.15 mmol) was carried out using HOBT (0.06 g, 0.47 mmol) and PyBOP (0.24 g, 0.47 mmol) in THF (50 mL). The reaction was initiated by slow addition of DIPEA (0.06 g, 0.47 mmol) and further stirred at room temperature for 12 h. The reaction mixture was evaporated and washed with diethyl ether to yield 0.05 g of compound **1i**. LCMS: 617.9 $(M+H)^+$.

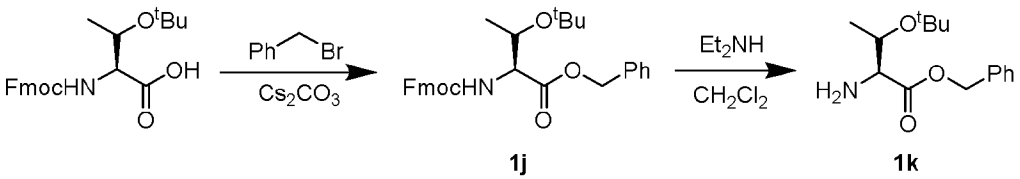
Step 1i:



1i 1

The acid sensitive protecting group on compound **1i** [(0.08 g) in CH_2Cl_2 (0.9 mL)] was removed using TFA (0.9 mL). The reaction mixture was stirred at room temperature for 4 h, followed by evaporation and washing with diethyl ether yielded 0.05 g of crude compound **1.** The crude solid material was purified using preparative HPLC method-A described under experimental conditions (yield: 9 mg). LCMS: 506.4 $(M+H)^+$; HPLC: t_R = 12.3 min..

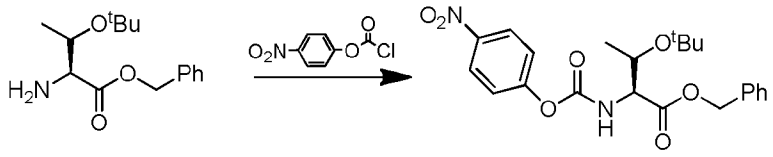
Synthesis of compound 1l (NO_2-C_6H_4-OCO-Thr(^{t}Bu)-OBzl,):



1j 1k

To a solution of Fmoc-Thr(^{t}Bu)-OH (15.0 g, 37.7 mmol) in 100.0 mL of DMF, Cs_2CO_3 (14.8 g, 45.2 mmol) was added and the resutling mixture was cooled to 0 °C. To the cooled reaction mixture benzyl bromide (7.74 g, 345.2 mmol) was added and the solution was stirred for 30 min at ice cold temperature followed by room temperature for 12 h. The reaction mixture was further concentrated under reduced pressure and diluted with ethyl acetate (150 mL). The organic layer was washed with water (2 × 100 mL), brine (1 × 100 mL) and dried over Na_2SO_4. The filtered solution was concentrated and purified by silica gel column chromatogrophy (Eluent: 0-30% ethyl acetate in Hexane) to yeild 18.5 g of intermediate **1j** as a white solid. LCMS: 433.1 $(M\text{-}O^tBu+H)^+$.

Fmoc group on compound **1j** (10.0 g, 20.5 mmol) in CH_2Cl_2 (40.0 mL) was deprotected by stirring it with diethyl amine (40.0 mL) for 1 h at room temperature. The resulting solution was concentrated in vacuum and the thick-residue was purified by column chromatography over neutral alumina (Eluent: 0-50% ethyl acetate in hexane then 0-5% methanol in chloroform) to yield 3.5 g of intermediate **1k** (Yield: 70%). LCMS: 266.5 $(M+H)^+$.

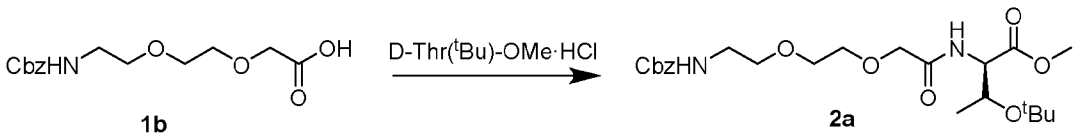


1k **1l**

TEA (1.2 g, 12.0 mmol) was added to a stirred solution of intermediate **1k** (1.6 g, 6.0 mmol) in CH_2Cl_2 (30 mL). Solution of 4-nitrophenyl chloroformate (1.3 g, 6.6 mmol) in CH_2Cl_2 (10 mL) was added to the above stirred solution and the reaction was continued for 12 h at room temperature. The completion of the reaction was confirmed by TLC analysis After completion of reaction, the reaction mixture was diluted with CH_2Cl_2 (50 mL) and washed with 1.0 M of sodium bi sulphate (50 mL × 2) and 1.0 M sodium carbonate (50 mL × 2), dried over Na_2SO_4 and evaporated under reduced pressure to yield crude compound **1l**, which was further purified by silica gel column chromatography (eluent: 0-20% ethyl acetate in hexane) to yield 0.8 g of compound **1l**. ^1H NMR (DMSO-d_6, 300 MHz): δ 1.04 (s, 9H), 1.16 (d, 3H), 4.11 (m, 1H), 5.11 (m, 3H), 6.91 (d, 2H), 7.40 (m, 5H), 8.10 (d, 2H), 8.26 (brs, 1H).

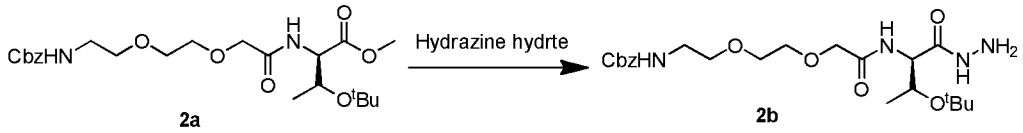
Example 2: Synthesis of compound 2

Step 2a:



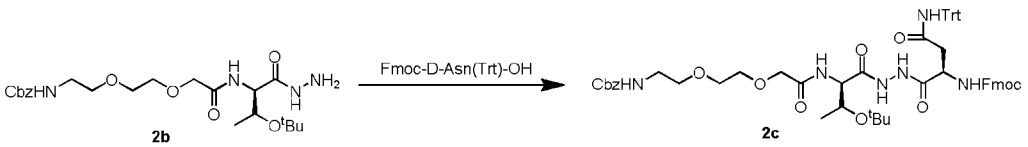
DIPEA (2.71 g, 21 mmol) was added slowly to a stirred solution of compound **1b** (3.12 g, 10.5 mmol), HATU (4.41 g, 11.6 mmol) in DMF (30 mL) and was allowed to stir at room temperature for 5 min. To the above reaction mixture D-Thr(^{t}Bu)-OMe·HCl (2.0 g, 10.5 mmol) was added slowly and stirred at room temperature for 12 h. The completeness of the reaction was confirmed by TLC analysis. The reaction mixture was then quenched with ice, precipitate was filtered and re-crystallized with CH_2Cl_2 to yield 4.2 g of compound **2a**. LCMS: 491.2 $(M+Na)^+$.

Step 2b:



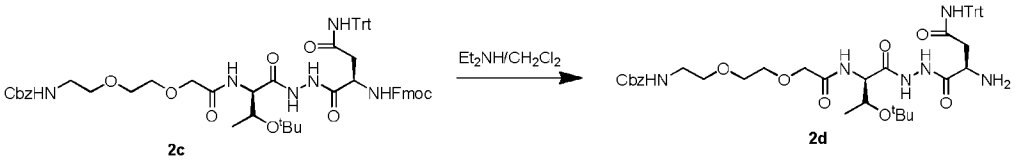
99% Hydrazine hydrate solution (5 mL) was added slowly to a stirred solution of compound **2a** (4.2 g) in methanol (40 mL) and the completion of the reaction was confirmed by TLC analysis. The reaction mixture on evaporation under reduced pressure yielded 4.2 g of compound **2b** (Yield: 90%). LCMS: 469.4 $(M+H)^+$.

