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(54) **PYRROLO[3,4-d]PYRIMIDINONE DERIVATIVES AND THEIR USE AS IMMUNOSUPPRESSANTS**

PYRROLO[3,4-d]PYRIMIDINON-DERIVATE UND IHRE VERWENDUNG ALS
IMMUNOSUPPRESSOREN

DERIVES DE PYRROLO[3,4-d]PYRIMIDINONE ET LEUR UTILISATION COMME
IMMUNOSUPPRESSEURS

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WO-A-93/04047 **WO-A-96/17610**

- **J. MED. CHEM., Volume 38, No. 14, 1995, WILLIAM F. MICHNE et al., "Novel Inhibitors of the Nuclear Factor of Activated T Cells (NFAT)-Mediated Transcription of Beta-Galactosidase: Potential Immunosuppressive and Antiinflammatory Agents", pages 2557-2569.**
- **BULL. CHEM. SOC. JPN., Volume 62, No. 9, 1989, MICHIIHIKO NOGUCHI et al., "A Facile Preparation of 7-(Substituted Amino)-6H-Pyrrolo(3,4-d)-Pyrimidine Derivatives", pages 3043-3045.**
- **CHEM. PHARM. BULL., Volume 29, No. 6, 1981, KOSAKU HIROTA et al., "Pyrimidine Derivatives and Related Compounds. XXXIII. Reactions of 6-Bromomethyl-5-Formyl-1,3-Dimethyluracil and Its Hydrazones with Nucleophiles. Synthesis of Pyrrolo(3,4-d)Pyrimidines and Pyrimido(4,5-d).....", pages 1525-1532.**
- **SYNTHESIS, Volume 6, June 1978, SHIGEO SENDA et al., "A Facile Synthesis of Pyrrolo(3,4-d)Pyrimidines and Pyrimido(4,5-d)Pyridazines", pages 463-465.**

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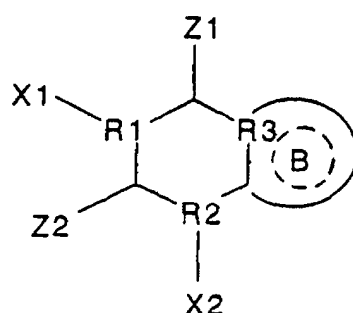
Description

[0001] The present invention provides certain novel 5-substituted pyrrolo[3,4-d]pyrimidine-2,4-diones, processes for their preparation, pharmaceutical compositions containing them, a process for preparing the pharmaceutical compositions, and methods of treatment involving their use.

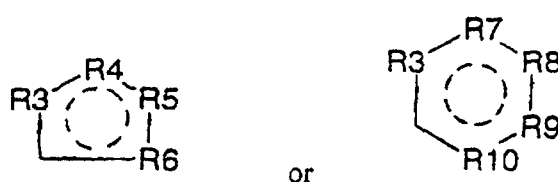
[0002] T-cells play an important role in the immune response, however in autoimmune disease T-cells are activated against particular tissues, e.g. causing the inflammation associated with rheumatoid arthritis. Interleukin-2 (IL-2) is an essential autocrine growth factor for T-cells and hence inhibition of IL-2 transcription is beneficial in the modulation of autoimmune disease. Formation of a transcriptional complex of the protein nuclear factor of activated T-cells-1 (NFAT-1) on the IL-2 promoter is essential for IL-2 transcription. NFAT-1 mediated transcription has therefore been proposed as appropriate molecular target for immunomodulation, Y. Baine *et al.*, *J. Immunol.*, 1995, **154**, 3667-3677.

[0003] W. F. Michne *et al.*, in *J. Med. Chem.* (1995) **38**, 2557-2569 disclose a number of quinazoline-2,4-diones and pyrrolo[3,4-d]pyrimidine-2,4-diones which inhibit transcription regulated by the DNA region bound by the NFAT-1 protein.

[0004] WO 96/17610 discloses the use of compounds of the following general formula and their salts as anti-ischaemic agents,

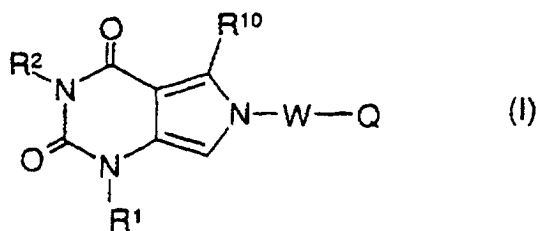


wherein R1, R2 and R3 which may be the same or different are N or CH; X1 and X2 which may be the same or different are hydrogen, hydroxy or an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, aryl or heterocyclyl group and Z1 and Z2 which may be the same or different are hydrogen, hydroxy, keto or an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, aryl or heterocyclyl group or one of Z1 and X1 and Z2 and X2 form the second bond of a double bond at the 1,6 or 2,3 positions, with the proviso that at least one of the groupings R1Z1X1, R2Z2X2 and R1X1Z2 form a hydroxamate moiety (-N(OH)C(=O)-) in which R1 and/or R2 is N, Z1 and/or Z2 is =O and X1 and/or X2 is OH or R1 is N, Z2 is =O and X1 is OH and B is a 5- or 6-membered ring of formula



in which R4, R5, R6, R7, R8, R9 and R10 which may be the same or different are CH or N with the proviso that ring B cannot contain more than 3 ring members which are nitrogen and the ring B may optionally be substituted by one or more of hydroxy, keto and an optionally substituted alkyl, alkenyl, alkynyl, cycloalkyl, aryl or heterocyclyl group. Preferred compounds of WO 96/17610 include those compounds in which the ring B contains no substituent groups.

[0005] In accordance with the present invention, there is provided a compound according to the general formula:



wherein—

W represents —CH₂— or a bond; Q represents Ar¹ or Ar²; in the case where W represents —CH₂—, Q represents an aryl group Ar¹ wherein Ar¹ represents naphthyl, phenyl, quinolyl, isoquinolyl, indolyl, benzofuranyl or benzothienyl; in the case where W represents a bond, Q represents an aryl group Ar² wherein Ar² represents acenaphthenyl, fluorenyl or indanyl; wherein the ring systems which Ar¹ and Ar² represent may all be optionally substituted by one or more substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen, or trifluoromethyl; R¹⁰ represents X—(A)_p—Y; X represents S(O)_n, C≡C, (CH₂)₂, CH=CH or CH₂CH=CH; n represents 0, 1 or 2; A represents C₁₋₆ alkylene; p is 0 or 1; Y represents CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵R¹⁶, NHSO₂R¹⁷, NHCOR¹⁸ or an optionally substituted aryl or heteroaryl group, provided that when X represents S(O)_n and Y is other than an optionally substituted aryl or heteroaryl group, then p is 1 and also provided that when X represents S(O)_n, p is 1 and Y represents OH, then n is not 0; R¹³ and R¹⁴ independently represent H, C₁₋₅ alkyl or phenyl, which latter group may be substituted by one or more substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen, or CO₂R²¹; and R¹, R², R¹¹, R¹², R¹⁵, R¹⁶, R¹⁷, R¹⁸ and R²¹ independently represent H or C₁₋₅ alkyl; or a pharmaceutically acceptable derivative thereof.

[0006] In the present specification, unless otherwise indicated, an alkyl substituent or alkyl moiety in an alkoxy, alkoxycarbonyl, alkylsulphonamido, (di)alkylamido, (di)alkylamino or acylamino substituent group may be linear or branched.

[0007] When W in formula (I) represents —CH₂—, then Q represents an aryl group Ar¹ wherein Ar¹ preferably represents a naphthyl or phenyl group, especially a naphthyl group, which aryl group may be optionally substituted by one or more, preferably one to four, particularly one or two, substituents selected from C₁₋₄ alkyl, e.g., methyl or ethyl, C₁₋₄ alkoxy, e.g. methoxy or ethoxy, halogen, e.g. fluorine, chlorine or bromine, or trifluoromethyl. Ar¹ is preferably an unsubstituted naphthyl group.

[0008] When W in formula (I) represents a bond, then Q represents an aryl group Ar² wherein Ar² preferably represents an indanyl group, which may be optionally substituted by one or more, preferably one to four, particularly one or two, substituents selected from C₁₋₄ alkyl, e.g. methyl or ethyl, C₁₋₄ alkoxy, e.g. methoxy or ethoxy, halogen, e.g. fluorine, chlorine or bromine, or trifluoromethyl. Ar² is preferably an unsubstituted indanyl group.

[0009] Preferably, X represents S(O)_n wherein n is 0, 1 or 2, C≡C, (CH₂)₂ or CH₂CH=CH. Particularly advantageous compounds of formula (I) are those in which X represents S(O)_n wherein n is 0, 1 or 2.

[0010] When p is 1, A preferably represents C₁₋₄ alkylene, more preferably CH₂, (CH₂)₂ or (CH₂)₃.

[0011] Each of groups R¹, R², R¹¹, R¹², R¹⁵, R¹⁶, R¹⁷, R¹⁸ and R²¹ preferably represents H or a C₁₋₄ alkyl group. R¹ is most preferably a cyclic or branched C₃₋₄ alkyl group, e.g., a 1-methylethyl or 2-methylpropyl group, and R² is most preferably a methyl group.

[0012] Each of groups R¹³ and R¹⁴ preferably represents H, C₁₋₃ alkyl or phenyl, which latter group may be substituted by one or more, e.g. one to four, substituents selected from C₁₋₄ alkyl, e.g., methyl or ethyl, C₁₋₄ alkoxy, e.g., methoxy or ethoxy, halogen, e.g. fluorine, chlorine or bromine, or CO₂R²¹.

[0013] More preferably, each of groups R¹³ and R¹⁴ represents H, C₁₋₃ alkyl or phenyl, which latter group may be substituted by one or two substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen, or CO₂R²¹.

[0014] Most preferably, each of groups R¹³ and R¹⁴ represents H, C₁₋₃ alkyl or phenyl, especially H.

[0015] The group Y may represent an optionally substituted aryl or heteroaryl group. Preferably p is 0 when Y represents an optionally substituted aryl or heteroaryl group. Examples of aryl and heteroaryl groups include phenyl, furyl, imidazolyl, pyrazinyl, pyrazolyl, pyridazinyl, pyridyl, pyrimidinyl, pyrrolyl, tetrazolyl and thienyl groups. The groups phenyl, 2-pyridyl, 4-pyridyl and 5-tetrazolyl are most preferred. Examples of substituents that may be present in the aryl or heteroaryl group include C₁₋₄ alkyl, e.g. methyl or ethyl, C₁₋₄ alkoxy, e.g. methoxy or ethoxy, halogen, e.g. fluorine, chlorine or bromine, hydroxyl and trifluoromethyl. One or more, e.g. 1, 2, 3 or 4, substituent groups may be present but preferably only one substituent group is present.

[0016] A preferred subset of compounds of formula (I) is one in which W represents —CH₂— or a bond; Q represents Ar¹ or Ar²; in the case where W represents —CH₂—, Q represents an aryl group Ar¹ wherein Ar¹ represents naphthyl or phenyl; in the case where W represents a bond, Q represents an aryl group Ar² wherein Ar² represents indanyl; wherein the ring systems which Ar¹ and Ar² represent may all be optionally substituted by one or more, e.g. one, two, three or four, substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen, or trifluoromethyl; R¹⁰ represents X—(A)_p—Y;

X represents $S(O)_n$, $C\equiv C$, $(CH_2)_2$ or $CH_2CH=CH$; n represents 0, 1 or 2; A represents C_{1-6} alkylene; p is 0 or 1; Y represents CN, OR^{11} , CO_2R^{12} , $CONR^{13}R^{14}$, $NR^{15}R^{16}$ or an optionally substituted phenyl, pyridyl or tetrazolyl group, provided that when X represents $S(O)_n$ and Y is other than an optionally substituted aryl or heteroaryl group, then p is 1 and also provided that when X represents $S(O)_n$, p is 1 and Y represents OH, then n is not 0; R^{13} and R^{14} independently represent H, C_{1-5} alkyl or phenyl, which latter group may be substituted by one or more, e.g. one, two, three or four, substituents selected from C_{1-4} alkyl, C_{1-4} alkoxy, halogen, or CO_2R^{21} ; and R^1 , R^2 , R^{11} , R^{12} , R^{15} , R^{16} and R^{21} independently represent H or C_{1-5} alkyl.

[0017] An especially preferred subset of compounds of formula (I) is one in which W represents $-CH_2-$ or a bond; Q represents Ar^1 or Ar^2 ; in the case where W represents $-CH_2-$, Q represents an aryl group Ar^1 wherein Ar^1 represents naphthyl; in the case where W represents a bond, Q represents an aryl group Ar^2 wherein Ar^2 represents indanyl; R^{10} represents $X-(A)_p-Y$; X represents $S(O)_n$, $C\equiv C$, $(CH_2)_2$ or $CH_2CH=CH$; n represents 0, 1 or 2; A represents C_{1-3} alkylene; p is 0 or 1; Y represents CN, OR^{11} , CO_2R^{12} , $CONR^{13}R^{14}$, $NR^{15}R^{16}$ or a phenyl, pyridyl or tetrazolyl group optionally substituted by a hydroxyl or methoxy group, provided that when X represents $S(O)_n$ and Y is other than an optionally substituted aryl or heteroaryl group, then p is 1 and also provided that when X represents $S(O)_n$, p is 1 and Y represents OH, then n is not 0; R^{13} and R^{14} independently represent H; and R^1 , R^2 , R^{11} , R^{12} , R^{15} and R^{16} independently represent H or C_{1-4} alkyl.

[0018] Specific examples of preferred compounds of formula (I) are:

- (i) 5-[(3-hydroxypropyl)sulphinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (ii) 5-[(3-hydroxypropyl)sulphonyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (iii) methyl 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanoate;
- (iv) 5-[(3-methoxypropyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (v) 5-[(2-hydroxyethyl)sulphinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (vi) 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanoic acid;
- (vii) 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanoic acid, sodium salt;
- (viii) 5-[(2-dimethylaminoethyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (ix) 6-(2,3-dihydro-1*H*-inden-2-yl)-5-[(3-hydroxypropyl)sulphinyl]-3-methyl-1-(1-methylethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (x) 6-(2,3-dihydro-1*H*-inden-2-yl)-5-[(3-hydroxypropyl)sulphonyl]-3-methyl-1-(1-methylethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (xi) 5-[(3-hydroxypropyl)sulphinyl]-3-methyl-1-(1-methylethyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (xii) 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanamide;
- (xiii) 5-(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)pent-3-enoic acid;
- (xiv) 5-(5-hydroxypent-1-ynyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (xv) 5-(5-hydroxypentyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (xvi) 5-(4-hydroxybut-1-ynyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (xvii) 5-(4-hydroxybutyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
- (xviii) 5-(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)pentanoic acid;
- (xix) 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanenitrile;
- (xx) 5-[(3-{1*H*-tetrazol-5-yl}propyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

(xxi) 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)thio]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

(xxii) 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)sulphinyl]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

(xxiii) 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(4-pyridinyl)thio]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

(xxiv) 5-[(3-methoxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

(xxv) 5-[(3-hydroxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

(xxvi) 5-[(4-methoxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

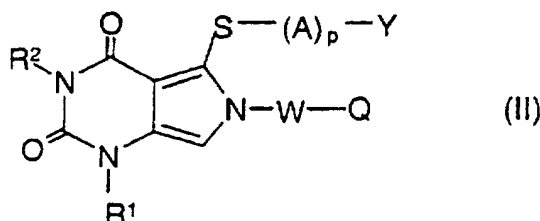
(xxvii) 5-[(4-hydroxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

(xxviii) 5-[(2-methoxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; and

(xxix) 5-[(2-hydroxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione.