Step 2c:



DIPEA (2.7 mL, 20.9 mmol) was added slowly to a stirred solution of compound **2b** (4.9 g, 10.5 mmol), HATU (4.8 g, 12.5 mmol) in DMF (50 mL).. To the above stirred solution, Fmoc-D-Asn(Trt)-OH (6.2 g, 10.5 mmol) was added and further stirred at room temperature for 12 h. The completeness of the reaction was confirmed by TLC analysis. The reaction mixture was diluted with EtOAc (30 mL) and washed with 1.0 M sodium carbonate (20 mL × 2), 10% citric acid (20 mL × 2), water (20 mL × 2), dried over Na_2SO_4 and evaporated under reduced pressure to yield 10 g of crude intermediate **2c** and was further purified by silica gel column chromatography (eluent: 0-5% MeOH in EtOAc) to yield 5 g of compound **2c**. LCMS: 1047.7 $(M+H)^+$.

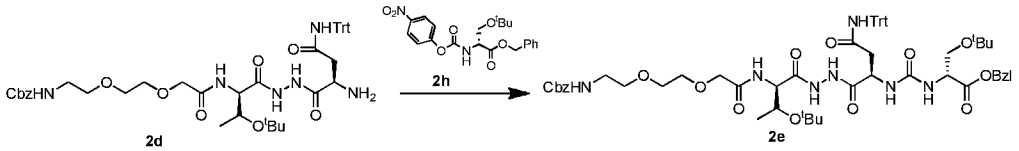
Step 2d:



2c 2d

Fmoc deprotection of compound **2c** [(3.2 g) in CH_2Cl_2 (10 mL)] was carried out using diethyl amine (10 mL). The completion of the reaction was confirmed by TLC analysis. The resulting solution on evaporation under reduced pressure yielded 1.2 g of compound **2d.**

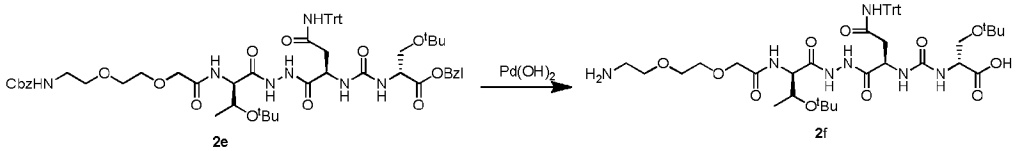
Step 2e:



2d 2e

Triethylamine (0.32 g, 3.2 mmol) was added slowly to initiate the coupling of compound **2d** (1.3 g, 1.6 mmol) and compound **2h** (0.79 g, 1.9 mmol) in THF (20 mL). The resulting solution was further allowed to stir for 12 h at room temperature and completeness of the reaction was confirmed by TLC analysis. Organic layer was washed with $NaHCO_3$, citric acid solution, brine, dried over Na_2SO_4 and evaporated under reduced pressure to yield 1.3 g of compound **2e**.

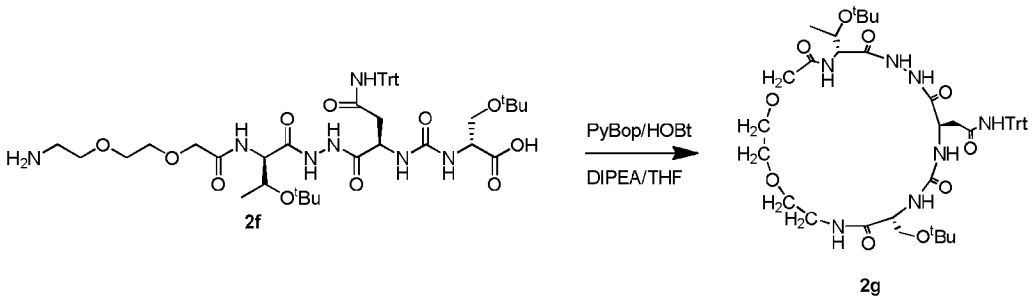
Step 2f:



2e 2f

Cbz group and benzyl ester deprotection was carried out on compound **2e** (1.3 g) in methanol using palladium hydroxide (1.0 g) for 1 h at room temperature. The completeness of the reaction was confirmed by TLC analysis. Palladium hydroxide was removed by celite® bed filtration and the filtrate was evaporated under reduced pressure to yield 0.45 g of compound **2f**. LCMS: 878.4 $(M+H)^+$.

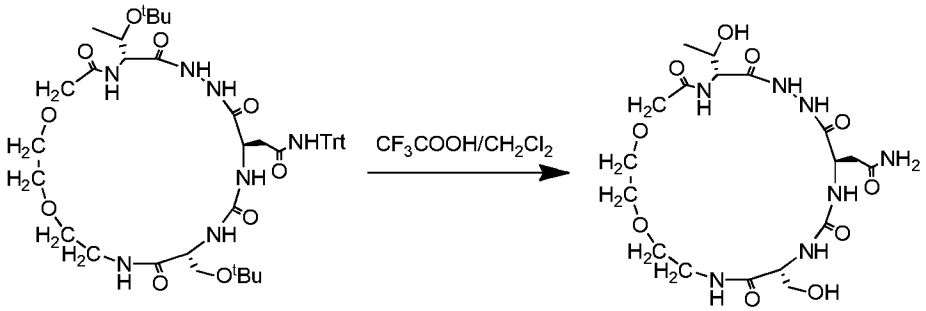
Step 2g:



2f 2g

DIPEA (0.2 g, 1.5 mmol) was added slowly to a stirred solution of compound **2f** (0.45 g, 0.51 mmol), HOBT (0.21 g, 1.53 mmol) and PyBOP (0.8 g, 1.53 mmol) in THF (200 mL). The reaction mixture was further stirred at room temperature for 12 h. The completeness of the reaction was confirmed by TLC analysis. The reaction mixture was evaporated and washed with diethyl ether to yield 0.41 g of intermediate **2g**. LCMS: 860.7 $(M+H)^+$.

Step 2h:



2g 2

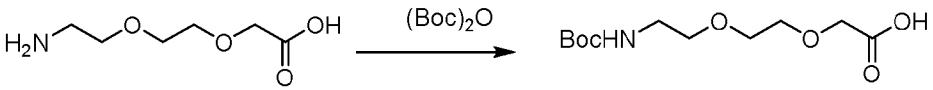
To a solution of compound **2g** (0.4 g) in CH_2Cl_2 (5 mL), trifluoroacetic acid (5 mL) and catalytic amount of triisopropylsilane were added and stirred for 3 h at room temperature. The resulting solution was concentrated in vacuum to yield 0.2 g of crude compound **2.** The crude solid material was purified (yield: 10 mg,) using preparative HPLC method-B described under experimental conditions. LCMS: 506.6 $(M+H)^+$; HPLC: t_R = 12.4 min..

Synthesis of 2h (NO_2-C_6H_4-OCO-D-Ser(^{t}Bu)-OBzl,):

The compound was synthesised using similar procedure as exemplified in (example 1, compound **1l**) using Fmoc-D-Ser(^{t}Bu)-OH instead of Fmoc-Thr(^{t}Bu)-OH to yield 1 g crude material of **2h**.

Example 3: Synthesis of compound 3

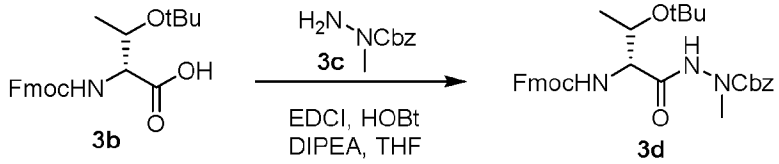
Step 3a:



1a 3a

To a stirred solution of compound **1a** (5.0 g, 30.6 mmol) in 1,4-Dioxane (50 mL), Sodium carbonate (8.12 g, 76.5 mmol, dissolved in 10 mL water) and $(Boc)_2O$ (9.98 mL, 45.7 mmol) were added and stirred at room temperature for 12 h. The progress of reaction was monitored by TLC. The reaction mass was partitioned between diethyl ether and water. Then aqueous layer was made acidic (pH = 3) by 3N HCl solution and was extracted with DCM (2 × 200 mL). Organic layer was washed with water, brine, dried over Na_2SO_4 and evaporated under reduced pressure to yield 50 g of pure **3a** (Yield: 62.1%). LCMS: 263.0 $(M+H)^+$.

Step 3b:



DIPEA (6.5 mL, 37.8 mmol) was added slowly to a stirred solution of compound **3b** (5 g, 12.6 mmol), compound **3c** (2.72 g, 15 mmol), HOBt (2.55 g, 18.9 mmol) and EDC.HCl (3.62 g, 18.9 mmol) in DMF (75 mL) at 0 °C. The reaction mixture was further stirred at room temperature for 12 h. The progress of the reaction was confirmed by TLC analysis. The reaction mass was partitioned between ethyl acetate and water. Organic layer was washed with water, brine, dried over Na_2SO_4 and evaporated under reduced pressure to yield crude. The crude compound was purified by silica gel (60-120 mesh) column chromatography using hexane/ ethyl acetate (40:60) as elute to yield 5.2 g of compound **3d,** (Yield: 71.0 %). LCMS: 560.6 $(M+H)^+$.

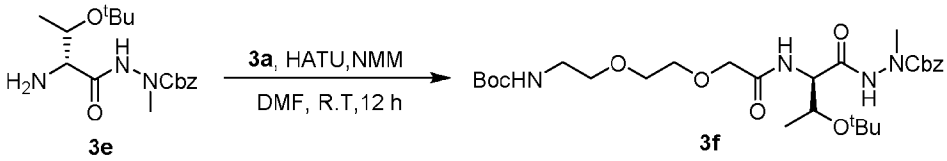
Step 3c:



To a stirred solution of compound **3d** (5 g, 8.9 mmol) in dry DCM, diethyl amine (50 mL) was added dropwise at -10 °C and stirred for 1 h at room temperature. After completion of reaction, the mixture was evaporated under reduced pressure to give crude

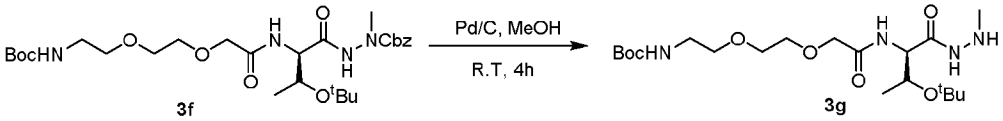
compound. The crude was purified with (1:1) n-pentane/diethyl ether wash and dried under high vacuum to yield 3.5 g of compound **3e**. LCMS: 338.58 $(M+H)^+$.

Step 3d:



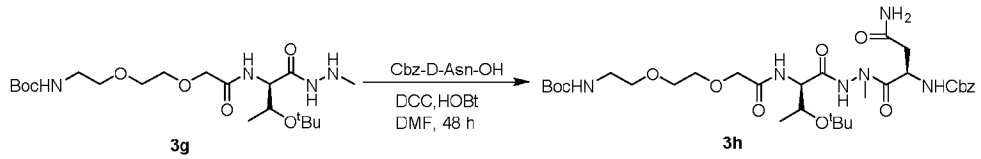
NMM (1.4 mL, 14.0 mmol) was added slowly to a stirred solution of compound **3a** (3 g, 11.3 mmol), compound **3e** (4.3 g, 12.9 mmol) and HATU (6.5 g, 17.1 mmol) in DMF (75 mL) at 0 °C. The reaction mixture was further stirred for 6 h at room temperature. Progress of reaction was monitored by TLC. After completion, the reaction mass was partitioned between ethyl acetate and water. Organic layer was washed with water, brine, dried over Na_2SO_4 and evaporated under reduced pressure to give crude compound. The crude was purified by silica gel column chromatography (Eluent: 50% hexane in ethyl acetate) to yield 4.8 g of compound **3f**, LCMS: 583.7 $(M+H)^+$.

Step 3e:



To a stirred solution of compound **3f** (4.5 g, 7.7 mmol) in MeOH, Pd/C (2.0 g) was added slowly and stirred under H_2 atmosphere for 4 h at room temperature. Progress of reaction was monitored by TLC. After completion, the reaction mass was filtered through celite® and washed with MeOH (2 × 150 mL). The resulting filtrate was evaporated under reduced pressure to yield 3 g of compound **3g** LCMS: 448.6 $(M+H)^+$.

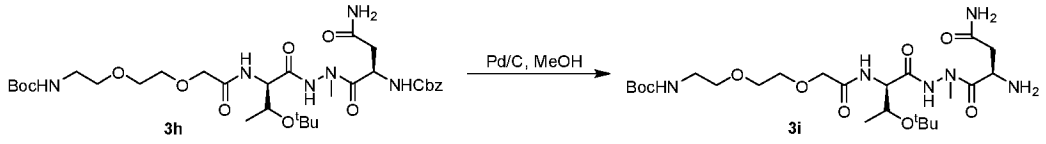
Step 3f:



To a stirred solution of Cbz-D-Asn-OH (1.78 g, 6.7 mmol) and compound **3g** (3.0 g, 6.8 mmol) in DMF (75 mL), DCC (4.12 g, 20.3 mmol) and HOBT (1.8 g, 13.5 mmol) were added slowly at 0 °C. The reaction mixture was stirred for 48 h at room temperature. Progress of reaction was monitored by TLC. After completion, the reaction mass was partitioned between ethyl acetate and water. Organic layer was washed with water, brine,

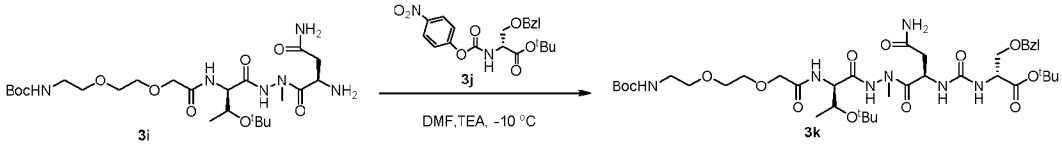
dried over Na_2SO_4 and evaporated under reduced pressure to yield crude. The crude compound was purified by silica gel (60-120 mesh) column chromatography (Eluent: 4% MeOH in DCM) to yield 2.5 g of Compound **3h**, LCMS: 697.50 $(M+H)^+$.