[0019] According to the invention there is also provided a process for the preparation of a compound of formula I which comprises:

(a) when X represents S(O)_n and n is 1 or 2, oxidising a compound of general formula



wherein R¹, R², A, p, Y, W and Q are as hereinbefore defined including the provisos, in the presence of an appropriate quantity of a suitable oxidising agent (e.g. 3-chloroperoxybenzoic acid or potassium peroxymonosulphate, commercially sold under the trade mark "OXONE") and an appropriate organic solvent (e.g. dichloromethane) under conditions which are well known to those skilled in the art;

(b) when Y represents OR¹¹ and R¹¹ represents C₁₋₅ alkyl, reacting a corresponding compound of formula (I) in which Y represents OH, with an alkyl halide of general formula



wherein R^{11a} represents C₁₋₅ alkyl and Hal represents a halogen atom such as bromine or iodine, for example, at 25 °C in the presence of a suitable base (e.g. sodium hydride) and a suitable organic solvent (e.g. tetrahydrofuran);

(c) when Y represents CO₂R¹² and R¹² represents C₁₋₅ alkyl, esterifying a corresponding compound of formula (I) in which Y represents CO₂H with an alcohol of general formula



wherein R^{12a} represents C₁₋₅ alkyl, under conditions that are well known to those skilled in the art;

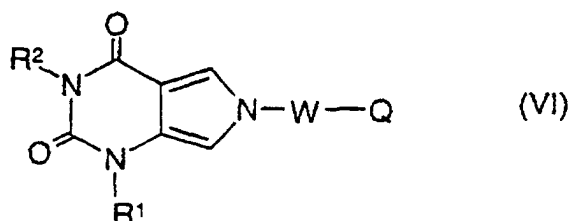
(d) when Y represents CONR¹³R¹⁴, reacting a corresponding compound of formula (I) in which Y represents CO₂H with an amine of general formula



wherein R^{13} and R^{14} are as hereinbefore defined, for example, at 25 °C in the presence of an appropriate peptide synthesis agent (e.g. diisopropylcarbodiimide and *N,N*-dimethylaminopyridine or, alternatively, ethyl chloroformate and triethylamine) and a suitable organic solvent (e.g. dichloromethane);

(e) when Y represents CO_2H , hydrolysing a corresponding compound of formula (I) in which Y represents CO_2R^{12} and R^{12} represents C_{1-5} alkyl, using a suitable base (e.g. lithium or sodium hydroxide) in a suitable solvent (e.g. aqueous tetrahydrofuran) at a temperature of from 0 °C to 80 °C;

(f) when X represents S, A represents a C_{1-6} alkylene group, Y represents CO_2R^{12} and R^{12} represents C_{1-5} alkyl, reacting a compound of general formula



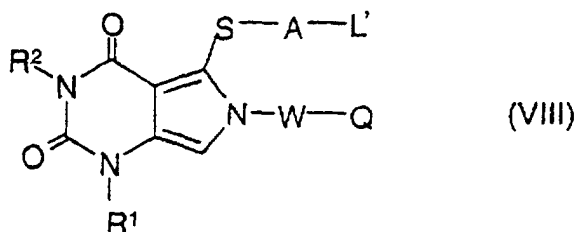
in which R^1 , R^2 , W and Q are as hereinbefore defined, with a compound of general formula



wherein L is a suitable leaving group, for example *para*-toluenesulphinate, and A and R^{12} are as hereinbefore defined, in the presence of a suitable base, for example lithium diisopropylamide, in an appropriate solvent, for example tetrahydrofuran, at from -78 °C to room temperature, followed by hydrolysis of the resulting ortho ester;

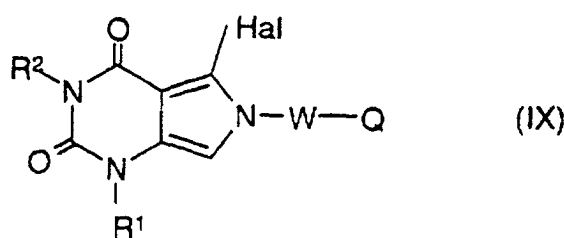
(g) when X represents S, A represents a C_{2-6} alkylene group, Y represents $\text{NR}^{15}\text{R}^{16}$ and R^{15} and R^{16} are as hereinbefore defined, reducing a corresponding compound of formula (II) as hereinbefore defined in which A represents a C_{1-5} alkylene group, Y represents $\text{CONR}^{13}\text{R}^{14}$ and R^{13} and R^{14} are respectively equal to R^{15} and R^{16} , with a suitable reducing agent, for example diborane, in a suitable solvent, for example tetrahydrofuran;

(h) when X represents S, A represents a C_{1-6} alkylene group, Y represents $\text{NR}^{15}\text{R}^{16}$ and R^{15} and R^{16} are as hereinbefore defined, reacting a corresponding compound of general formula



wherein L' represents a leaving group such as *para*-toluenesulphonate and R^1 , R^2 , A, W and Q are as hereinbefore defined, with a compound of formula (V) wherein R^{13} and R^{14} are respectively equal to R^{15} and R^{16} , typically in a suitable solvent, such as dimethylformamide, in the presence of a suitable base, such as triethylamine;

(j) when X represents $\text{C}\equiv\text{C}$, $\text{CH}=\text{CH}$ or $\text{CH}_2\text{CH}=\text{CH}$, reacting a compound of general formula



in which Hal represents a halogen atom, e.g. bromine or iodine, and R¹, R², W and Q are as hereinbefore defined, with a compound of general formula (X), H-X[']-(A)_p-Y, in which X['] represents C≡C, CH=CH or CH=CHCH₂ and A, p and Y are as hereinbefore defined in the presence of a palladium catalyst (e.g. bis-triphenylphosphinepalladium (II) chloride), and optionally hydrogenating the compound of formula (I) obtained wherein X represents C≡C or CH=CH in the presence of a palladium on carbon catalyst to produce a further compound of formula (I) wherein X represents (CH₂)₂;

(k) when X represents S, A represents a C₁₋₆ alkylene group and Y represents CN, reacting a compound of formula (VIII) as hereinbefore defined with sodium cyanide (NaCN);

(l) when X represents S, A represents a C₁₋₆ alkylene group and Y represents NHSO₂R¹⁷, reacting a corresponding compound of formula (I) in which Y represents NH₂ with a compound of general formula (XI), R¹⁷SO₂Cl, wherein R¹⁷ is as hereinbefore defined;

(m) when X represents S, A represents a C₁₋₆ alkylene group and Y represents NHCOR¹⁸, reacting a corresponding compound of formula (I) in which Y represents NH₂ with a compound of general formula (XII), R¹⁸COCl, wherein R¹⁸ is as hereinbefore defined;

(n) when X represents S and Y represents an optionally substituted aryl or heteroaryl group, reacting a compound of formula (VI) as hereinbefore defined with a compound of general formula



wherein Y' represents an optionally substituted aryl or heteroaryl group and p and A are as hereinbefore defined; or (p) when X represents S, A represents a C₁₋₆ alkylene group and Y represents a tetrazolyl group, reacting a compound of formula (I) in which X represents S, A represents a C₁₋₆ alkylene group and Y represents CN, with trialkyltin azide (e.g. trimethyltin azide), typically in a solvent such as toluene under reflux conditions;

and optionally forming a pharmaceutically acceptable derivative thereof.

[0020] Compounds of formula (II) wherein Y represents OH may be prepared by reaction of a compound of formula (VI) as hereinbefore defined with a compound of general formula



wherein L'' is a suitable leaving group, for example *para*-toluenesulphinate, A is as hereinbefore defined, and R²² is H or a suitable protecting group such as *tert*-butyldimethylsilyl, in the presence of a suitable base, for example lithium diisopropylamide, in a suitable solvent, for example tetrahydrofuran at around -70 °C.

[0021] Compounds of formula (II), wherein Y represents OR¹¹, CO₂R¹², CONR¹³R¹⁴, NHSO₂R¹⁷ or NHCOR¹⁸ and wherein R¹¹ or R¹² as appropriate represent C₁₋₅ alkyl and R¹³ and R¹⁴ or R¹⁷ or R¹⁸ as appropriate are as hereinbefore defined, may be prepared from corresponding compounds of formula (II) wherein Y represent OH, CO₂H or NH₂ as appropriate in accordance with the methods described in steps (b) to (d), (l) and (m) hereinbefore.

[0022] Compounds of formula (VI) are known from *J. Med. Chem.* (1995) **38**, 2557, or may be prepared analogously by methods described therein.

[0023] Compounds of formula (VIII) may be prepared from compounds of formula (II) where Y represents OH by techniques known to those skilled in the art.

[0024] Compounds of formula (IX) may be prepared by reacting a compound of formula (VI) with lithium diisopropylamide at -78 °C, followed by the addition of a halogen.

[0025] Other compounds of formula (II), (III), (IV), (V), (VII), (X), (XI), (XII), (XIII) and (XIV) are either commercially

available, are well known in the literature or may be prepared easily using known techniques.

[0026] It will be appreciated by those skilled in the art that in the processes described above the functional groups (e.g. hydroxy or amino groups) of intermediate compounds may need to be protected by protecting groups. The final stage in the preparation of the compounds of formula (I) may involve the removal of one or more protecting groups.

[0027] The protection and deprotection of functional groups is fully described in 'Protective Groups in Organic Chemistry', edited by J. W. F. McOmie, Plenum Press (1973), and 'Protective Groups in Organic Synthesis', 2nd edition, T. W. Greene & P. G. M. Wuts, Wiley-Interscience (1991).

[0028] Pharmaceutically acceptable derivatives of the compounds of formula (I) include solvates and salts.

[0029] Salts of the compounds of formula (I) may be formed by reacting the free acid, or a salt thereof, or the free base, or a salt or derivative thereof, with one or more equivalents of the appropriate base or acid. The reaction may be carried out in a solvent or medium in which the salt is insoluble or in a solvent in which the salt is soluble, e.g. ethanol, tetrahydrofuran or diethyl ether, which may be removed *in vacuo*, or by freeze drying. The reaction may also be a metathetical process or it may be carried out on an ion exchange resin. The non-toxic physiologically acceptable salts are preferred, although other salts may be useful, e.g. in isolating or purifying the product.

[0030] Particular salts which may be mentioned include sodium, potassium, hydrochloride, hydrobromide, sulphate, tosylate and methanesulphonate.

[0031] The compounds of formula (I) may exhibit tautomerism. All tautomeric forms and mixtures thereof are included within the scope of the invention.

[0032] The compounds of formula (I) have a number of chiral centres and may exist in a variety of stereoisomers. The invention provides all optical and stereoisomers, as well as racemic mixtures. The isomers may be resolved or separated by conventional techniques, e.g. chromatography or fractional crystallisation. Enantiomers may be isolated by separation of a racemic or other mixture of the compounds using conventional, e.g. chiral HPLC, techniques. Alternatively the desired optical isomers may be made by reaction of the appropriate optically active starting materials under conditions which will not cause racemisation, or by derivatisation, for example with a homochiral acid followed by separation of the diastereomeric derivatives by conventional means (e.g. HPLC, chromatography over silica) or may be made with achiral starting materials and chiral reagents. All stereoisomers are included within the scope of the invention.

[0033] The compounds of formula (I) may be isolated from their reaction mixtures using conventional techniques.

[0034] The compounds of formula (I) are useful because they possess pharmacological activity in human and non-human animals. They are therefore indicated as pharmaceuticals. In particular they are useful because they possess immunosuppressive activity, for example as demonstrated in the test described below.

[0035] The compounds are thus indicated for use in the treatment or prevention of resistance to transplanted organs or tissues, such as kidney, heart, lung, bone marrow, skin and cornea; and of autoimmune, inflammatory, proliferative and hyperproliferative diseases including cancer, and of cutaneous manifestations of immunologically-mediated diseases: for example rheumatoid arthritis, lupus erythematosus, systemic lupus erythematosus, Hashimoto's thyroiditis, multiple sclerosis, myasthenia gravis, type 1 diabetes, uveitis, nephrotic syndrome, psoriasis, atopic dermatitis, contact dermatitis and further eczematous dermatitides, seborrhoeic dermatitis, Lichen planus, Pemphigus, bullous Pemphigoid, Epidermolysis bullosa, urticaria, angioedemas, vasculitides, erythemas, cutaneous eosinophilias, Alopecia areata, eosinophilic fasciitis and atherosclerosis.

[0036] The compounds of formula (I) are also indicated in the treatment of respiratory diseases, for example sarcoidosis, farmer's lung and related diseases, fibroid lung, idiopathic interstitial pneumonia and reversible obstructive airways diseases which latter includes conditions such as asthma (e.g. bronchial asthma, allergic asthma, intrinsic asthma, extrinsic asthma and dust asthma), particularly chronic or inveterate asthma (e.g. late asthma and airway hyperresponsiveness) and bronchitis.

[0037] Further, the compounds of formula (I) are indicated in the treatment of a disease selected from intestinal inflammations/allergies such as Coeliac disease, proctitis, eosinophilic gastro-enteritis, mastocytosis, Crohn's disease and ulcerative colitis; and food related allergic diseases which have symptomatic manifestation remote from the gastrointestinal tract, for example, migraine, rhinitis and eczema.

[0038] For the above-mentioned therapeutic uses the dosage administered will, of course, vary with the compound employed, the mode of administration, the treatment desired and the disease indicated.

[0039] The compounds of formula (I) and pharmaceutically acceptable derivatives thereof, may be used on their own but will generally be administered in the form of a pharmaceutical composition in which the compound or derivative (active ingredient) is in admixture with a pharmaceutically acceptable adjuvant, diluent or carrier. The pharmaceutical composition will preferably comprise from 0.05 to 80 %w (per cent by weight), more preferably from 0.10 to 50 %w, of active ingredient, and, from 20 to 99.95 %w, more preferably from 50 to 99.90 %w, of a pharmaceutically acceptable adjuvant, diluent or carrier.

[0040] Thus, the present invention also provides a pharmaceutical composition comprising a compound of formula (I), or a pharmaceutically acceptable derivative thereof, in admixture with a pharmaceutically acceptable adjuvant,

diluent or carrier.

[0041] The invention further provides a process for the preparation of a pharmaceutical composition according to the invention which comprises admixing a compound of formula (I), or a pharmaceutically acceptable derivative thereof, with a pharmaceutically acceptable adjuvant, diluent or carrier.

[0042] According to a further aspect of the invention, there is provided a method of effecting immunosuppression which comprises administering a therapeutically effective amount of a compound of formula (I), or a pharmaceutically acceptable derivative thereof, to a patient.

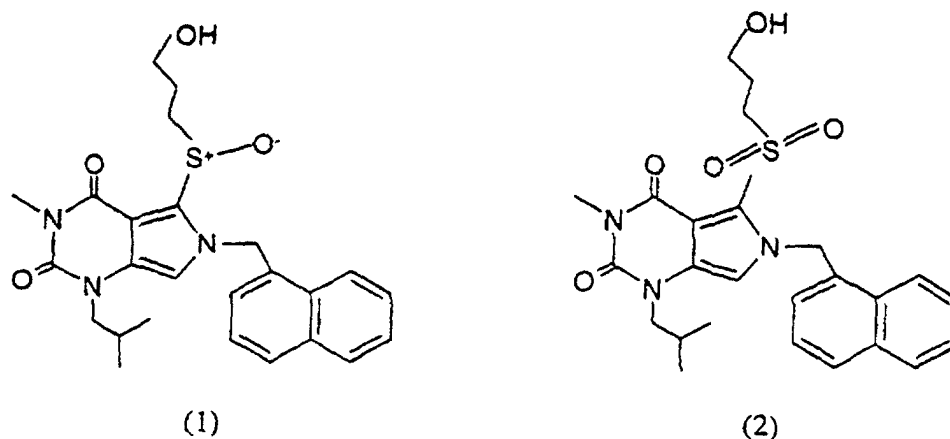
[0043] The invention also provides a method of treating, or reducing the risk of, a reversible obstructive airways disease in a patient suffering from, or at risk of, said disease, which comprises administering to the patient a therapeutically effective amount of a compound of formula (I), or a pharmaceutically acceptable derivative thereof.

[0044] The invention will be further illustrated by reference to the following examples in which MS and NMR are the abbreviations for Mass Spectrometry and Nuclear Magnetic Resonance respectively.

Example 1

5-[(3-Hydroxypropyl)sulphinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (1) and 5-[(3-hydroxypropyl)sulphonyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo [3,4-d]pyrimidine-2,4(3H,6H)-dione(2)

[0045]



[0046] To a stirred solution of 5-[(3-hydroxypropyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-pyrrolo-[3,4-d]-pyrimidine-2,4-dione (0.39 g; 0.864 mmol; *J. Med. Chem.* (1995) **38**, 2557) in dichloromethane (20 ml) was added 3-chloroperoxybenzoic acid (55-60%: 0.526 g). After 30 minutes the reaction was diluted with dichloromethane (80 ml) and washed with sodium bicarbonate solution (50 ml) containing sodium metabisulphite (1 g). The organic layer was dried over magnesium sulphate (MgSO₄), concentrated *in vacuo* and chromatographed on silica eluting with hexane : acetone (3:2) to give separately the two title compounds which were each subsequently recrystallised from hexane: ethyl acetate [1:2].

Title Compound 1

[0047]

Melting point: 204-206 °C

Elemental Analysis (in %):				
Theory	C 64.22,	H 6.25,	N 8.99,	S 6.86
Found	C 64.10,	H 6.51,	N 9.22,	S 6.53

MS(FAB) 468 (M + H)⁺

Title Compound 2**[0048]**

5 Melting point: 201-202 °C

Elemental Analysis (in %):				
Theory	C 62.09,	H 6.04,	N 8.69,	S 6.63
Found	C 61.84,	H 6.21,	N 8.62,	S 6.22

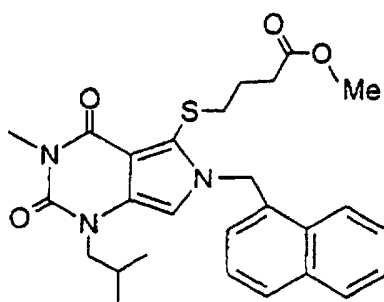
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MS(FAB) 484 (M + H)⁺**Example 2**

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Methyl 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoate**[0049]**

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a) 4,4,4-Trimethoxybutyl para-toluenethiosulphonate

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[0050] A mixture of *para*-toluenethiosulphonic acid potassium salt (24 mmol), trimethyl 4-bromoorthobutyrate (22 mmol) and hexamethylphosphoramide (30 ml) was stirred at room temperature for 48h before being poured into 10:1 hexane/diethyl ether (500 ml) and shaken vigorously. The mixture was washed with water (2 x 200 ml) and then brine. The organic phase was collected and dried over magnesium sulphate (MgSO₄) and evaporated to dryness *in vacuo* to yield the sub-title ester as an oil (5.3 g) containing *ca* 7% 4,4,4-trimethoxybutyl*para*toluene(dithioperoxy)sulphonate.

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¹H NMR (CDCl₃) δ 1.95 (2H, m), 2.37 (2H, t), 2.44 (3H, s), 3.02 (2H, t), 3.16 (9H, s), 7.33 (2H, d), 7.80 (2H, d)

b) Methyl 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoate

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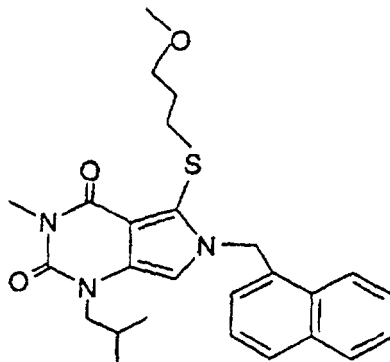
[0051] To a solution of 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H, 6H)-dione (1.4 mmol) in tetrahydrofuran (4 ml) at -78 °C under nitrogen was added a freshly prepared 1M solution of lithium diisopropylamide (8.5 mmol) in tetrahydrofuran followed by 4,4,4-trimethoxybutyl *para*-toluenethiosulphonate (2.3 mmol). The reaction was allowed to warm to room temperature and then quenched via addition of saturated aqueous NH₄Cl and then brine. The mixture was extracted into diethyl ether which was collected, dried over magnesium sulphate (MgSO₄) and evaporated to dryness *in vacuo*. The residual oil was redissolved in methanol/water and treated with glacial acetic acid for 0.5h. The reaction was then basified via addition of solid sodium hydrogencarbonate. The mixture was extracted into diethyl ether, washed with brine, dried over magnesium sulphate (MgSO₄) and evaporated to dryness *in vacuo*. The resultant oil was chromatographed twice (silica) eluting with 1:3 hexanes/diethyl ether to yield the title compound as an oil (133 mg).

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MS (APCI +ve) 464 (M + H)⁺

¹H NMR (CDCl₃) δ 0.88 (6H, d), 1.85 (2H, m), 2.12 (1H, m), 2.40 (2H, m), 3.04 (2H, m), 3.42 (3H, s), 3.55 (2H, d), 3.62 (3H, s), 5.84 (2H, s), 6.35 (1H, s), 6.80 (1H, d), 7.39 (1H, t), 7.57 (2H, m), 7.82 (1H, d), 7.91 (2H, m)

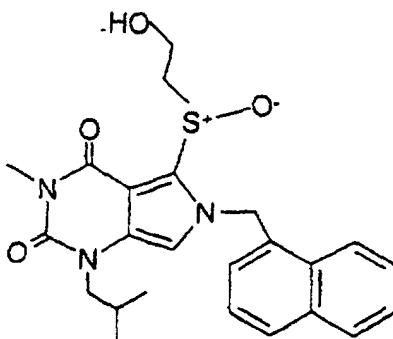
Example 3**5-[(3-Methoxypropyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione****[0052]**

[0053] To a 60% dispersion of sodium hydride in mineral oil (0.035 g, 0.886 mmol) under nitrogen, was added a solution of 5-[3-hydroxypropyl]thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (0.20 g) in anhydrous tetrahydrofuran (10 ml). The mixture was stirred at room temperature for 30 minutes, iodomethane (0.055 ml) was added, and stirring was continued for 18 hours. The mixture was added to saturated sodium bicarbonate solution (20 ml) and extracted with ethyl acetate (20 ml). The organic extracts were dried over anhydrous magnesium sulphate, filtered and evaporated under reduced pressure. The residue was purified by column chromatography over silica eluting with hexane : acetone (4:1), and then by column chromatography over silica, eluting with hexane : ethyl acetate (2:1). The resulting oil was crystallised from an ethyl acetate/hexane mixture to give the title compound (95 mg).

Melting point: 92-94°C

MS (FAB) 466 (M + H)⁺

¹H NMR (CDCl₃) δ 0.87 (6H, d), 1.81 (2H, quin), 2.12 (1H, m), 3.07 (2H, t), 3.25 (3H, s), 3.38 (2H, t), 3.43 (3H, s), 3.54 (2H, d), 5.84 (2H, s), 6.34 (1H, s), 6.82 (1H, d), 7.39 (1H, t), 7.53-7.59 (2H, m), 7.83 (1H, d), 7.91-7.93 (2H, m)

Example 4**5-[(2-Hydroxyethyl)sulphinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenyl)-methyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione****[0054]****a) Bis-[dimethyl(1,1-dimethyl)silyloxyethyl]disulphide**

[0055] To a stirred solution of 2-hydroxyethyl disulphide (2 g) and imidazole (5.3 g) in dichloromethane (100 ml) was

added dimethyl(1,1-dimethylethyl)silyl chloride. The solution was stirred overnight and then diluted with diethyl ether. The mixture was washed with dilute hydrochloric acid, then with sodium bicarbonate solution and then dried over magnesium sulphate. Concentration *in vacuo* followed by chromatography on silica gel (hexane:diethyl ether/20:1) gave the subtitle compound as a clear oil (3.75 g).

MS (EI) 382 ((M-CH₃)⁺).

b) 5-(2-Hydroxyethyl)thio-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione

[0056] To a stirred solution of 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-pyrrolo[3,4-d]pyrimidine-4,6-dione ((J. Med. Chem., 1995, **38**, 2557; 0.50 g) and bis-[dimethyl(1,1-dimethylethyl)silyloxyethyl] disulphide (1.06 g) in anhydrous tetrahydrofuran (15 ml) at -78 °C was added dropwise a solution of lithium diisopropylamide (2.78 mmol) in tetrahydrofuran (5 ml). The solution was stirred for a further 0.5h at -78 °C and then allowed to warm to ambient temperature. Saturated aqueous sodium bicarbonate solution (10 ml) was added and the solution was extracted with ethyl acetate. The organic extracts were dried over magnesium sulphate and concentrated *in vacuo*. The residue was redissolved in acetonitrile (10 ml) and treated with 40% aqueous hydrofluoric acid at ambient temperature. The solution was stirred for 1 hour, then neutralised with aqueous sodium bicarbonate solution and extracted with ethyl acetate. The organic extracts were dried over magnesium sulphate and concentrated *in vacuo*. Chromatography on silica gel (diethyl ether) gave the subtitle compound (0.47 g) as a white solid.

Melting point: 138-141°C

MS (FAB) 353 ((M+H)⁺).

c) 5-[(2-Hydroxyethyl)sulphinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione

[0057] To a stirred solution of 5-(2-hydroxyethyl)thio-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (100 mg) in methanol (20 ml) was added potassium peroxymonosulphate (commercially sold under the trade mark "OXONE") (300 mg) in water (10 ml). After stirring for 10 minutes the reaction mixture was diluted with water and extracted with ethyl acetate. The organic extracts were dried over magnesium sulphate and concentrated *in vacuo*. Chromatography on silica gel (ethyl acetate) gave the title compound (70 mg) as a white foam.

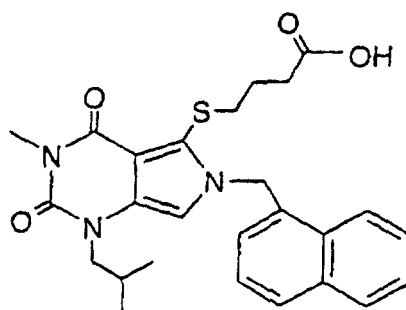
MS (FAB) 454 ((M+H)⁺).

¹H NMR (CDCl₃) δ 0.85 (3H, d), 0.87 (3H, d), 2.05-2.13 (1H, m), 3.21-3.33 (1H, m), 3.36 (3H, s), 3.49-3.61 (2H, m), 3.65-3.73 (1H, m), 3.84-4.05 (2H, m), 6.17-6.27 (2H, m), 6.42 (1H, s), 6.95 (1H, d), 7.44 (1H, t), 7.54-7.66 (2H, m) and 7.87-7.98 (3H, m).

Example 5

4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoic acid

[0058]



[0059] The compound of Example 2, methyl 4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoate (400 mg), was dissolved in 3:1:1 tetrahydrofuran/methanol/1M lithium hydroxide and stirred for 1.5h before being acidified by dropwise addition of concentrated hydro-

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chloric acid (HCl). The mixture was then extracted with ethyl acetate. The organic phase was washed with brine, dried over magnesium sulphate (MgSO₄) and evaporated to dryness *in vacuo*. The resultant yellow oil was chromatographed (silica), eluting with 200:10:1 dichloromethane/methanol/glacial acetic acid. The resultant red oil was dissolved in toluene and then evaporated, then similarly with trichloromethane to yield a pink foam. The foam was recrystallised from ethyl acetate/hexane to yield 129 mg of the title compound.

MS (APCI +ve) (M + H)⁺ 480

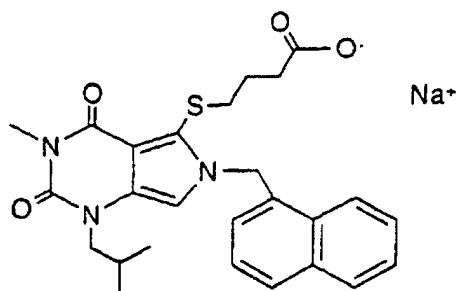
Elemental Analysis (in %):				
Theory	C 65.11,	H 6.10,	N 8.76,	S 6.69
Found	C 65.15,	H 6.24,	N 8.83,	S 6.70

¹H NMR (CDCl₃) δ 0.88 (6H, d), 1.85 (2H, quin), 2.10 (1H, m), 2.47 (2H, t), 3.02 (2H, t), 3.42 (3H, s), 3.55 (2H, d), 5.84 (2H, s), 6.37 (1H, s), 6.79 (1H, d), 7.38 (1H, t), 7.56 (2H, m), 7.82 (1H, d), 7.91 (2H, m)

Example 6

4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoic acid, sodium salt

[0060]



[0061] The compound of Example 5, 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoic acid (200 mg), was dissolved in dioxane (5 ml) and sodium hydroxide solution (2.5 M) (0.163 ml) was added. The solvent was removed by evaporation and freeze drying to give the title compound as a 1:1 mixture with sodium carbonate.

Elemental Analysis for C ₂₇ H ₂₈ N ₃ Na ₃ O ₇ S (in %):				
Theory	C 53.37,	H 4.65,	N 6.92,	S 5.28
Found	C 53.51,	H 5.15,	N 6.65,	S 5.07

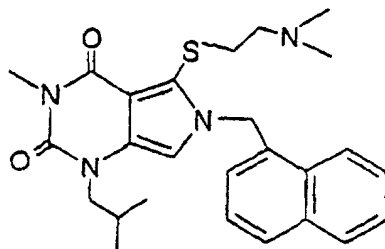
Melting point: >163°C slow melt

MS (APCI) 480 (M+H)⁺

¹H NMR (DMSO) δ 0.85 (6H,d), 1.4-1.6 (2H,m), 1.80 (2H,t), 2.0-2.2 (1H,m), 2.88 (2H,t), 3.57 (2H,d), 5.89 (2H,s), 6.57 (1H,d), 7.12 (1H,s), 7.41 (1H,t), 7.5-7.7 (2H,m), 7.86 (1H,d), 7.99 (1H,d), 8.18 (1H,d)

Example 7**5-[(2-Dimethylaminoethyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0062]



[0063] 3-Methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo-[3,4-d]pyrimidine-2,4(3H,6H)-dione (J. Med. Chem., 1995, **38**, 2557) (473 mg) and bis(2-dimethylaminoethyl)disulphide (0.6ml) were dissolved in tetrahydrofuran (10 ml) and cooled to -78°C. Lithium diisopropylamide in tetrahydrofuran (2.5 eq) was added dropwise and the resultant deep red solution was stirred for 75 minutes at -78°C. The cooling bath was removed and the solution allowed to stir for a further 60 minutes. Sodium bicarbonate (aqueous) was added followed by ether and the phases were separated. The aqueous phase was extracted twice with ether. The organic phases were combined and washed twice with brine before being dried, filtered and concentrated. The resultant oil was purified by column chromatography (eluant, dichloromethane : methanol : triethylamine 450:50:0.2) and then recrystallised from ether-isohexane to give the title compound (230 mg).

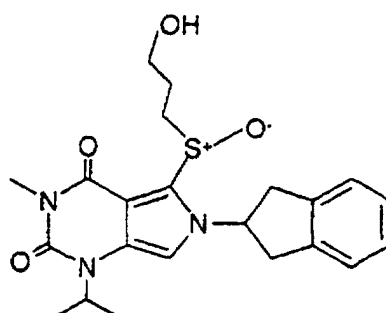
Melting point: 140-144°C

MS (APCI +ve) 465 (M+H)⁺

¹H NMR (DMSO d₆) δ 0.87 (6H, d), 2.01 (6H, s), 2.10-2.16 (1H, m), 2.25 (1H, t), 2.99 (2H, t), 3.25 (3H, s), 3.59 (2H, d), 5.92 (2H, s), 6.54 (1H, d), 7.18 (1H, s), 7.41 (1H, t), 7.58-7.67 (2H, m), 7.86 (1H, d), 7.99 (1H, d), 8.17 (1H, d)

Example 8**6-(2,3-Dihydro-1H-inden-2-yl)-5-[(3-hydroxypropyl)sulphonyl]-3-methyl-1-(1-methylethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0064]

**a) 6-(2,3-Dihydro-1H-inden-2-yl)-3-methyl-1-(1-methylethyl)-1H-pyrrolo-[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0065] 3,6-Dimethyl-5-formyl-1-(1-methylethyl)pyrimidine-2,4-dione (J. Med. Chem., 1995, **38**, 2557; 1.70 g) was dissolved in chloroform (25 ml) and the solution was heated to 50°C. A solution of bromine (0.413 ml) in chloroform (20 ml) was added dropwise to the aldehyde solution over 24 minutes. The reaction was maintained at 50°C for a further 15 minutes, then allowed to cool to ambient temperature. The reaction mixture was diluted with dichloromethane and was washed successively with water, dilute sodium thiosulphate solution (twice) and brine. The resultant solution was dried, filtered and evaporated to a crude oil which was dissolved in ethanol (50 ml). Triethylamine (3.38 ml) was

added to the solution followed by 2-aminoindane (1.49 g) and the mixture was stirred under nitrogen overnight. The reaction mixture was filtered, the white solid collected was washed with a little ethanol and the filtrate was evaporated to give a brown oil. Ethyl acetate was added to the oil and the resultant precipitate was collected by filtration and was washed with a little ethyl acetate. The filtrate was washed with hydrochloric acid (HCl) (2.5 M) and then brine. The resultant ethyl acetate phase was dried, filtered and evaporated to an oil. The oil was purified by chromatography, eluting with isohexane : acetone (4:1) to give a solid which was triturated with hot ethyl acetate : isohexane (3:1) to give the subtitle compound (0.50 g).