Step 3g:



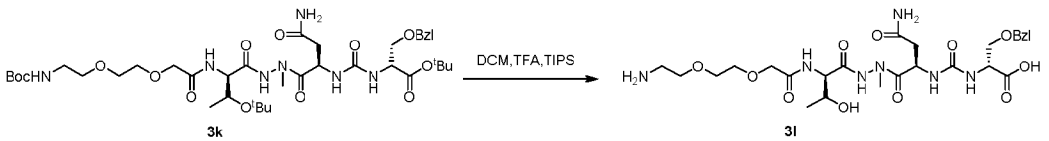
To a stirred solution of compound **3h** (2.5 g, 3.6 mmol) in MeOH (50 mL), Pd/C (1.2 g) was added and stirred under H_2 atmosphere for 4 h at room temperature. Progress of reaction was monitored by TLC. After completion, the reaction mass was filtered through celite® and washed with MeOH (2 × 150 mL). The resulting filtrate was evaporated under reduced pressure to yield 1.5 g of compound **3i**, LCMS: 563.6 $(M+H)^+$.

Step 3h:



Compound **3i** (1.3 g, 2.3 mmol), TEA (0.43 mL, 3.5 mmol) in DMF (25 mL) and was added dropwise slowly to a solution of **3j** (1.1 g, 2.6 mmol) at -10 °C. The mixture was further stirred at room temperature for 2h. Progress of reaction was monitored by TLC. After completion, the reaction mass was partitioned between ethyl acetate and water. Organic layer was washed with $NaHCO_3$, citric acid solution, brine, then organic layer was dried over Na_2SO_4 and evaporated under reduced pressure to give crude. The crude was purified by silica gel (60-120 mesh) column chromatography (hexane/ ethyl acetate (10:90) as elute) to yield 1.2 g of compound **3k.** LCMS: 840.6 $(M+H)^+$.

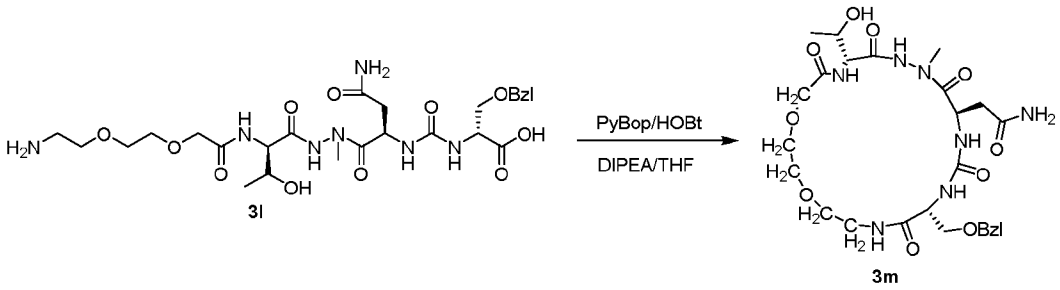
Step 3i:



To a solution of compound **3k** (1.0 g, 1.2 mmol) in CH_2Cl_2 (10 mL), trifluoroacetic acid (10 mL) and catalytic amount of triisopropylsilane were added and stirred for 3 h at room temperature to remove the acid sensitive protecting groups. The resulting solution was

concentrated in vacuum and washed with diethyl ether to afford 1.0 g of crude compound **3l**, LCMS: 628.65 $(M+H)^+$.

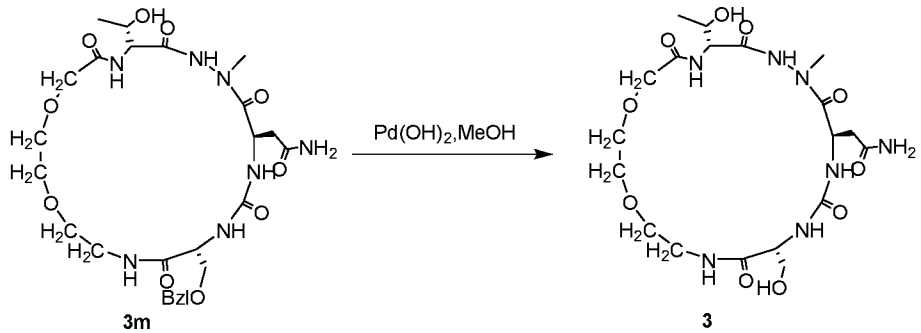
Step 3j:



3l 3m

To a stirred solution of compound **3l** (1.0 g, 1.5 mmol) in THF, PyBOP (2.4 g, 4.7 mmol), HOBT (0.6, 4.7 mmol) and DIPEA (0.8 mL, 4.7 mmol) were added slowly and stirred for 12 h at room temperature. The reaction mass was partitioned between water and ethyl acetate. Organic layer was washed with water, brine, dried over Na_2SO_4 and evaporated under reduced pressure to give crude. Crude compound was washed with diethyl ether to yield 0.8 g of compound **3m,** LCMS: 610.5 $(M+H)^+$.

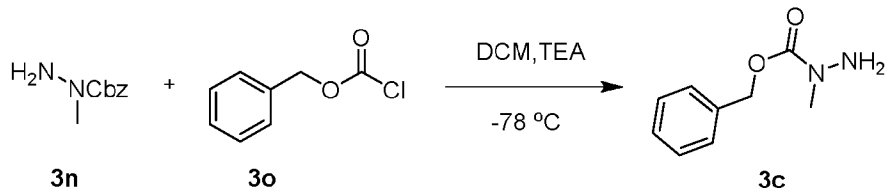
Step 3k:



3m 3

To a stirred solution of compound **3m** (0.8 g, 1.3 mmol) in MeOH (30 mL), $Pd(OH)_2$ (0.4 g) was added and stirred under H_2 atmosphere for 4 h at room temperature. Progress of reaction was monitored by TLC. After completion, the reaction mass was filtered through celite® and washed with MeOH (2 × 150 mL). The resulting filtrate was evaporated under reduced pressure to yield 0.7 g of compound **3.** LCMS: 520.5 $(M+H)^+$; HPLC: t_R = 9.9 min..

Synthesis of intermediate 3c:



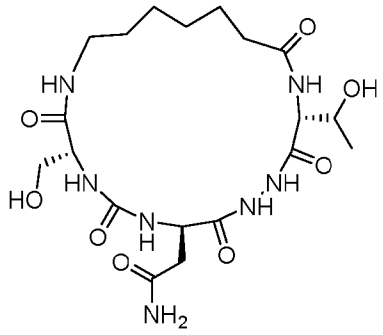
3n 3o 3c

To a stirred solution of compound **3n** (4 g, 88.3 mmol) and compound **3o** (10.2 mL, 71.2 mmol) in DCM (150 mL), TEA (14.4 mL, 105 mmol) was added dropwise at -78 °C. The reaction mixture was allowed to attain room temperature and stirred for 12 h. Progress of reaction was monitored by TLC. After completion, the reaction mass was partitioned between water and DCM. Organic layer was washed with water, brine, dried over Na_2SO_4 and evaporated under reduced pressure to yield crude compound and was purified by silica gel (60-120 mesh) column chromatography (Eluent: 80% ethyl acetate in hexane) to yield 10 g of Compound **3c**, LCMS: 181.18 $(M+H)^+$.

Synthesis of 3j (NO_2-C_6H_4-OCO-D-Ser(Bzl)-O^{t}Bu):

The compound was synthesised using similar procedure as exemplified in (example 1, compound **1k**) using Fmoc-D-Ser(Bzl)-O^{t}Bu instead of Fmoc-Thr(^{t}Bu)-OH to yield 1.5 g of compound **3j**.