Melting point: 158-160°C

MS (APCI +ve) 3.24 (M+H)⁺

b) 6-(2,3-Dihydro-1H-inden-2-yl)-5-[(3-hydroxypropyl)thio]-3-methyl-1-(1-methylethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione

[0066] 6-(2,3-Dihydro-1H-inden-2-yl)-3-methyl-1-(1-methylethyl)-1H-pyrrolo-[3,4-d]pyrimidine-2,4(3H,6H)-dione (165 mg) and S-{3-[1,1-dimethylethyl]-dimethylsilyloxypropyl}toluenethiosulphonate (J. Med. Chem., 1995, **38**, 2557) (362 mg) were dissolved in tetrahydrofuran (6ml) and the resulting solution was cooled to -78°C. Lithium diisopropylamide in tetrahydrofuran (3 eq) was added dropwise to the cold solution and the resulting solution was stirred for 75 minutes at -78°C and then the cooling bath was removed. The solution was stirred for a further 75 minutes and then sodium bicarbonate (aqueous) was added. The reaction mixture was extracted thrice with ether. The organic phases were combined and washed twice with brine before being dried, filtered and evaporated. The resultant oil was purified by column chromatography (eluant, isohexane : ethyl acetate 7:2).

[0067] The product was dissolved in acetonitrile (10 ml) and hydrofluoric acid (40%, 6 drops) was added. The solution was stirred at ambient temperature for 30 minutes then sodium bicarbonate (aqueous) was added. Ether-ethyl acetate mixture (ca 1:1) was added to the reaction mixture and the phases were separated. The aqueous phase was extracted twice with ether-ethyl acetate mixtures. The organic phases were combined and washed twice with brine before being dried, filtered and concentrated. Crystallisation from ether-cyclohexane gave the subtitle compound (141 mg).

Melting point: 123-125°C

MS (APCI +ve) 414 (M+H)⁺

c) 6-(2,3-Dihydro-1H-inden-2-yl)-5-[(3-hydroxypropyl)sulphinyl]-3-methyl-1-(1-methylethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione

[0068] 6-(2,3-Dihydro-1H-inden-2-yl)-5-[(3-hydroxypropyl)thio]-3-methyl-1-(1-methylethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (100 mg) was dissolved in methanol (40 ml). Water (10 ml) and potassium peroxymonosulphate (commercially sold under the trade mark "OXONE") (185 mg) were added and the solution was stirred for 15 minutes. The reaction mixture was diluted with water and then extracted with ethyl acetate thrice. The extracts were combined, washed with brine, then dried, filtered and the solvent was evaporated. The resultant oil was triturated with isohexane, then recrystallised from ethyl acetate - isohexane mixtures to give the title compound (15 mg).

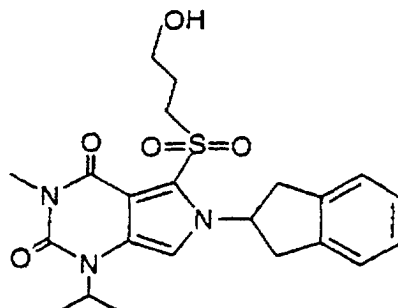
Melting point: 164-165°C

MS (APCI +ve) 430 (M+H)⁺

¹H (DMSO d₆) δ 1.35 (6H, d), 1.73 (2H, quin), 3.19 (3H, s), 3.26-3.56 (8H, m), 4.65 (1H, t), 4.71 (1H, sept), 6.08-6.12 (1H, m), 7.22-7.32 (4H, m), 7.50 (1H, s)

Example 9**6-(2,3-Dihydro-1H-inden-2-yl)-5-[(3-hydroxypropyl)sulphonyl]-3-methyl-1-(1-methylethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0069]



[0070] The compound of Example 8, 6-(2,3-Dihydro-1H-inden-2-yl)-5-[(3-hydroxypropyl)sulphonyl]-3-methyl-1-(1-methylethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (80 mg), was dissolved in dichloromethane (5 ml) and 3-chloroperoxybenzoic acid (57-85%) (50 mg) was added. The reaction mixture was stirred for 75 minutes then water and sodium metabisulphite (45 mg) were added and the mixture was stirred for 5 minutes. The phases were separated and the organic phase was washed with sodium bicarbonate (aqueous), then dried, filtered and evaporated. The resultant foam was recrystallised from isohexane-ethyl acetate-ether to give the title compound (15 mg).

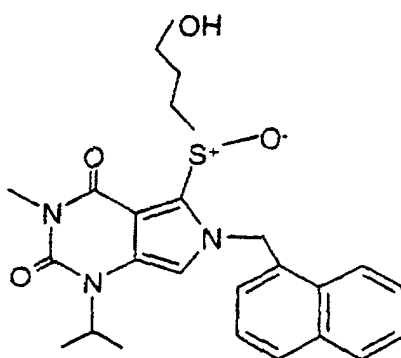
Melting point: 171-172°C

MS (APCI +ve) 446 (M+H)⁺

¹H NMR (DMSO d₆) δ 1.34 (6H, d), 1.73-1.83 (2H, m), 3.22 (3H, s), 3.39-3.50 (6H, m), 3.77-3.83 (2H, m), 4.66 (1H, t), 4.64-4.72 (1H, m), 6.24 (1H, quin), 7.22-7.32 (4H, m), 7.54 (1H, s)

Example 10**5-[(3-Hydroxypropyl)sulphonyl]-3-methyl-1-(1-methylethyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0071]



[0072] The title compound was prepared from 5-[(3-Hydroxypropyl)thio]-3-methyl-1-(1-methylethyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (J. Med. Chem., 1995, **38**, 2557) in a manner analogous to the method of Example 8 (c) above.

Melting point: 184-185°C

MS (APCI +ve) (M+H)⁺

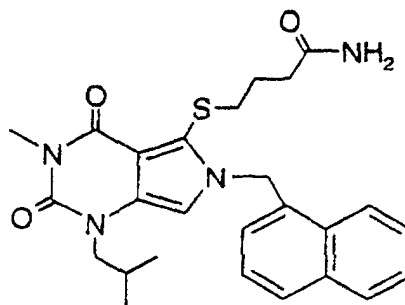
¹H NMR (CDCl₃) δ 1.35 (3H, d), 1.37 (3H, d), 1.97-2.07 (2H, m), 2.60 (1H, t), 3.24-3.51 (2H, m), 3.72-3.86 (2H, m), 4.68-4.70 (1H, m), 6.23 (2H, s), 6.48 (1H, s), 7.00 (1H, d), 7.44 (1H, t), 7.53-7.62 (2H, m), 7.86-7.94 (2H, m), 7.99-8.02

(1H, m)

Example 11

5 **4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanamide**

[0073]



[0074] The compound of Example 5, 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoic acid (100 mg), was dissolved in tetrahydrofuran (3 ml) and the solution was cooled in ice. Triethylamine (30 μ l) was added followed by ethyl chloroformate (21 μ l); the ice bath was removed and the solution was allowed to stir for 15 minutes and was then cooled in ice again. Aqueous ammonia (0.88 specific gravity, 1 ml) was added and the mixture was stirred for 3 days. The mixture was poured onto water and extracted thrice with dichloromethane. The organic extracts were combined, washed with brine, dried, filtered and evaporated to give an oil which was purified by chromatography, eluting first with ethyl acetate ; isohexane : acetic acid (75:25:1) and then with ethyl acetate : acetic acid (199:1) to give the title compound (70 mg).

Melting point: 162-165°C

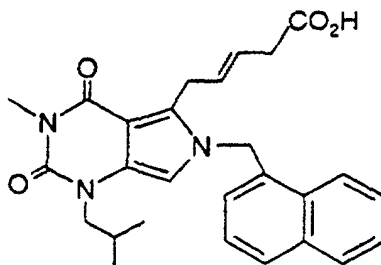
MS (APCI +ve) 479 (M+H)⁺

¹H NMR (CDCl₃) δ 0.94 (6H, d), 1.86 (2H, quin), 2.12-2.16 (1H, m), 2.45 (2H, t), 2.90 (2H, t), 3.41 (3H, t), 3.56 (2H, d), 5.30 (1H, br), 5.86 (2H, s), 6.08 (1H, br), 6.39 (1H, s), 6.81 (1H, d), 7.40 (1H, dd), 7.58 (2H, m), 7.84 (1H, d), 7.91 (2H, m)

Example 12

5 **5-(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)pent-3-enoic acid**

[0075]



55 **a) 5-Iodo-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo-[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0076] 3-Methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo-[3,4-d]pyrimidine-2,4(3H,6H)-dione ((J. Med. Chem., 1995, **38**, 2557; 500 mg) was dissolved in tetrahydrofuran (15 ml) and cooled to -78°C. A solution of

lithium diisopropylamide (2 eq) in tetrahydrofuran (5 ml) was added dropwise with stirring at -78°C. Iodine (350 mg) was added and the reaction mixture was allowed to stir at -78°C for 1 hour and was then allowed to warm to room temperature. The mixture was then poured into saturated ammonium chloride solution and extracted twice with ethyl acetate. The combined organic phases were washed with sodium thiosulphate solution, and with brine, before being dried and evaporated. The resultant foam was chromatographed using isohexane : diethyl ether (1:3) to give a foam which was recrystallised from diethyl ether/isohexane to give the subtitle compound as a pale yellow solid (350 mg).

Melting point: 140-142°C

MS (APCI +ve) 488 (M+H)⁺

¹H NMR (CDCl₃) δ 0.85 (d, 6H), 2.09 (m, 1H), 3.41 (s, 3H), 3.53 (d, 2H), 5.65 (s, 2H), 6.51 (s, 1H), 6.85 (d, 1H), 7.42 (dd, 1H), 7.58 (m, 2H), 7.84-7.95 (m, 3H)

b) Trans-5-(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)pent-3-enoic acid

[0077] 5-Iodo-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo-[3,4-d]pyrimidine-2,4(3H,6H)-dione (100 mg), 4-pentenoic acid (0.042 ml), palladium acetate (5 mg) and tri(o-tolyl)phosphine (13 mg) were dissolved in triethylamine (1 ml) and acetonitrile (5 ml) and heated to 95°C in a sealed pressure tube for 3 hours. The reaction mixture was allowed to cool to room temperature and was then evaporated to leave a residue which was chromatographed using ethyl acetate containing 1% acetic acid to give an oil (160 mg). Recrystallisation from diethyl ether/isohexane gave the title compound as a pale brown solid (48 mg).

Melting point: 176-180°C

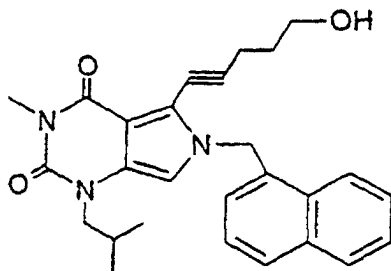
MS (APCI +ve) 460 (M+H)⁺ (APCI -ve) 458 (M-H)⁻

¹H NMR (CDCl₃) δ 0.89 (d, 6H), 2.14 (m, 1H), 2.98 (d, 2H), 3.40 (s, 3H), 3.56 (d, 2H), 3.82 (d, 2H), 5.50 (dt, [J= 15Hz, 6Hz]1H), 5.57 (s, 2H), 5.65 (dt, [J= 15Hz, 7Hz] 1H), 6.17 (s, 1H), 6.69 (d, 1H), 7.39 (m, 1H), 7.55 (m, 2H), 7.80-7.93 (m, 3H)

Example 13

5-(5-Hydroxypent-1-ynyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione

[0078]

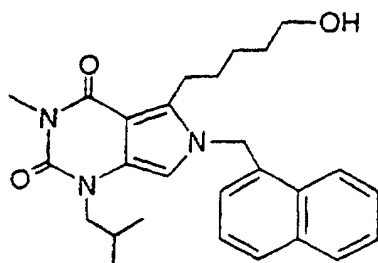


[0079] 5-Iodo-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo-[3,4-d]pyrimidine-2,4(3H,6H)-dione (100 mg), 4-pentyn-1-ol (0.080 ml), bis-triphenylphosphinepalladium (II) chloride (3 mg) and copper (I) iodide (1 mg) were dissolved in triethylamine (3 ml) and acetonitrile (1 ml) and heated to 90°C in a sealed pressure tube for 3 hours. The reaction mixture was allowed to cool to room temperature and was then evaporated to leave a residue which was recrystallised from ethyl acetate. The resultant brown solid was chromatographed, eluting with ethyl acetate to give a white solid which was triturated with ethyl acetate to give the title compound (45 mg).

Melting point: 176-177°C

MS (APCI +ve) 444 (M+H)⁺

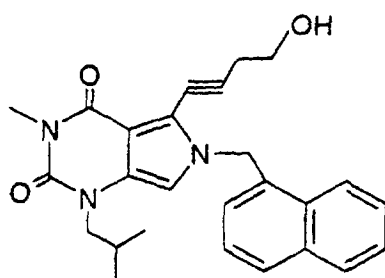
¹H NMR (CDCl₃) δ 0.84 (d, 6H), 1.82 (m, 2H), 2.08 (m, 1H), 2.36 (t, 1H), 2.65 (t, 2H), 3.40 (s, 3H), 3.50 (d, 2H), 3.77 (q, 2H), 5.67 (s, 2H), 6.10 (s, 1H), 7.08 (d, 1H), 7.47 (dd, 1H), 7.55 (m, 2H), 7.86-7.94 (m, 3H)

Example 14**5-(5-Hydroxypentyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione****[0080]**

[0081] The compound of Example 13, 5-(5-hydroxypent-1-ynyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (75 mg) was suspended in ethanol (50 ml). A suspension of 10% palladium on carbon (7 mg) in ethanol (3 ml) was added and the mixture was hydrogenated. When hydrogen uptake ceased, the reaction mixture was filtered and the solvent was removed by rotary evaporation. The crude product was purified by chromatography on silica eluting with ethyl acetate : isohexane (3:1) to give the title compound (29 mg) as an oil.

MS (APCI +ve) 448 (M+H)⁺; (APCI -ve) 446 (M-H)⁻

¹H NMR (CDCl₃) δ 0.90 (6H, d), 1.3-1.65 (6H, m), 2.17 (1H, m), 3.01 (2H, t), 3.41 (3H, s), 3.55-3.58 (4H, m), 3.64 (1H, t), 5.57 (2H, s), 6.70 (1H, d), 7.39 (1H, t), 7.56-7.60 (2H, m), 7.85-7.95 (3H, m)

Example 15**5-(4-Hydroxybut-1-ynyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione****[0082]**

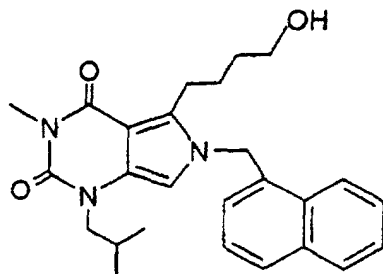
[0083] The title compound was prepared from 5-iodo-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione and 3-butyn-1-ol in a manner analogous to the method of Example 13 above. Melting point: 170-171°C

MS (APCI +ve) 430 (M+H)⁺

¹H NMR (CDCl₃) δ 0.84 (d, 6H), 2.09 (m, 1H), 2.74 (t, 2H), 3.40 (s, 3H), 3.50 (d, 2H), 3.88 (m, 3H), 5.68 (s, 2H), 6.08 (s, 1H), 7.10 (d, 1H), 7.46 (t, 1H), 7.55 (m, 2H), 7.87-7.94 (m, 3H)

Example 16**5-(4-Hydroxybutyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0084]



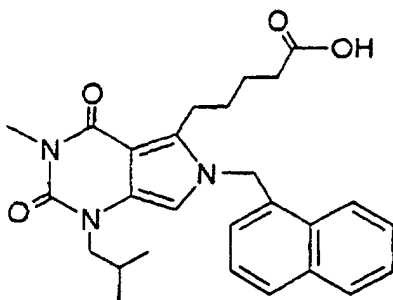
[0085] The title compound was prepared from the compound of Example 15, 5-(4-hydroxybut-1-ynyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione, in a manner analogous to the method of Example 14 above.

MS (APCI +ve) 434 (M+H)⁺; (APCI -ve) 432 (M-H)⁻

¹H NMR (CDCl₃) δ 0.88 (6H, d), 1.56-1.72 (4H, m), 2.18 (1H, m), 2.3 (1H, br), 3.01 (2H, t), 3.41 (3H, s), 3.57 (2H, d), 3.65-3.70 (2H, m), 5.58 (2H, s), 6.69 (1H, d), 7.41 (1H, t), 7.56-7.62 (2H, m), 7.84 (1H, d), 7.88-7.95 (2H, m)

Example 17**5-(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)pentanoic acid**

[0086]

**a) 5-(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)pent-4-ynoic acid**

[0087] The sub-title compound was prepared from 5-iodo-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione, and 4-pentynoic acid in the presence of bistrimethylsilyltrifluoroacetamide in a manner analogous to the method of Example 13 above.

MS (APCI +ve) 458 (M+H)⁺, (APCI -ve) 456 (M-H)⁻

¹H NMR (CDCl₃) δ 0.85 (d, 6H), 2.07 (m, 1H), 2.61 (m, 2H), 2.80 (t, 2H), 3.39 (s, 3H), 3.48 (d, 2H), 5.65 (s, 2H), 6.09 (s, 1H), 7.11 (d, 1H), 7.44 (dd, 1H), 7.53 (m, 2H), 7.88-7.94 (m, 3H)

b) 5-(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)pentanoic acid

[0088] The title compound was prepared from 5-(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenyl-

methyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)-pent-4-ynoic acid in a manner analogous to the method of Example 14 above.

Melting point: 146-147°C

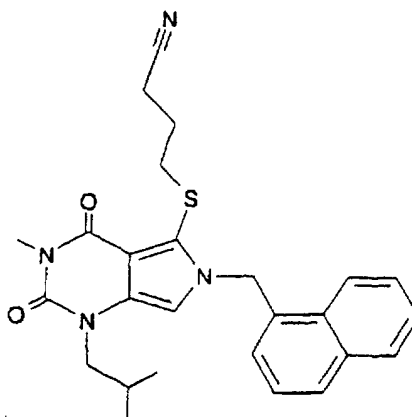
MS (APCI +ve) 462 (M+H), (APCI -ve) 460 (M-H)

¹H NMR (CDCl₃) δ 0.90 (d, 6H), 1.66 (m, 4H), 2.16 (m, 1H), 2.34 (t, 2H), 3.02 (t, 2H), 3.40 (s, 3H), 3.56 (d, 2H), 5.56 (s, 2H), 6.15 (s, 1H), 6.69 (d, 1H), 7.38 (t, 1H), 7.53-7.62 (m, 2H), 7.82-7.94 (m, 3H)

Example 18

4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanenitrile

[0089]



a) 5-[(3-{Methanesulphonyloxy}propyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione

[0090] 5-[(3-Hydroxypropyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione (J. Med. Chem., 1995, **38**, 2557) (260 mg), methanesulphonyl chloride (54 μl) and triethylamine (97 μl) were dissolved in dichloromethane (15 ml) and the mixture was stirred overnight. The reaction mixture was poured onto sodium bicarbonate (aqueous) and extracted twice with ethyl acetate. The extracts were combined, dried, filtered and evaporated to give the subtitle compound as a gum (391 mg).

MS (+ve APCI) (M+H)⁺ 530

b) 4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanenitrile

[0091] 5-[(3-{Methanesulphonyloxy}propyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione (391 mg) was dissolved in dimethylformamide (15 ml) and sodium cyanide (254 mg) was added. The mixture was sonicated for 4 hours and then poured onto sodium bicarbonate (aqueous). The mixture was extracted thrice with ethyl acetate, the extracts were combined, washed twice with water and once with brine, then dried, filtered and evaporated. The resultant oil was chromatographed, eluting with ethyl acetate : isohexane (4:5) and then triturated with cyclohexane-ethyl acetate to give the title compound (95 mg).

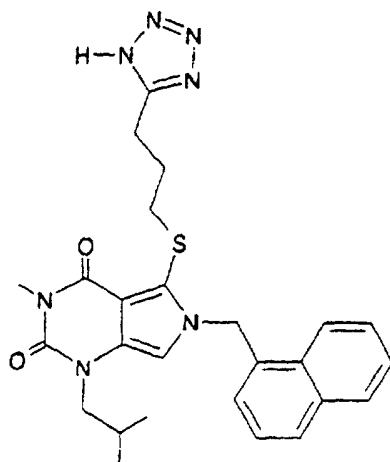
Melting point: 127-128°C

MS (+ve APCI) (M+H)⁺ 461

¹H NMR (CDCl₃) δ 0.89 (6H, d), 1.86 (2H, quin), 2.07-2.19 (1H, m), 2.48 (2H, t), 3.02 (2H, t), 3.42 (3H, s), 3.57 (2H, d), 5.85 (2H, s), 6.42 (1H, s), 6.77 (1H, d), 7.37 (1H, t), 7.56-7.63 (2H, m), 7.85 (1H, d), 7.91-7.95 (2H, m)

Example 19**5-[(3-{1H-Tetrazol-5-yl}propyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0092]

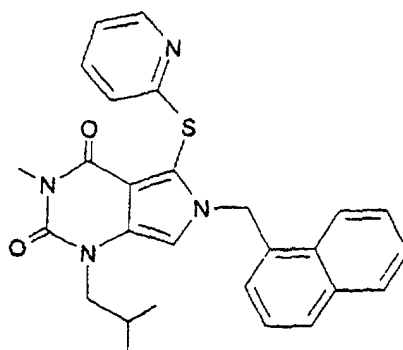


[0093] The compound of Example 18, 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanenitrile (98 mg) was dissolved in toluene (20 ml) and trimethyltin azide (100 mg) was added. The solution was heated under reflux for 110 hours, then the solvent was evaporated and the residue was chromatographed, eluting with ethanol : dichloromethane (1:19), to give the title compound (30 mg). MS (+ve APCI) (M+H)⁺ 504

¹H NMR (DMSO d-6) δ 0.86 (6H, d), 1.79 (2H, quin), 2.05-2.16 (1H, m), 2.87 (2H, t), 2.91 (2H, t), 3.23 (3H, s), 3.59 (2H, d), 5.90 (2H, s), 6.54 (1H, d), 7.19 (1H, s), 7.38 (1H, t), 7.57-7.66 (2H, m), 7.85 (1H, d), 7.99 (1H, d), 8.17 (1H, d)

Example 20**3-Methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)thiol]-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0094]



[0095] Prepared from 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo-[3,4-d]pyrimidine-2,4(3H,6H)-dione (J. Med. Chem., 1995, **38**, 2557) and 2,2'-pyridyl disulphide following the method of Example 7.

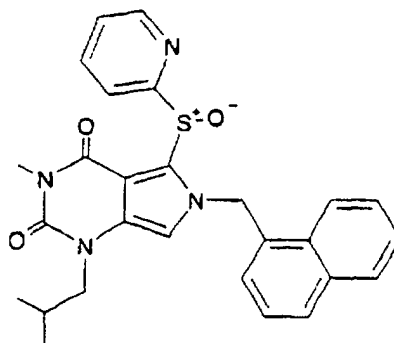
Melting point: 146-148°C

MS (FAB) ((M+H)⁺) 471

¹H NMR (CDCl₃) δ 0.85 (6H, d), 2.08 (1H, m), 3.38 (3H, s), 3.52 (2H, d), 5.78 (2H, s), 6.39 (1H, s), 7.03 (1H, m), 7.10 (2H, m), 7.44 (4H, m), 7.86 (3H, m), 8.38 (1H, d)

Example 21**3-Methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)sulphinyl]-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0096]



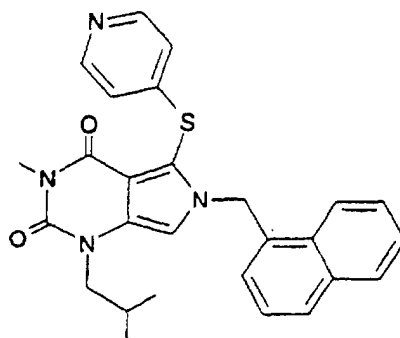
[0097] Prepared from the compound of Example 20, 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)thio]-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione and potassium peroxymonosulphate (commercially sold under the trade mark "OXONE") following the method of Example 8 c).

MS (FAB) ((M+H)⁺) 487

¹H NMR (CDCl₃) δ 0.81 (6H, d), 2.04 (1H, m), 3.43 (3H, s), 3.49 (2H, m), 5.83 (1H, d), 5.94 (1H, d), 6.24 (1H, s), 6.64 (1H, d), 7.07 (1H, m), 7.20 (1H, t), 7.47 (3H, m), 7.70 (2H, m), 7.84 (1H, d), 7.92 (1H, d), 8.48 (1H, d)

Example 22**3-Methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(4-pyridinyl)thiol]-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0098]



[0099] Prepared from 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H pyrrolo-[3,4-d]pyrimidine-2,4(3H, 6H)-dione (J. Med. Chem., 1995, **38**, 2557) and 4,4'-pyridyl disulphide following the method of Example 7.

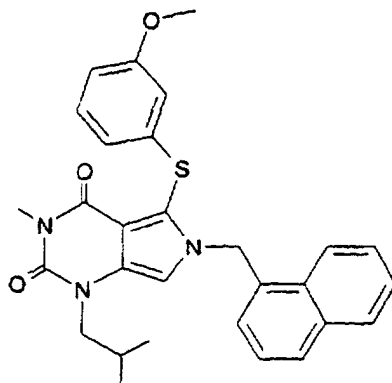
Melting point: 154-156°C

MS (FAB) 471 ((M+H)⁺)

¹H NMR (CDCl₃) δ 0.87 (6H, d), 2.11 (1H, m), 3.38 (3H, s), 3.56 (2H, d), 5.70 (2H, s), 6.51 (1H, s), 6.88 (2H, m), 6.92 (1H, d), 7.35 (1H, t), 7.48 (2H, m), 7.75 (1H, d), 7.81 (1H, d), 7.87 (1H, d), 8.34 (2H, d)

Example 23**5-([3-Methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0100]

**a) 3-Methoxyphenyldisulphide**

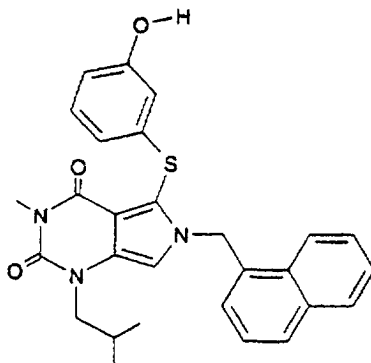
[0101] 4-Toluenesulphonylchloride (8 g) was added portionwise to a solution of 3-methoxythiophenol (5 ml) and triethylamine (5.6 ml) in dichloromethane (50 ml) at 0°C. After 3.5 hours the reaction mixture was diluted with dichloromethane and washed once with water, twice with dilute hydrochloric acid, twice with saturated sodium hydrogen carbonate solution and once with brine. The organic layer was dried over magnesium sulphate, filtered and evaporated *in vacuo*. Purification of the residue by chromatography on silica gel, eluting with isohexane/ethyl acetate (19:1), gave the subtitle compound as an oil (2.65 g).

MS (EI) (M⁺) 278¹H NMR (CDCl₃) δ 3.77 (6H, s), 6.75 (2H, dd), 7.06 (2H, s), 7.07 (2H, d), 7.21 (2H, t)**b) 5-([3-Methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0102] To a stirred solution of 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (0.50 g) (J. Med. Chem., 1995, **38**, 2557) and 3-methoxyphenyldisulphide (0.77 g) in anhydrous tetrahydrofuran (20 ml) at -70°C was added dropwise a solution of lithium diisopropylamide (2.79 mmol) in tetrahydrofuran (7 ml). The solution was stirred for a further 2 hours at -70°C and then allowed to warm to ambient temperature. Water (10 ml) was added and the solution was extracted with ethyl acetate. The organic phase was separated and washed once with water, twice with dilute hydrochloric acid, twice with saturated sodium hydrogen carbonate solution and once with brine. The organic layer was dried over magnesium sulphate and evaporated *in vacuo*. Purification by chromatography on silica gel, eluting with isohexane/ethyl acetate (4:1 to 2:1) followed by recrystallisation from isohexane/ethyl acetate (4:1), gave the title compound (430 mg).

Melting point: 130-133°C

MS (APCI) 500 ((M+H)⁺)¹H NMR (DMSO) δ 0.86 (6H, d), 2.1-2.2 (1H, m), 3.22 (3H, s), 3.60 (3H, s), 3.62 (2H, d), 5.86 (2H, s), 6.55-6.65 (3H, m), 6.73 (1H, dd), 7.16 (1H, t), 7.33 (2H, t), 7.50-7.60 (2H, m), 7.83 (1H, d), 7.96 (1H, dd), 8.05 (1H, dd)

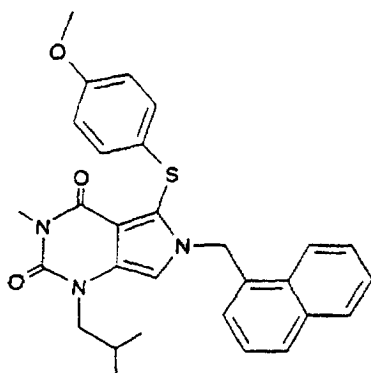
Example 24**5-([3-Hydroxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione****[0103]**

[0104] A solution of boron tribromide in dichloromethane (1M, 3 ml) was added to a solution of 5-([3-methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (200 mg) (compound of Example 23) in dichloromethane (20 ml) at ambient temperature. After 6 hours, water (10 ml) was added carefully and the reaction mixture was partitioned between dichloromethane and brine. The organic phase was dried over magnesium sulphate, filtered and evaporated *in vacuo*. Purification by chromatography on silica gel, eluting with isohexane/ethyl acetate (2:1 to 1:1) followed by recrystallisation from isohexane/ethyl acetate (3:1), gave the title compound (120 mg).

Melting point: 150-151°C

MS (APCI) 486 ((M+H)⁺)

¹H NMR (DMSO) δ 0.86 (6H, d), 2.1-2.2 (1H, m), 3.23 (3H, s), 3.61 (2H, d), 5.83 (2H, s), 6.45 (1H, t), 6.53 (2H, dt), 6.63 (1H, d), 7.03 (1H, t), 7.30 (1H, s), 7.36 (1H, t), 7.50-7.60 (2H, m), 7.85 (1H, d), 7.96 (1H, dd), 8.05 (1H, dd), 9.51 (1H, brs)

Example 25**5-([4-Methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione****[0105]**

[0106] Prepared from 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (0.50 g) (J. Med. Chem., 1995, **38**, 2557) and 4-methoxyphenyldisulphide following the method of Example 23.