Example 4: Synthesis of compound 4

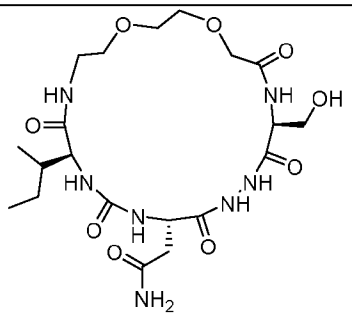
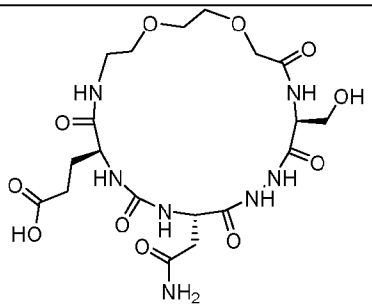
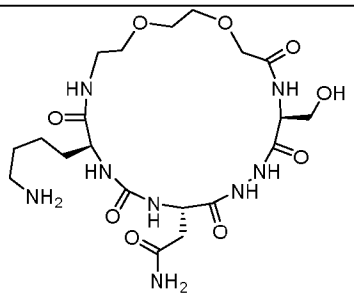
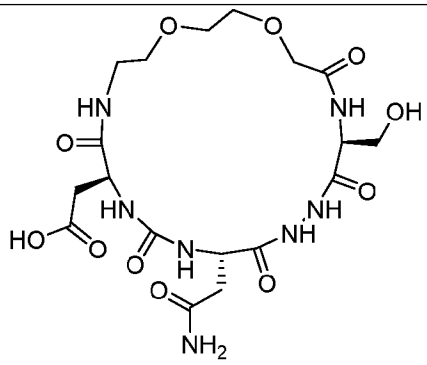


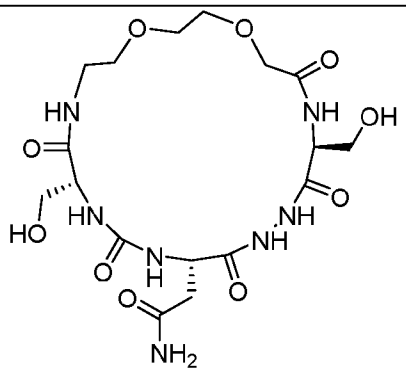
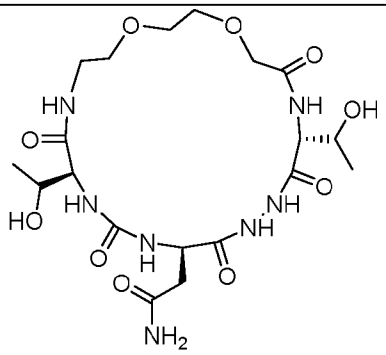
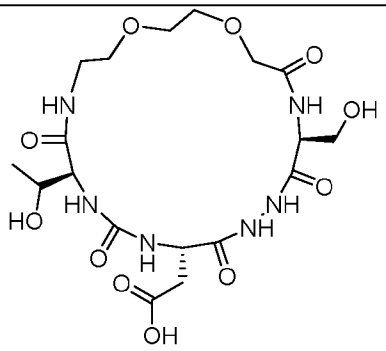
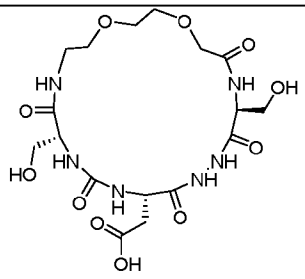
The compound was synthesised using similar procedure as depicted in Example 2 (compound 2) using 7-aminoheptanoic acid instead compound 1a to yield 0.3 g crude material of the title compound. The crude solid material was purified using preparative HPLC described under experimental conditions. LCMS: 488.2 $(M+H)^+$; HPLC: t_R = 11.9 min..

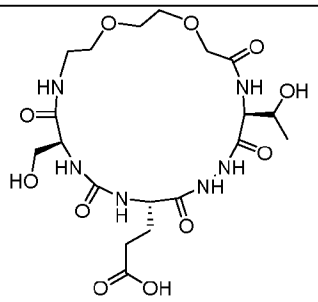
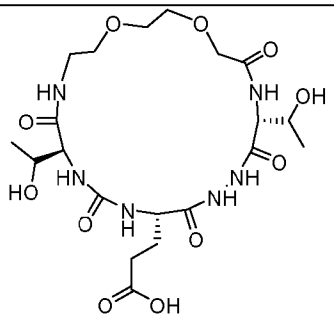
The compounds in table 3 below were prepared based on the experimental procedures described above.

Table 3

Comp	Structure	LCMS	HPLC

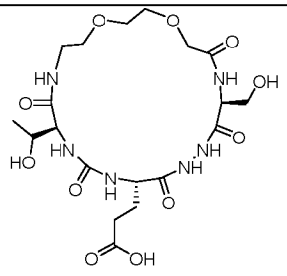
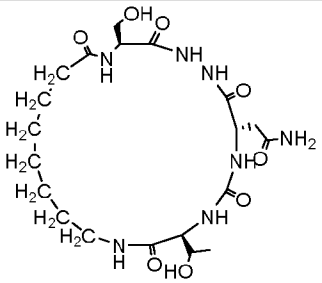
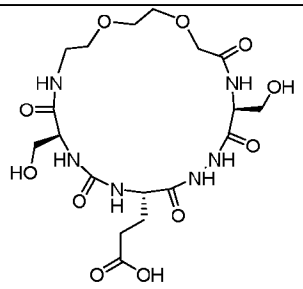
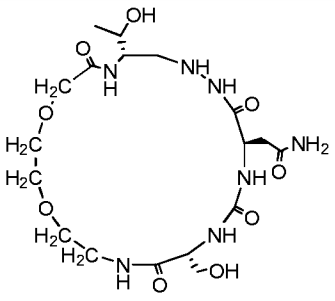
ound No		$(M+H)^+$	(t_R in min.)
5.		518.2	9.7
6.		534.2	12.4
7.		532.9	-
8.		520.2	9.03

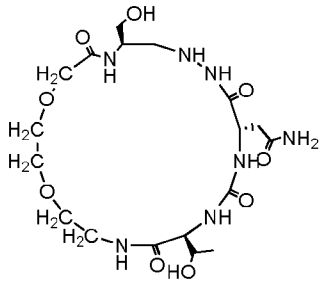
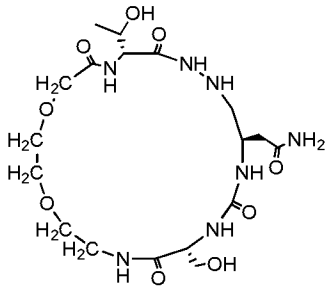
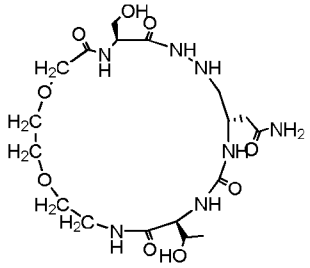
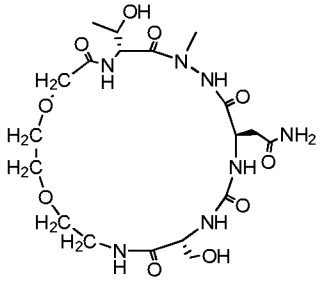
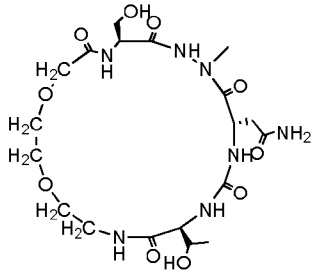
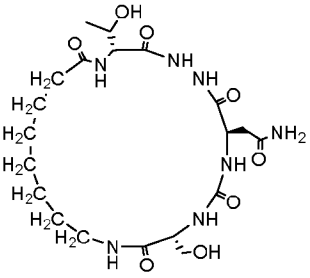
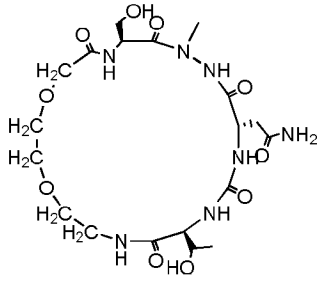
9.		492.1	12.9
10.		520.2	11.23
11.		507.2	11.96
12.		493.2	8.35

13.		521.3	12.2
14.		535.4	11.2

The compounds shown in below table 4, which can be prepared by following similar procedure as described above with suitable modification known to the one ordinary skilled in the art are also included in the scope of the present application.

Table 4

Compound No.	Structure	Compound No.	Structure
15.		21.	
16.		22.	

17.		23.	
18.		24.	
19.		25.	 and
20.		-	-

Example 5: Rescue of mouse splenocyte proliferation in the presence of recombinant PD-L1

Recombinant mouse PD-L1 (rm-PDL-1, cat no: 1019-B7-100; R&D Systems) were used as the source of PD-L1.

Requirement:

Mouse splenocytes harvested from 6-8 weeks old C57 BL6 mice; RPMI 1640 (GIBCO, Cat # 11875); DMEM with high glucose (GIBCO, Cat # D6429); Fetal Bovine Serum

[Hyclone, Cat # SH30071.03]; Penicillin (10000unit/ml)-Streptomycin(10,000µg/ml) Liquid (GIBCO, Cat # 15140-122); MEM Sodium Pyruvate solution 100 mM (100x), Liquid (GIBCO, Cat # 11360); Nonessential amino acid (GIBCO, Cat # 11140); L-Glutamine (GIBCO, Cat # 25030); Anti-CD3 antibody (eBiosciences – 16-0032); Anti-CD28 antibody (eBiosciences – 16-0281); ACK lysis buffer (1mL) (GIBCO, Cat # -A10492); Histopaque (density-1.083 gm/mL) (SIGMA 10831); Trypan blue solution (SIGMA-T8154); 2mL Norm Ject Luer Lock syringe- (Sigma 2014-12); 40 µm nylon cell strainer (BD FALCON 35230); Hemacytometer (Bright line-SIGMA Z359629); FACS Buffer (PBS/0.1% BSA): Phosphate Buffered Saline (PBS) pH 7.2 (HiMedia TS1006) with 0.1% Bovine Serum Albumin (BSA) (SIGMA A7050) and sodium azide (SIGMA 08591); 5 mM stock solution of CFSE: CFSE stock solution was prepared by diluting lyophilized CFSE with 180 µL of Dimethyl sulfoxide (DMSO C_2H_6SO, SIGMA-D-5879) and aliquoted in to tubes for further use. Working concentrations were titrated from 10 µm to 1 µm. (eBioscience-650850-85); 0.05% Trypsin and 0.02% EDTA (SIGMA 59417C); 96-well format ELISA plates (Corning CLS3390); BD FACS caliber (E6016); Recombinant mouse B7-H1/PDL1 Fc Chimera, (rm-PD-L1 cat no: 1019-B7-100).

Protocol

Splenocyte preparation and culturing:

Splenocytes harvested in a 50 mL falcon tube by mashing mouse spleen in a 40 µm cell strainer were further treated with 1ml ACK lysis buffer for 5mins at room temperature. After washing with 9 mL of RPMI complete media, cells were re-suspended in 3ml of 1xPBS in a 15 mL tube. 3 mL of Histopaque was added carefully to the bottom of the tube without disturbing overlaying splenocyte suspension. After centrifuging at 800xg for 20 min. at room temperature, the opaque layer of splenocytes was collected carefully without disturbing / mixing the layers. Splenocytes were washed twice with cold 1xPBS followed by total cell counting using Trypan Blue exclusion method and used further for cell based assays.

Splenocytes were cultured in RPMI complete media (RPMI + 10% fetal bovine serum + 1mM sodium pyruvate + 10,000units/mL penicillin and 10,000µg/mL streptomycin) and maintained in a CO_2 incubator with 5% CO_2 at 37°C.

CFSE Proliferation assay:

CFSE is a dye that passively diffuses into cells and binds to intracellular proteins. $1x10^6$ cells/ml of harvested splenocytes were treated with 5 µm of CFSE in pre-warmed 1xPBS/0.1%BSA solution for 10mins at 37°C. Excess CFSE was quenched using 5 volumes of ice-cold culture media to the cells and incubated on ice for 5 min. CFSE labelled splenocytes were further given three washes with ice cold complete RPMI media. CFSE labelled $1x10^5$ splenocytes added to wells containing either MDA-MB231 cells ($1x10^5$ cells cultured in high glucose DMEM medium) or recombinant human PDL-1 (100ng/mL) and test compounds. Splenocytes were stimulated with anti-mouse CD3 and anti- mouse CD28 antibody (1µg/mL each), and the culture was further incubated for 72 h at 37°C with 5% CO_2. Cells were harvested and washed thrice with ice cold FACS buffer and % proliferation was analysed by flow cytometry with 488 nm excitation and 521nm emission filters.

Data compilation, processing and inference:

Percent splenocyte proliferation was analysed using cell quest FACS program and percent rescue of splenocyte proliferation by compound was estimated after deduction of % background proliferation value and normalising to % stimulated splenocyte proliferation (positive control) as 100%.

Background proliferation: Splenocytes + anti-CD3/CD28 + PD-L1

Stimulated splenocytes: Splenocytes + anti-CD3/CD28 stimulation

Compound proliferation: Splenocytes + anti-CD3/CD28 + PD-L1 + Compound

Compound effect is examined by adding required conc. of compound to anti-CD3/CD28 stimulated splenocytes in presence of ligand (PDL-1) (Table 5)

Table: 5 Rescue of mouse splenocyte proliferation inhibited by recombinant mouse PDL1 using CFSE based assay:

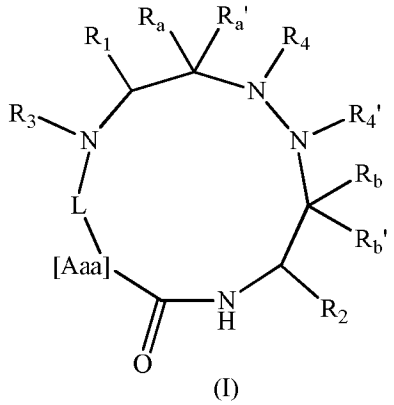
Table 5

Compound No.	Percent rescue of splenocyte proliferation (@100 nM compound concentration)
1.	95
2.	94
3.	58
4.	49
5.	53
8.	68

9.	73
10.	89
12.	91

We claim:

1. A compound of formula (I)



(I)

or a pharmaceutically acceptable salt or a stereoisomer thereof;

wherein,

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr;

R_3 is hydrogen or alkyl;

each of R_4 and R_4' independently represents hydrogen or alkyl;

both R_a and R_a' represent hydrogen; or together represent an oxo (=O) group;

both R_b and R_b' represent hydrogen; or together represent an oxo (=O) group;

L is $-C(O)-(CH_2)_m-(X-\underset{\displaystyle R_5}{\underset{|}{C}}H-CH_2)_n-NH-$;

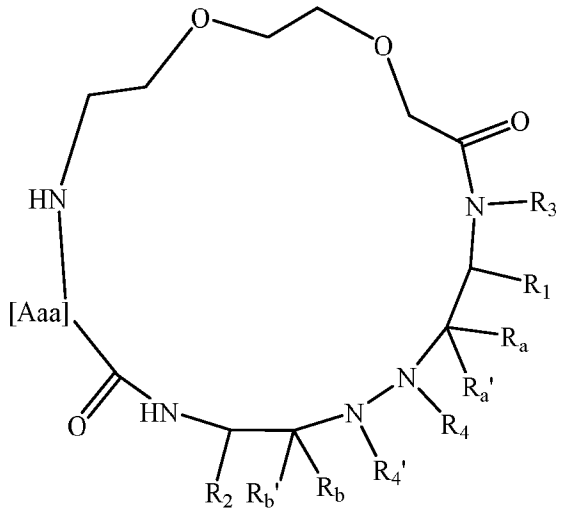
X is selected from CH_2, O or S;

R_5 is hydrogen or alkyl;

m is an integer selected from 1 to 3;

n is an integer selected from 2 to 20.