Melting point: 60-63°C (foam)

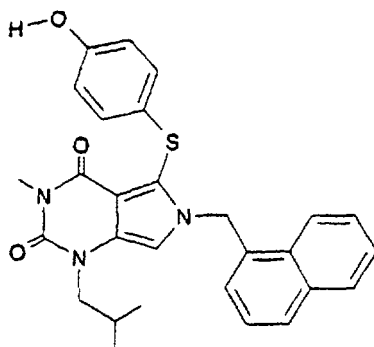
MS (APCI) 500 ((M+H)⁺)

¹H NMR (DMSO) δ 0.81 (6H, d), 2.1-2.2 (1H, m), 3.24 (3H, s), 3.58 (2H, d), 3.68 (3H, s), 5.91 (2H, s), 6.50 (1H, d), 6.80 (2H, d), 7.20 (3H, d), 7.31 (1H, t), 7.55-7.60 (2H, m), 7.83 (1H, d), 7.98 (1H, dd), 8.08 (1H, dd)

Example 26

5-([4-Hydroxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione

[0107]



[0108] Prepared from the compound of Example 25 following the method of Example 24.

Melting point: 228-230°C

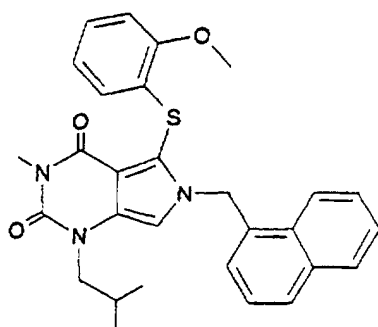
MS (APCI) 486 ((M+H)⁺)

¹H NMR (DMSO) δ 0.83 (6H, d), 2.1-2.2 (1H, m), 3.24 (3H, s), 3.56 (2H, d), 5.91 (2H, s), 6.52 (1H, d), 6.63 (2H, d), 7.14-7.16 (3H, m), 7.35 (1H, t), 7.55-7.60 (2H, m), 7.84 (1H, d), 7.97 (1H, dd), 8.06 (1H, dd), 9.59 (1H, s)

Example 27

5-([2-Methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione

[0109]



[0110] Prepared following the method of Example 23 using 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione (0.50 g) (J. Med. Chem., 1995, **38**, 2557) and 2-methoxyphenyldisulphide.

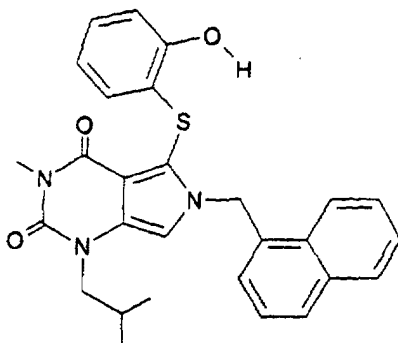
Melting point: 153°C

MS (APCI) 500 ((M+H)⁺)

¹H NMR (DMSO) δ 0.87 (6H, d), 2.1-2.2 (1H, m), 3.21 (3H, s), 3.61 (2H, d), 3.69 (3H, s), 5.85 (2H, s), 6.59 (1H, d), 6.69 (1H, dd), 6.81 (1H, dt), 6.91 (1H, dd), 7.12 (1H, dt), 7.34 (2H, t), 7.55-7.60 (2H, m), 7.82 (1H, d), 7.96 (1H, dd), 8.05 (1H, dd)

Example 28**5-([2-Hydroxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione**

[0111]



[0112] Prepared from the compound of Example 27 following the method of Example 24.

Melting point: 190-192°C

MS (APCI) 486 ((M+H)⁺)

¹H NMR (DMSO) δ 0.85 (6H, d), 2.1-2.2 (1H, m), 3.22 (3H, s), 3.59 (2H, d), 5.88 (2H, s), 6.63 (1H, d), 6.69 (1H, dd), 6.79 (2H, dt), 7.00 (1H, dt), 7.26 (1H, s), 7.37 (1H, t), 7.55-7.60 (2H, m), 7.85 (1H, d), 7.96 (1H, dd), 8.05 (1H, dd), 10.02 (1H, s)

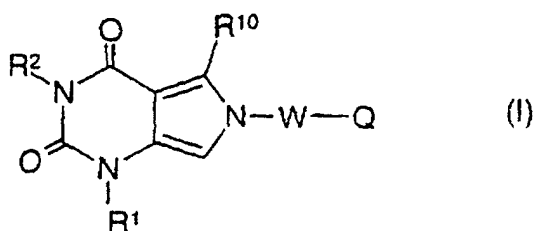
Example 29**Inhibition of Human Mixed Lymphocyte Reaction (MLR)**

[0113] The MLR test was performed in 96-well flat bottomed microtitre plates. Compounds were prepared as 10 mM stock solution in dimethyl sulphoxide. A 50 fold dilution of this was prepared in a cell culture solution obtained from the Roswell Park Memorial Institute (RPMI 1640 medium). Serial dilutions were prepared from this solution. 10 μl of the 50 fold diluted stock, or dilutions of it, were added to the wells to give concentrations in the assay starting at 9.5 μM and decreasing. Into each well was placed 1.5 x 10⁵ cells from each of two responding donors in a final volume of 0.2 ml RPMI 1640 medium supplemented with 10% human serum, 2 mM L-glutamine and penicillin/streptomycin. The cells were incubated at 37 °C in a humidified atmosphere at 5% carbon dioxide for 120 hours. ³H-Thymidine (0.5 μCi) was added for the final 6 hours of the incubation. The level of radioactivity incorporated by the cells was then determined, which is a measure of T-cell proliferation.

[0114] The title compounds of Examples 1 to 28 were found to exhibit an IA₅₀ value of less than 1 x 10⁻⁶ M in the above test.

Claims

1. A compound according to the general formula:



wherein—

W represents —CH₂— or a bond; Q represents Ar¹ or Ar²; in the case where W represents —CH₂—, Q represents an aryl group Ar¹ wherein Ar¹ represents naphthyl, phenyl, quinolyl, isoquinolyl, indolyl, benzofuranyl or benzothienyl; in the case where W represents a bond, Q represents an aryl group Ar² wherein Ar² represents acenaphthenyl, fluorenyl or indanyl; wherein the ring systems which Ar¹ and Ar² represent may all be optionally substituted by one or more substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen, or trifluoromethyl; R¹⁰ represents X—(A)_p—Y; X represents S(O)_n, C≡C, (CH₂)₂, CH=CH or CH₂CH=CH; n represents 0, 1 or 2; A represents C₁₋₆ alkylene; p is 0 or 1; Y represents CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵R¹⁶, NHSO₂R¹⁷, NHCOR¹⁸ or an optionally substituted aryl or heteroaryl group, provided that when X represents S(O)_n and Y is other than an optionally substituted aryl or heteroaryl group, then p is 1 and also provided that when X represents S(O)_n, p is 1 and Y represents OH, then n is not 0; R¹³ and R¹⁴ independently represent H, C₁₋₅ alkyl or phenyl, which latter group may be substituted by one or more substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen, or CO₂R²¹; and R¹, R², R¹¹, R¹², R¹⁵, R¹⁶, R¹⁷, R¹⁸ and R²¹ independently represent H or C₁₋₅ alkyl; or a pharmaceutically acceptable derivative thereof.

2. A compound according to claim 1, wherein in formula (I), W represents —CH₂— and Q represents an aryl group Ar¹ wherein Ar¹ represents a naphthyl or phenyl group, each of which may be optionally substituted by one or more substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen or trifluoromethyl.
3. A compound according to claim 1, wherein, in formula (I), W represents a bond and Q represents an aryl group Ar² wherein Ar² represents an indanyl group which may be optionally substituted by one or more substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen or trifluoromethyl.
4. A compound according to any one of claims 1 to 3, wherein, in formula (I), X represents S(O)_n wherein n is 0, 1 or 2, C≡C, (CH₂)₂ or CH₂CH=CH.
5. A compound according to any one of claims 1 to 4, wherein, in formula (I), X represents S(O)_n wherein n is 0, 1 or 2.
6. A compound according to any one of claims 1 to 5, wherein, in formula (I), A represents C₁₋₄ alkylene.
7. A compound according to any one of claims 1 to 6, wherein, in formula (I), each of groups R¹, R², R¹¹, R¹², R¹⁵, R¹⁶, R¹⁷, R¹⁸ and R²¹ represents H or a C₁₋₄ alkyl group.
8. A compound according to any one of claims 1 to 7, wherein, in formula (I), each of groups R¹³ and R¹⁴ represents H, C₁₋₃ alkyl or phenyl, which latter group may be substituted by one or more substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen or CO₂R²¹.
9. A compound according to claim 1, wherein, in formula (I), W represents —CH₂— or a bond; Q represents Ar¹ or Ar²; in the case where W represents —CH₂—, Q represents an aryl group Ar¹ wherein Ar¹ represents naphthyl or phenyl; in the case where W represents a bond, Q represents an aryl group Ar² wherein Ar² represents indanyl; wherein the ring systems which Ar¹ and Ar² represent may all be optionally substituted by one or more, e.g. one, two, three or four, substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen, or trifluoromethyl; R¹⁰ represents X—(A)_p—Y; X represents S(O)_n, C≡C, (CH₂)₂ or CH₂CH=CH; n represents 0, 1 or 2; A represents C₁₋₆ alkylene; p is 0 or 1; Y represents CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵R¹⁶ or an optionally substituted phenyl, pyridyl or tetrazolyl group, provided that when X represents S(O)_n and Y is other than an optionally substituted aryl or heteroaryl group, then p is 1 and also provided that when X represents S(O)_n, p is 1 and Y represents OH, then n is not 0; R¹³ and R¹⁴ independently represent H, C₁₋₅ alkyl or phenyl, which latter group may be substituted by one or more substituents selected from C₁₋₄ alkyl, C₁₋₄ alkoxy, halogen, or CO₂R²¹; and R¹, R², R¹¹, R¹², R¹⁵, R¹⁶ and R²¹ independently represent H or C₁₋₅ alkyl.
10. A compound according to claim 1, wherein, in formula (I), W represents —CH₂— or a bond; Q represents Ar¹ or Ar²; in the case where W represents —CH₂—, Q represents an aryl group Ar¹ wherein Ar¹ represents naphthyl; in the case where W represents a bond, Q represents an aryl group Ar² wherein Ar² represents indanyl; R¹⁰ represents X—(A)_p—Y; X represents S(O)_n, C≡C, (CH₂)₂ or CH₂CH=CH; n represents 0, 1 or 2; A represents C₁₋₃ alkylene; p is 0 or 1; Y represents CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵R¹⁶ or a phenyl, pyridyl or tetrazolyl group optionally substituted by a hydroxyl or methoxy group, provided that when X represents S(O)_n and Y is other than an optionally substituted aryl or heteroaryl group, then p is 1 and also provided that when X represents S(O)_n, p is 1 and Y represents OH, then n is not 0; R¹³ and R¹⁴ independently represent H; and R¹, R², R¹¹, R¹², R¹⁵

and R¹⁶ independently represent H or C₁₋₄ alkyl.

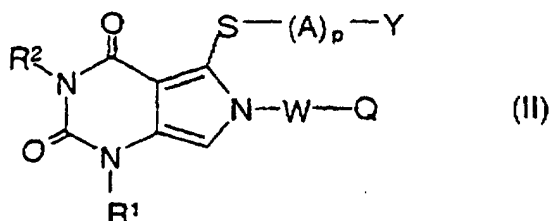
11. A compound according to claim 1 being:

- 5 5-[(3-hydroxypropyl)sulphinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 5-[(3-hydroxypropyl)sulphonyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 methyl 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanoate; or
 10 5-[(3-methoxypropyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 5-[(2-hydroxyethyl)sulphinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 15 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanoic acid; or
 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanoic acid, sodium salt; or
 20 5-[(2-dimethylaminoethyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 6-(2,3-dihydro-1*H*-inden-2-yl)-5-[(3-hydroxypropyl)sulphinyl]-3-methyl-1-(1-methylethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 6-(2,3-dihydro-1*H*-inden-2-yl)-5-[(3-hydroxypropyl)sulphonyl]-3-methyl-1-(1-methylethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 25 5-[(3-hydroxypropyl)sulphinyl]-3-methyl-1-(1-methylethyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanamide; or
 5-(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)pent-3-enoic acid; or
 30 5-(5-hydroxypent-1-ynyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 5-(5-hydroxypentyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 35 5-(4-hydroxybut-1-ynyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 5-(4-hydroxybutyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 40 5-(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)pentanoic acid;
 4-[(2,3,4,6-tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanenitrile;
 5-[(3-{1*H*-tetrazol-5-yl}propyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 45 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)thio]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)sulphinyl]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(4-pyridinyl)thio]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 50 5-[(3-methoxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 5-[(3-hydroxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 55 5-[(4-methoxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 5-[(4-hydroxyphenyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;

5-([2-methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; or
 5-([2-hydroxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione.

12. A process for the preparation of a compound of formula (I) as defined in claim 1, which comprises:

(a) when X represents S(O)_n and n is 1 or 2, oxidising a compound of general formula



wherein R¹, R², A, p, Y, W and Q are as defined in claim 1 including the provisos;

(b) when Y represents OR¹¹ and R¹¹ represents C₁₋₅ alkyl,

reacting a corresponding compound of formula (I) in which Y represents OH, with an alkyl halide of general formula



wherein R^{11a} represents C₁₋₅ alkyl and Hal represents a halogen atom;

(c) when Y represents CO₂R¹² and R¹² represents C₁₋₅ alkyl,

esterifying a corresponding compound of formula (I) in which Y represents CO₂H with an alcohol of general formula



wherein R^{12a} represents C₁₋₅ alkyl;

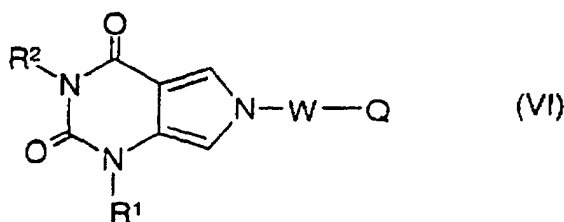
(d) when Y represents CONR¹³R¹⁴, reacting a corresponding compound of formula (I) in which Y represents CO₂H with an amine of general formula



wherein R¹³ and R¹⁴ are as defined in claim 1;

(e) when Y represents CO₂H, hydrolysing a corresponding compound of formula (I) in which Y represents CO₂R¹² and R¹² represents C₁₋₅ alkyl;

(f) when X represents S, A represents a C₁₋₆ alkylene group, Y represents CO₂R¹² and R¹² represents C₁₋₅ alkyl, reacting a compound of general formula



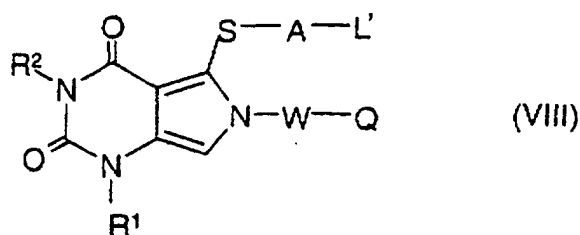
in which R¹, R², W and Q are as defined in claim 1, with a compound of general formula



wherein L is a leaving group and A and R¹² are as defined in claim 1, followed by hydrolysis of the resulting ortho ester;

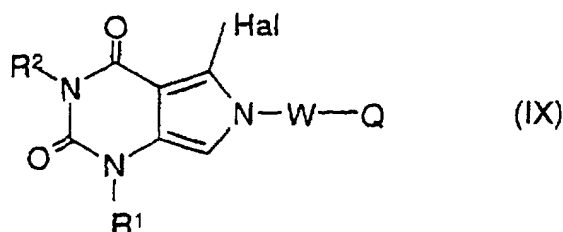
(g) when X represents S, A represents a C₂₋₆ alkylene group, Y represents NR¹⁵R¹⁶ and R¹⁵ and R¹⁶ are as defined in claim 1, reducing a corresponding compound of formula (II) as hereinbefore defined in which A represents a C₁₋₅ alkylene group, Y represents CONR¹³R¹⁴ and R¹³ and R¹⁴ are respectively equal to R¹⁵ and R¹⁶;

(h) when X represents S, A represents a C₁₋₆ alkylene group, Y represents NR¹⁵R¹⁶ and R¹⁵ and R¹⁶ are as defined in claim 1, reacting a corresponding compound of general formula



wherein L' represents a leaving group and R¹, R², A, W and Q are as defined in claim 1, with a compound of formula (V) wherein R¹³ and R¹⁴ are respectively equal to R¹⁵ and R¹⁶;

(j) when X represents C≡C, CH=CH or CH₂CH=CH, reacting a compound of general formula



in which Hal represents a halogen atom and R¹, R², W and Q are as defined in claim 1, with a compound of general formula (X), H-X'-(A)_p-Y, in which X' represents C≡C, CH=CH or CH=CHCH₂ and A, p and Y are as defined in claim 1, in the presence of a palladium catalyst, and optionally hydrogenating the compound of formula (I) obtained wherein X represents C≡C or CH=CH in the presence of a palladium on carbon catalyst to produce a further compound of formula (I) wherein X represents (CH₂)₂;

(k) when X represents S, A represents a C₁₋₆ alkylene group and Y represents CN, reacting a compound of formula (VIII) as hereinbefore defined with sodium cyanide;

(l) when X represents S, A represents a C₁₋₆ alkylene group and Y represents NHSO₂R¹⁷, reacting a corresponding compound of formula (I) in which Y represents NH₂ with a compound of general formula (XI), R¹⁷SO₂Cl, wherein R¹⁷ is as defined in claim 1;

(m) when X represents S, A represents a C₁₋₆ alkylene group and Y represents NHCOR¹⁸, reacting a corresponding compound of formula (I) in which Y represents NH₂ with a compound of general formula (XII), R¹⁸COCl, wherein R¹⁸ is as defined in claim 1;

(n) when X represents S and Y represents an optionally substituted aryl or heteroaryl group, reacting a compound of formula (VI) as hereinbefore defined with a compound of general formula



wherein Y' represents an optionally substituted aryl or heteroaryl group and p and A are as defined in claim 1; or
(p) when X represents S, A represents a C₁₋₆ alkylene group and Y represents a tetrazolyl group, reacting a

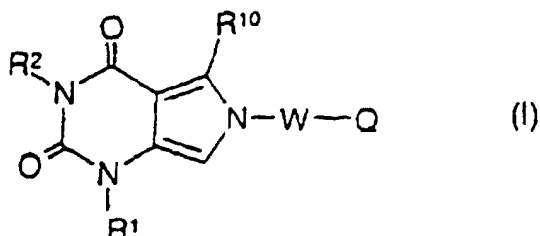
compound of formula (I) in which X represents S. A represents a C₁₋₆ alkylene group and Y represents CN, with trialkyltin azide;

and optionally forming a pharmaceutically acceptable derivative thereof.