2. The compound according to claim 1, wherein the compound of formula (I) is a compound of formula (IA):



(IA)

or a pharmaceutically acceptable salt or a stereoisomer thereof; wherein,

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr;

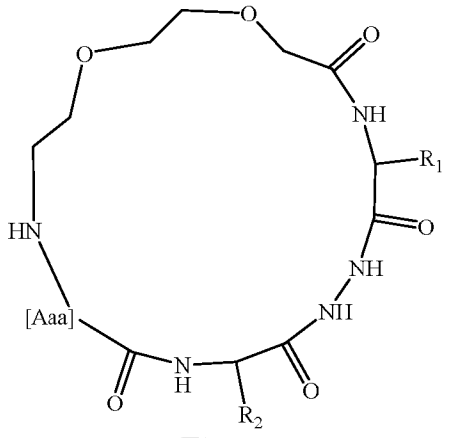
R_3 is hydrogen or alkyl;

each of R_4 and R_4' independently represents hydrogen or alkyl;

both R_a and R_a' represent hydrogen; or together represent an oxo (=O) group;

both R_b and R_b' represent hydrogen; or together represent an oxo (=O) group.

3. The compound according to any one of claims 1 to 2, wherein the compound of formula (I) is a compound of formula (IB):



(IB)

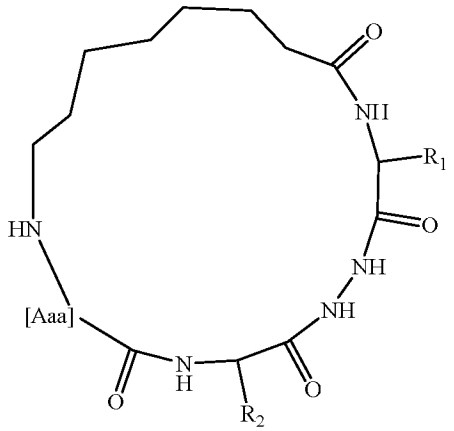
or a pharmaceutically acceptable salt or a stereoisomer thereof; wherein,

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr.

4. The compound according to claim 1, wherein the compound of formula (I) is a compound of formula (IC):



(IC)

or a pharmaceutically acceptable salt or a stereoisomer thereof; wherein,

R_1 is side chain of Ala, Ser, Thr or Leu;

R_2 is side chain of Asp, Glu, Gln or Asn;

[Aaa] is an amino acid residue selected from Ser, Asp, Ala, Ile, Phe, Trp, Lys, Glu or Thr.

5. The compound according to claim 1, wherein,

R_1 is side chain of Ser or Thr;

R_2 is side chain of Asp, Asn or Glu;

[Aaa] is an amino acid residue selected from Ser or Thr;

R_3, R_4 and R_4' independently are hydrogen;

both R_a and R_a' together represent an oxo (=O) group;

both R_b and R_b' together represent an oxo (=O) group;

L is $-C(O)-(CH_2)_m-(X-CH_2-CH_2)_n-NH-$;

X is CH_2 or O;

m is an integer selected from 1 to 3;

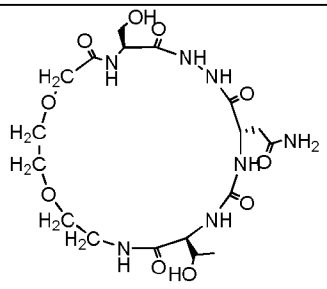
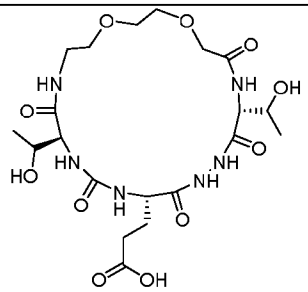
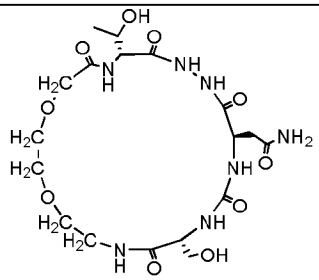
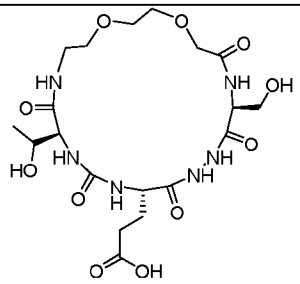
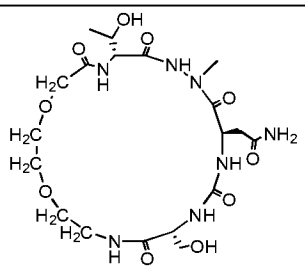
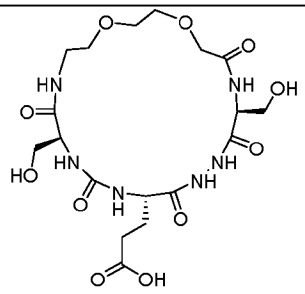
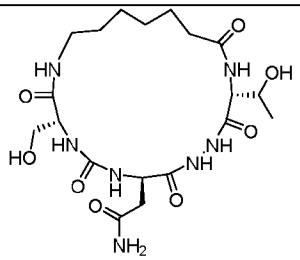
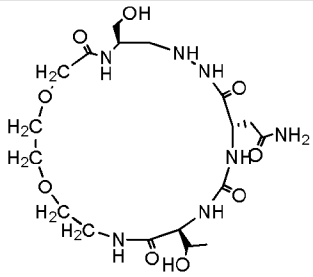
n is an integer selected from 2 to 20;

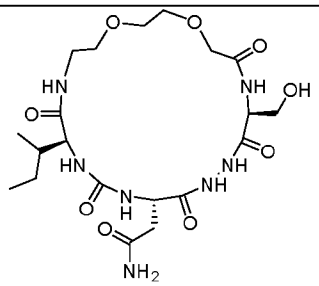
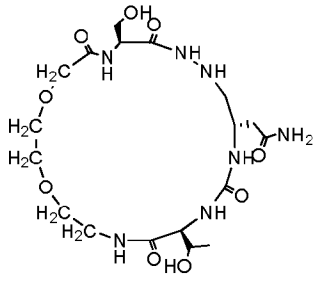
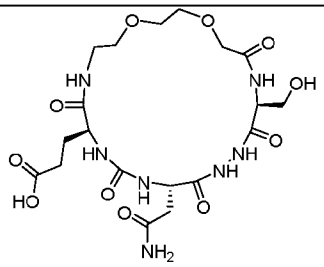
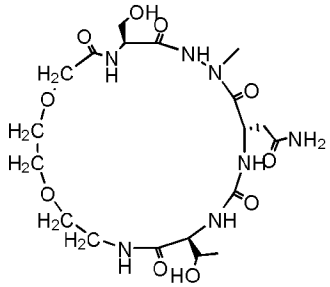
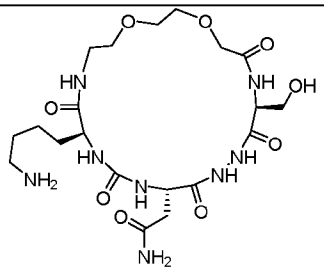
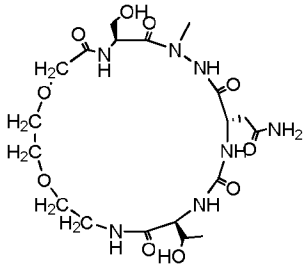
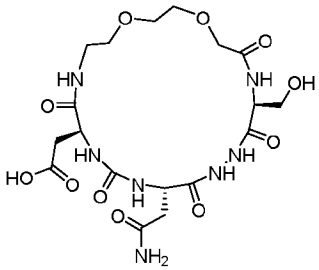
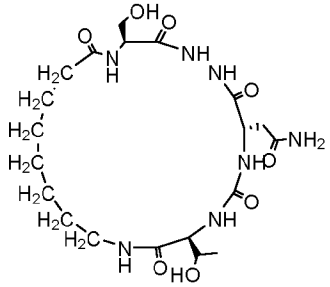
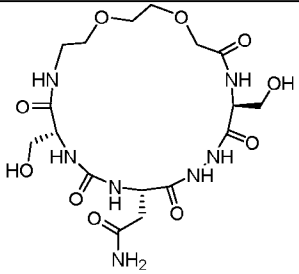
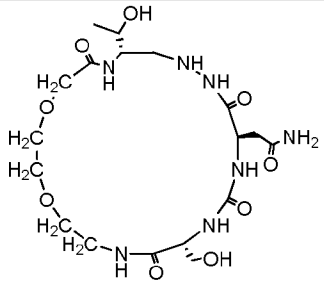
or a pharmaceutically acceptable salt or a stereoisomer thereof.

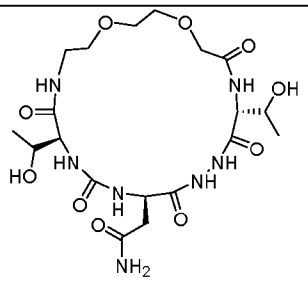
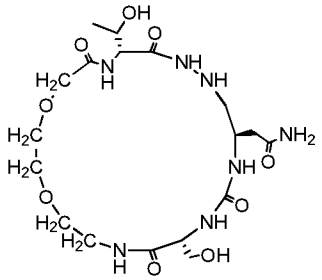
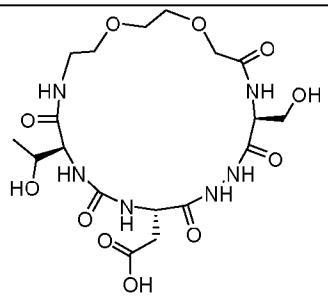
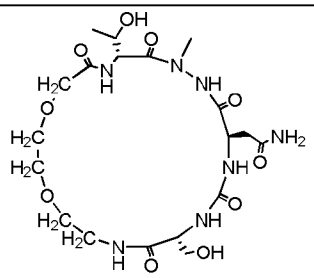
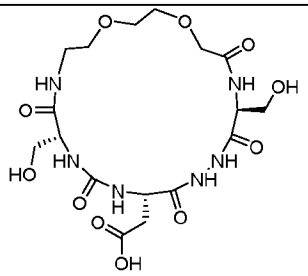
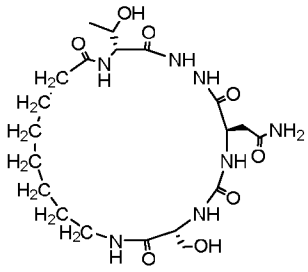
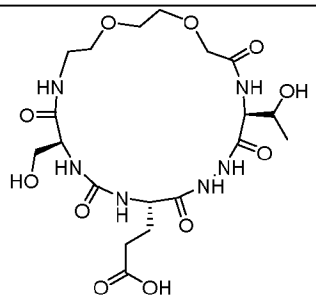
6. The compound according to any one of claims 1 to 2, wherein R_4 is C_{1-5} alkyl.

7. The compound according to any one of claims 1, 2 or 7, wherein R_4' is C_{1-5} alkyl.

8. A compound is selected from the group consisting of

Compound No.	Structure	Compound No	Structure
1.		14.	
2.		15.	
3.		16.	
4.		17.	

5.		18.	
6.		19.	
7.		20.	
8.		21.	
9.		22.	

10.		23.	
11.		24.	 and
12.		25.	
13.		-	-

or a pharmaceutically acceptable salt or a stereoisomer thereof.

9. A pharmaceutical composition comprising at least one compound according to any one of claims 1 to 8 or a pharmaceutically acceptable salt or a stereoisomer thereof, and a pharmaceutically acceptable carrier or excipient.

10. The pharmaceutical composition according to claim 9, further comprising at least one of an anticancer agent, chemotherapy agent, or antiproliferative compound.

11. A compound according to any one of claims 1 to 8, or a pharmaceutically acceptable salt or a stereoisomer thereof, for use as a medicament.

12. A compound according to any one of claims 1 to 8 or a pharmaceutically acceptable salt or a stereoisomer thereof, for use as a medicament for the treatment of cancer or infectious disease.

13. The compound for use according to claim 12, wherein the cancer is selected from the group consisting of breast cancer, colon cancer, lung cancer, melanoma, prostate cancer and renal cancer, bone cancer, cancer of the head or neck, pancreatic cancer, skin cancer, cutaneous or intraocular malignant melanoma, uterine cancer, ovarian cancer, rectal cancer, cancer of the anal region, stomach cancer, testicular cancer, uterine cancer, carcinoma of the fallopian tubes, carcinoma of the endometrium, carcinoma of the cervix, carcinoma of the vagina, carcinoma of the vulva, Hodgkin's Disease, non-Hodgkin's lymphoma, cancer of the esophagus, cancer of the small intestine, cancer of the endocrine system, cancer of the thyroid gland, cancer of the parathyroid gland, cancer of the adrenal gland, sarcoma of soft tissue, cancer of the urethra, cancer of the penis, chronic or acute leukemias including acute myeloid leukemia, chronic myeloid leukemia, acute lymphoblastic leukemia, chronic lymphocytic leukemia, solid tumours of childhood, lymphocytic lymphoma, cancer of the bladder, cancer of the kidney or ureter, carcinoma of the renal pelvis, neoplasm of the central nervous system (CNS), primary CNS lymphoma, tumour angiogenesis, spinal axis tumour, brain stem glioma, pituitary adenoma, Kaposi's sarcoma, epidermoid cancer, squamous cell cancer, T-cell lymphoma, environmentally induced cancers including those induced by asbestos, and combinations of said cancers.

14. The compound for use according to claim 12, wherein the cancer is breast cancer, colon cancer, lung cancer, melanoma, prostate cancer, or renal cancer.

15. The compound for use according to claim 12, wherein the infectious disease is a bacterial infectious disease, a viral infectious disease or a fungal infectious disease.

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/064283

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61K31/38 A61K31/395 C07D273/00 C07D285/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61K C07D

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data, BIOSIS, CHEM ABS Data, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011/161699 A2 (AURIGENE DISCOVERY TECH LTD [IN]; SASIKUMAR POTTAYIL GOVINDAN NAIR [IN) 29 December 2011 (2011-12-29) cited in the application claims 1-29; compounds 22-24	1-15
A	WO 2012/168944 A1 (AURIGENE DISCOVERY TECH LTD [IN]; SASIKUMAR POTTAYIL GOVINDAN NAIR [IN) 13 December 2012 (2012-12-13) cited in the application claims 1-34	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 November 2014	09/12/2014

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/064283

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