- 5
13. A pharmaceutical composition comprising a compound of formula (I) or a pharmaceutically acceptable derivative thereof as defined in claim 1, in admixture with a pharmaceutically acceptable adjuvant, diluent or carrier.
- 10
14. A process for the preparation of a pharmaceutical composition according to claim 13, which comprises admixing a compound of formula (I) or a pharmaceutically acceptable derivative thereof as defined in claim 1, with a pharmaceutically acceptable adjuvant, diluent or carrier.
- 15
15. A compound of formula (I) or a pharmaceutically acceptable derivative thereof as defined in claim 1 for use in therapy.
16. Use of a compound of formula (I) or a pharmaceutically acceptable derivative thereof as defined in claim 1 in the manufacture of a medicament for use in therapy.
- 20
17. Use according to claim 16 wherein the medicament is used in a method of effecting immunosuppression which comprises administering to a patient a therapeutically effective amount of a compound of formula (I) or a pharmaceutically acceptable derivative thereof as defined in claim 1.
- 25
18. Use according to claim 16 wherein the medicament is used in a method of treating, or reducing the risk of, a reversible obstructive airways disease in a patient suffering from, or at risk of, said disease, which comprises administering to the patient a therapeutically effective amount of a compound of formula (I) or a pharmaceutically acceptable derivative thereof as defined in claim 1.

Patentansprüche

- 30
1. Verbindungen der allgemeinen Formel:



in welcher

45 W für -CH₂- oder eine Bindung steht; Q für Ar¹ oder Ar² steht; wobei für den Fall, daß W für -CH₂- steht, Q für eine Arylgruppe Ar¹ steht, in welcher Ar¹ für Naphthyl, Phenyl, Chinolyl, Isochinolyl, Indolyl, Benzofuranyl oder Benzothienyl steht; und wobei für den Fall, daß W für eine Bindung steht, Q für eine Arylgruppe Ar² steht, in welcher Ar² für Acenaphthenyl, Fluorenyl oder Indanyl steht; wobei die von Ar¹ und Ar² dargestellten Ringsysteme jeweils gegebenenfalls durch einen oder mehrere Substituenten ausgewählt aus C₁₋₄-Alkyl, C₁₋₄-Alkoxy, Halogen und Trifluormethyl substituiert sein können; R¹⁰ für X-(A)_p-Y steht; X für S(O)_n, C≡C, (CH₂)₂, CH=CH oder CH₂CH=CH steht; n für 0, 1 oder 2 steht; A für C₁₋₆-Alkylen steht; p für 0 oder 1 steht; Y für CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵R¹⁶, NHSO₂R¹⁷, NHCOR¹⁸ oder eine gegebenenfalls substituierte Aryl- oder Heteroarylgruppe steht, mit der Maßgabe, daß wenn X für S(O)_n steht und Y nicht für eine gegebenenfalls substituierte Aryl- oder Heteroarylgruppe steht, p für 1 steht, und weiterhin mit der Maßgabe, daß wenn X für S(O)_n, p für 1 und Y für OH steht, n nicht für 0 steht; R¹³ und R¹⁴ unabhängig voneinander für H, C₁₋₅-Alkyl oder Phenyl stehen, wobei die letztgenannte Gruppe durch einen oder mehrere Substituenten ausgewählt aus C₁₋₄-Alkyl, C₁₋₄-Alkoxy, Halogen und CO₂R²¹ substituiert sein kann; und R¹, R², R¹¹, R¹², R¹⁵, R¹⁶, R¹⁷, R¹⁸ und R²¹ unabhängig voneinander für H oder C₁₋₅-Alkyl stehen; und deren pharmazeutisch unbedenkliche Derivate.

55

2. Verbindungen nach Anspruch 1, wobei in der Formel (I) W für -CH₂- und Q für eine Arylgruppe Ar¹ steht, wobei Ar¹ für eine Naphthyl- oder Phenylgruppe steht, die jeweils gegebenenfalls durch einen oder mehrere aus C₁₋₄-Alkyl, C₁₋₄-Alkoxy, Halogen und Trifluormethyl ausgewählte Substituenten substituiert sein können.
- 5 3. Verbindungen nach Anspruch 1, wobei, in der Formel (I), W für eine Bindung und Q für eine Arylgruppe Ar² steht, wobei Ar² für eine Indanylgruppe steht, die gegebenenfalls durch einen oder mehrere aus C₁₋₄-Alkyl, C₁₋₄-Alkoxy, Halogen und Trifluormethyl ausgewählte Substituenten substituiert sein kann.
- 10 4. Verbindungen nach einem der Ansprüche 1 bis 3, wobei, in der Formel (I), X für S(O)_n, wobei n für 0, 1 oder 2 steht, C≡C, (CH₂)₂ oder CH₂CH=CH steht.
- 15 5. Verbindungen nach einem der Ansprüche 1 bis 4, wobei, in der Formel (I), X für S(O)_n steht, wobei n für 0, 1 oder 2 steht.
- 15 6. Verbindungen nach einem der Ansprüche 1 bis 5, wobei, in der Formel (I), A für C₁₋₄-Alkylen steht.
7. Verbindungen nach einem der Ansprüche 1 bis 6, wobei, in der Formel (I), die Gruppen R¹, R², R¹¹, R¹², R¹⁵, R¹⁶, R¹⁷, R¹⁸ und R²¹ jeweils für H oder eine C₁₋₄-Alkylgruppe stehen.
- 20 8. Verbindungen nach einem der Ansprüche 1 bis 7, wobei, in der Formel (I), die Gruppen R¹³ und R¹⁴ jeweils für H, C₁₋₃-Alkyl oder Phenyl stehen, wobei die letztgenannte Gruppe durch einen oder mehrere Substituenten ausgewählt aus C₁₋₄-Alkyl, C₁₋₄-Alkoxy, Halogen und CO₂R²¹ substituiert sein kann.
- 25 9. Verbindungen nach Anspruch 1, wobei in der Formel (I) W für -CH₂- oder eine Bindung steht; Q für Ar¹ oder Ar² steht; wobei für den Fall, daß W für -CH₂- steht, Q für eine Arylgruppe Ar¹ steht, in welcher Ar¹ für Naphthyl oder Phenyl steht; und wobei für den Fall, daß W für eine Bindung steht, Q für eine Arylgruppe Ar² steht, in welcher Ar² für Indanyl steht; wobei die von Ar¹ und Ar² dargestellten Ringsysteme jeweils gegebenenfalls durch einen oder mehrere, z.B. einen, zwei, drei oder vier, Substituenten ausgewählt aus C₁₋₄-Alkyl, C₁₋₄-Alkoxy, Halogen und Trifluormethyl substituiert sein können; R¹⁰ für X-(A)_p-Y steht; X für S(O)_n, C≡C, (CH₂)₂ oder CH₂CH=CH steht; n für 0, 1 oder 2 steht; A für C₁₋₆-Alkylen steht; p für 0 oder 1 steht; Y für CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵NR¹⁶ oder eine gegebenenfalls substituierte Phenyl-, Pyridyl- oder Tetrazolylgruppe steht, mit der Maßgabe, daß wenn X für S(O)_n und Y nicht für eine gegebenenfalls substituierte Aryl- oder Heteroarylgruppe steht, p für 1 steht, und weiterhin mit der Maßgabe, daß wenn X für S(O)_n, p für 1 und Y für OH steht, n nicht für 0 steht; R¹³ und R¹⁴ unabhängig voneinander für H, C₁₋₅-Alkyl oder Phenyl stehen, wobei die letztgenannte Gruppe durch einen oder mehrere Substituenten ausgewählt aus C₁₋₄-Alkyl, C₁₋₄-Alkoxy, Halogen und CO₂R²¹ substituiert sein kann; und R¹, R², R¹¹, R¹², R¹⁵, R¹⁶ und R²¹ unabhängig voneinander für H oder C₁₋₅-Alkyl stehen.
- 30 10. Verbindungen nach Anspruch 1, wobei, in der Formel (I), W für -CH₂- oder eine Bindung steht; Q für Ar¹ oder Ar² steht; wobei für den Fall, daß W für -CH₂- steht, Q für eine Arylgruppe Ar¹ steht, in welcher Ar¹ für Naphthyl steht; und wobei für den Fall, daß W für eine Bindung steht, Q für eine Arylgruppe Ar² steht, in welcher Ar² für Indanyl steht; R¹⁰ für X-(A)_p-Y steht; X für S(O)_n, C≡C, (CH₂)₂ oder CH₂CH=CH steht; n für 0, 1 oder 2 steht; A für C₁₋₃-Alkylen steht; p für 0 oder 1 steht; Y für CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵R¹⁶ oder eine Phenyl-, Pyridyl- oder Tetrazolylgruppe steht, die gegebenenfalls durch eine Hydroxyl- oder Methoxygruppe substituiert ist, mit der Maßgabe, daß, wenn X für S(O)_n und Y nicht für eine gegebenenfalls substituierte Aryl- oder Heteroarylgruppe steht, p für 1 steht, und weiterhin mit der Maßgabe, daß, wenn X für S(O)_n, p für 1 und Y für OH steht, n nicht für 0 steht; R¹³ und R¹⁴ unabhängig voneinander für H stehen; und R¹, R², R¹¹, R¹², R¹⁵ und R¹⁶ unabhängig voneinander für H oder C₁₋₄-Alkyl stehen.
- 35 11. Verbindungen nach Anspruch 1, bei denen es sich um:
- 50 5-[(3-Hydroxypropyl)sulfinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*, 6*H*)-dion; oder
- 55 5-[(3-Hydroxypropyl)sulfonyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder
- 4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]buttersäuremethylester; oder

- 5-[(3-Methoxypropyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder
- 5 5-[(2-Hydroxyethyl)sulfinyl]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder
- 4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]buttersäure; oder
- 10 4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]buttersäure-Natriumsalz; oder
- 5-[(2-Dimethylaminoethyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*, 6*H*)-dion; oder
- 15 6-(2, 3-Dihydro-1*H*-inden-2-yl)-5-[(3-hydroxypropyl)-sulfinyl]-3-methyl-1-(1-methylethyl)-1*H*-pyrrolo-[3, 4-*d*]pyrimidin-2,4(3*H*, 6*H*)-dion; oder
- 20 6-(2, 3-Dihydro-1*H*-inden-2-yl)-5-[(3-hydroxypropyl)-sulfonyl]-3-methyl-1-(1-methylethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder
- 5-[(3-Hydroxypropyl)sulfinyl]-3-methyl-1-(1-methylethyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder
- 25 4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]buttersäureamid; oder
- 5-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)pent-3-ensäure; oder
- 30 5-(5-Hydroxypent-1-inyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder
- 5-(5-Hydroxypentyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder
- 35 5-(4-Hydroxybut-1-inyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder
- 40 5-(4-Hydroxybutyl)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion;
- 5-(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)pentansäure;
- 45 4-[(2,3,4,6-Tetrahydro-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butyronitril;
- 5-[(3-{1*H*-Tetrazol-5-yl}propyl)thio]-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo-[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion;
- 50 3-Methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)thio]-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion;
- 55 3-Methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(2-pyridinyl)sulfinyl]-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion;
- 3-Methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-5-[(4-pyridinyl) thio]-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4

(3*H*,6*H*)-dion;

5-([3-Methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion;

5-([3-Hydroxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion;

5-([4-Methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion;

5-([4-Hydroxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion;

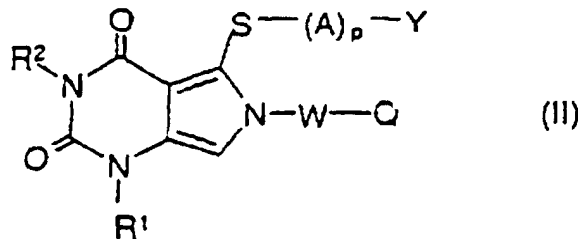
5-([2-Methoxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion; oder

5-([2-Hydroxyphenyl]thio)-3-methyl-1-(2-methylpropyl)-6-(1-naphthalenylmethyl)-1*H*-pyrrolo[3,4-*d*]pyrimidin-2,4(3*H*,6*H*)-dion

handelt.

12. Verfahren zur Herstellung einer wie in Anspruch 1 definierten Verbindung der Formel (I), bei dem man:

(a) in dem Fall, daß X für S(O)_n und n für 1 oder 2 steht, eine Verbindung der allgemeinen Formel



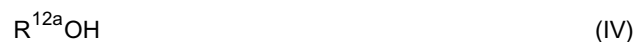
in welcher R¹, R², A, p, Y, W und Q wie in Anspruch 1 definiert sind, einschließlich der Maßgaben, oxidiert.

(b) in dem Fall, daß Y für OR¹¹ und R¹¹ für C₁₋₅-Alkyl steht, eine entsprechende Verbindung der Formel (I), in welcher Y für OH steht, mit einem Alkylhalogenid der allgemeinen Formel



in welcher R^{11a} für C₁₋₅-Alkyl und Hal für ein Halogenatom steht, umsetzt;

(c) in dem Fall, daß Y für CO₂R¹² und R¹² für C₁₋₅-Alkyl steht, eine entsprechende Verbindung der Formel (I), in welcher Y für CO₂H steht, mit einem Alkohol der allgemeinen Formel



in welcher R^{12a} für C₁₋₅-Alkyl steht, verestert;

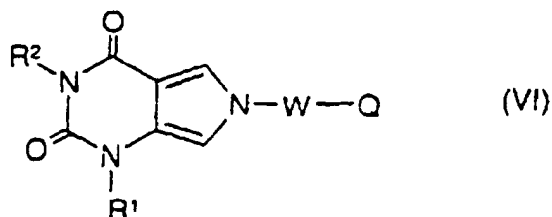
(d) in dem Fall, daß Y für CONR¹³R¹⁴ steht, eine entsprechende Verbindung der Formel (I), in welcher Y für CO₂H steht, mit einem Amin der allgemeinen Formel



in welcher R^{13} und R^{14} wie in Anspruch 1 definiert sind, umgesetzt;

(e) in dem Fall, daß Y für CO_2H steht, eine entsprechende Verbindung der Formel (I), in welcher Y für CO_2R^{12} und R^{12} für C_{1-5} -Alkyl steht, hydrolysiert;

(f) in dem Fall, daß X für S, A für eine C_{1-6} -Alkylengruppe, Y für CO_2R^{12} und R^{12} für C_{1-5} -Alkyl steht, eine Verbindung der allgemeinen Formel



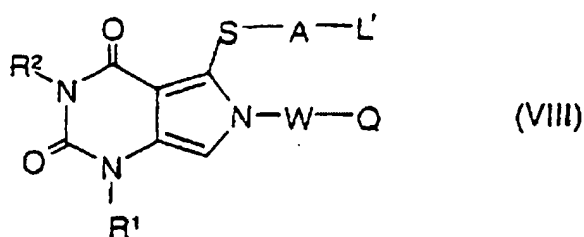
in welcher R^1 , R^2 , W und Q wie in Anspruch 1 definiert sind, mit einer Verbindung der allgemeinen Formel



in welcher L für eine Abgangsgruppe steht und A und R^{12} wie in Anspruch 1 definiert sind, umgesetzt und anschließend den so erhaltenen Orthoester hydrolysiert;

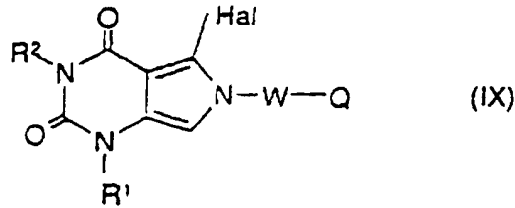
(g) in dem Fall, daß X für S, A für eine C_{2-6} -Alkylengruppe und Y für $NR^{15}R^{16}$ steht und R^{15} und R^{16} wie in Anspruch 1 definiert sind, eine entsprechende, wie oben definierte Verbindung der Formel (II), in welcher A für eine C_{1-5} -Alkylengruppe und Y für $CONR^{13}R^{14}$ steht und R^{13} und R^{14} gleich R^{15} bzw. R^{16} sind, reduziert;

(h) in dem Fall, daß X für S, A für eine C_{1-6} -Alkylengruppe und Y für $NR^{15}R^{16}$ steht und R^{15} und R^{16} wie in Anspruch 1 definiert sind, eine entsprechende Verbindung der allgemeinen Formel



in welcher L' für eine Abgangsgruppe steht, und R^1 , R^2 , A, W und Q wie in Anspruch 1 definiert sind, mit einer Verbindung der Formel (V), in welcher R^{13} und R^{14} gleich R^{15} bzw. R^{16} sind, umgesetzt;

(j) in dem Fall, daß X für $C=C$, $CH=CH$ oder $CH_2CH=CH$ steht, eine Verbindung der allgemeinen Formel



10 in welcher Hal für ein Halogenatom steht, und R¹, R², W und Q wie in Anspruch 1 definiert sind, mit einer Verbindung der allgemeinen Formel (X), H-X'-(A)_p-Y, in welcher X' für C≡C, CH=CH oder CH=CHCH₂ steht und A, p und Y wie in Anspruch 1 definiert sind, in Gegenwart eines Palladiumkatalysators umgesetzt und gegebenenfalls die so erhaltene Verbindung der Formel (I), in der X für C≡C oder CH=CH steht, in Gegenwart eines Palladium-auf-Kohle-Katalysators zu einer weiteren Verbindung der Formel (I), in der X für (CH₂)₂ steht, hydriert;

15 (k) in dem Fall, daß X für S, A für eine C₁₋₆-Alkylengruppe und Y für CN steht, eine wie oben definierte Verbindung der Formel (VIII) mit Natriumcyanid umgesetzt;

20 (l) in dem Fall, daß X für S, A für eine C₁₋₆-Alkylengruppe und Y für NHSO₂R¹⁷ steht, eine entsprechende Verbindung der Formel (I), in welcher Y für NH₂ steht, mit einer Verbindung der allgemeinen Formel (XI), R¹⁷SO₂Cl, in welcher R¹⁷ wie in Anspruch 1 definiert ist, umgesetzt;

25 (m) in dem Fall, daß X für S, A für eine C₁₋₆-Alkylengruppe und Y für NHCOR¹⁸ steht, eine entsprechende Verbindung der Formel (I), in welcher Y für NH₂ steht, mit einer Verbindung der allgemeinen Formel (XII), R¹⁸COCl, in welcher R¹⁸ wie in Anspruch 1 definiert ist, umgesetzt;

30 (n) in dem Fall, daß X für S und Y für eine gegebenenfalls substituierte Aryl- oder Heteroarylgruppe steht, eine wie oben definierte Verbindung der Formel (VI) mit einer Verbindung der allgemeinen Formel



35 in welcher Y' für eine gegebenenfalls substituierte Aryl- oder Heteroarylgruppe steht und p und A wie in Anspruch 1 definiert sind, umgesetzt; oder

40 (p) in dem Fall, daß X für S, A für eine C₁₋₆-Alkylengruppe und Y für eine Tetrazolylgruppe steht, eine Verbindung der Formel (I), in der X für S, A für eine C₁₋₆-Alkylengruppe und Y für CN steht, mit einem Trialkylzinnazid umgesetzt;

und gegebenenfalls ein pharmazeutisch unbedenkliches Derivat davon bildet.

45 **13.** Pharmazeutische Zusammensetzung, enthaltend eine Verbindung der Formel (I) oder ein pharmazeutisch unbedenkliches Derivat davon, wie in Anspruch 1 definiert, in einer Mischung mit einem pharmazeutisch unbedenklichen Adjuvans, Verdünnungsmittel oder Trägerstoff.

50 **14.** Verfahren zur Herstellung einer pharmazeutischen Zusammensetzung nach Anspruch 13, bei dem man eine Verbindung der Formel (I) oder ein pharmazeutisch unbedenkliches Derivat davon, wie in Anspruch 1 definiert, mit einem pharmazeutisch unbedenklichen Adjuvans, Verdünnungsmittel oder Trägerstoff mischt.

15. Verbindung der Formel (I) oder ein pharmazeutisch unbedenkliches Derivat davon, wie in Anspruch 1 definiert, zur Verwendung in der Therapie.

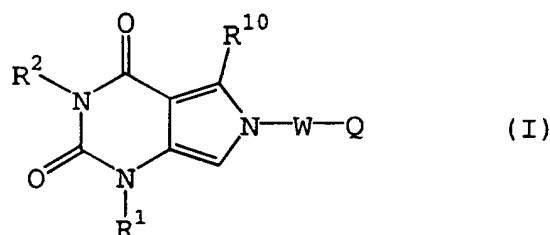
55 **16.** Verwendung einer Verbindung der Formel (I) oder eines pharmazeutisch unbedenklichen Derivats davon, wie in Anspruch 1 definiert, bei der Herstellung eines Medikaments zur Verwendung in der Therapie.

17. Utilisation selon la revendication 16, dans laquelle le médicament est utilisé par une méthode pour l'inhibition de réactions immunitaires, **caractérisé en ce que** l'on administre à un patient une dose thérapeutiquement efficace d'une quantité d'une molécule de la formule (I) ou d'un dérivé pharmaceutiquement acceptable de celle-ci, tel que défini dans la revendication 1, tel qu'administré.

18. Utilisation selon la revendication 16, dans laquelle le médicament est utilisé par une méthode pour le traitement ou la réduction du risque d'une maladie obstructive réversible des voies respiratoires chez un patient souffrant de cette maladie ou en danger de le devenir, **caractérisé en ce que** l'on administre à un patient une dose thérapeutiquement efficace d'une quantité d'une molécule de la formule (I) ou d'un dérivé pharmaceutiquement acceptable de celle-ci, tel que défini dans la revendication 1, tel qu'administré.

Revendications

1. Composé selon la formule générale :



dans laquelle

W représente $-CH_2-$ ou une liaison; Q représente Ar^1 ou Ar^2 ; dans le cas où W représente $-CH_2-$, Q représente un groupe aryle Ar^1 dans lequel Ar^1 représente un naphthyle, un phényle, un quinolyne, un i-quinolyne, un indolyne, un benzofuranyne ou un benzothiényle; dans le cas où W représente une liaison, Q représente un groupe aryle Ar^2 dans lequel Ar^2 représente un acénaphthényne, un fluorényne ou un indanyne; dans lequel les systèmes cycliques que Ar^1 et Ar^2 représentent peuvent tous être facultativement substitués par un ou plusieurs substituants sélectionnés parmi un alkyle en C_1-C_4 , un alcoyle en C_1-C_4 , un halogène, ou un trifluorométhyle; R^{10} représente $X-(A)_p-Y$; X représente $S(O)_n$, $C\equiv C$, $(CH_2)_2$, $CH=CH$ ou $CH_2CH=CH$; n représente 0, 1 ou 2; A représente un alkylène en C_1-C_6 ; p est 0 ou 1; Y représente CN , OR^{11} , CO_2R^{12} , $CONR^{13}R^{14}$, $NR^{15}R^{16}$, $NHSO_2R^{17}$, $NHCOR^{18}$ ou un groupe aryle ou hétéroaryle facultativement substitué, à condition que lorsque X représente $S(O)_n$ et Y est différent d'un groupe aryle ou hétéroaryle facultativement substitué, alors p est 1 et également à condition que lorsque X représente $S(O)_n$, p est 1 et Y représente OH , alors n n'est pas 0; R^{13} et R^{14} représentent indépendamment H, un alkyle en C_1-C_5 ou un phényle, ce dernier groupe peut être substitué par un ou plusieurs substituants sélectionnés parmi un alkyle en C_1-C_4 , un alcoyle en C_1-C_4 , un halogène, ou CO_2R^{21} ; et R^1 , R^2 , R^{11} , R^{12} , R^{15} , R^{16} , R^{17} , R^{18} et R^{21} représentent indépendamment H ou un alkyle en C_1-C_5 ; ou un dérivé pharmaceutiquement acceptable de celui-ci.

2. Composé selon la revendication 1, dans lequel dans la formule (I), W représente $-CH_2-$ et Q représente un groupe aryle Ar^1 dans lequel Ar^1 représente un groupe naphthyle ou phényle, dont chacun peut être facultativement substitué par un ou plusieurs substituants sélectionnés parmi un alkyle en C_1-C_4 , un alcoyle en C_1-C_4 , un halogène ou un trifluorométhyle.

3. Composé selon la revendication 1, dans lequel, dans la formule (I), W représente une liaison et Q représente un groupe aryle Ar^2 dans lequel Ar^2 représente un groupe indanyne qui peut être facultativement substitué par un ou plusieurs substituants sélectionnés parmi un alkyle en C_1-C_4 , un alcoyle en C_1-C_4 , un halogène ou un trifluorométhyle.

4. Composé selon l'une quelconque des revendications 1 à 3, dans lequel, dans la formule (I), X représente $S(O)_n$ dans lequel n est 0, 1 ou 2, $C\equiv C$, $(CH_2)_2$ ou $CH_2CH=CH$.

5. Composé selon l'une quelconque des revendications 1 à 4, dans lequel, dans la formule (I), X représente $S(O)_n$ dans lequel n est 0, 1 ou 2.

6. Composé selon l'une quelconque des revendications 1 à 5, dans lequel, dans la formule (I), A représente un alkylène en C₁-C₄.

7. Composé selon l'une quelconque des revendications 1 à 6, dans lequel, dans la formule (I), chacun des groupements R¹, R², R¹¹, R¹², R¹⁵, R¹⁶, R¹⁷, R¹⁸ et R²¹ représente H ou un groupement alkyle en C₁-C₄.

8. Composé selon l'une quelconque des revendications 1 à 7, dans lequel, dans la formule (I), chacun des groupements R¹³ et R¹⁴ représente H, un alkyle en C₁-C₃ ou un phényle, ce dernier groupement peut être substitué par un ou plusieurs substituants sélectionnés parmi un alkyle en C₁-C₄, un alcoxy en C₁-C₄, un halogène, ou CO₂R²¹.

9. Composé selon la revendication 1, dans lequel, dans la formule (I), W représente -CH₂- ou une liaison; Q représente Ar¹ ou Ar²; dans le cas où W représente -CH₂-, Q représente un groupement aryle Ar¹ dans lequel Ar¹ représente un naphthyle ou un phényle; dans le cas où W représente une liaison, Q représente un groupement aryle Ar² dans lequel Ar² représente un indanyle; dans lequel les systèmes cycliques que Ar¹ et Ar² représentent peuvent tous être facultativement substitués par un ou plusieurs substituants, par exemple un, deux, trois ou quatre, sélectionnés parmi un alkyle en C₁-C₄, un alcoxy en C₁-C₄, un halogène, ou un trifluorométhyle; R¹⁰ représente X-(A)_p-Y; X représente S(O)_n, C≡C, (CH₂)₂ ou CH₂CH=CH; n représente 0, 1 ou 2; A représente un alkylène en C₁-C₆; p est 0 ou 1; Y représente CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵R¹⁶ ou un groupement phényle, pyridyle ou tétrazolyle facultativement substitué, à condition que lorsque X représente S(O)_n et Y est différent d'un groupement aryle ou hétéroaryle facultativement substitué, alors p est 1 et également à condition que lorsque X représente S(O)_n, p est 1 et Y représente OH, alors n n'est pas 0; R¹³ et R¹⁴ représentent indépendamment H, un alkyle en C₁-C₅ ou un phényle, ce dernier groupement peut être substitué par un ou plusieurs substituants sélectionnés parmi un alkyle en C₁-C₄, un alcoxy en C₁-C₄, un halogène, ou CO₂R²¹; et R¹, R², R¹¹, R¹², R¹⁵, R¹⁶, et R²¹ représentent indépendamment H ou un alkyle en C₁-C₅.

10. Composé selon la revendication 1, dans lequel, dans la formule (I), W représente -CH₂- ou une liaison; Q représente Ar¹ ou Ar²; dans le cas où W représente -CH₂-, Q représente un groupement aryle Ar¹ dans lequel Ar¹ représente un naphthyle; dans le cas où W représente une liaison, Q représente un groupement aryle Ar² dans lequel Ar² représente un indanyle; R¹⁰ représente X-(A)_p-Y; X représente S(O)_n, C≡C, (CH₂)₂ ou CH₂CH=CH; n représente 0, 1 ou 2; A représente un alkylène en C₁-C₃; p est 0 ou 1; Y représente CN, OR¹¹, CO₂R¹², CONR¹³R¹⁴, NR¹⁵R¹⁶ ou un groupement phényle, pyridyle ou tétrazolyle facultativement substitué par un groupement hydroxy ou méthoxy, à condition que lorsque X représente S(O)_n et Y est différent d'un groupement aryle ou hétéroaryle facultativement substitué, alors p est 1 et également à condition que lorsque X représente S(O)_n, p est 1 et Y représente OH, alors n n'est pas 0; R¹³ et R¹⁴ représentent indépendamment H, et R¹, R², R¹¹, R¹², R¹⁵ et R¹⁶ représentent indépendamment H ou un alkyle en C₁-C₄.

11. Composé selon la revendication 1, étant

la 5-[(3-hydroxypropyl)sulfinyl]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalénylméthyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione; ou

la 5-[(3-hydroxypropyl)sulfonyl]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalénylméthyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione; ou

le méthyl-4-[(2,3,4,6-tétrahydro-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalénylméthyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoate; ou

la 5-[(3-méthoxypropyl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalénylméthyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione; ou

la 5-[(2-hydroxyéthyl)sulfinyl]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalénylméthyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione; ou

l'acide 4-[(2,3,4,6-tétrahydro-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalénylméthyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoïque; ou

le sel de sodium de l'acide 4-[(2,3,4,6-tétrahydro-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalénylméthyl)-2,4-dioxo-1H-pyrrolo[3,4-d]pyrimidin-5-yl)thio]butanoïque; ou

la 5-[(2-diméthylaminoéthyl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalénylméthyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione; ou

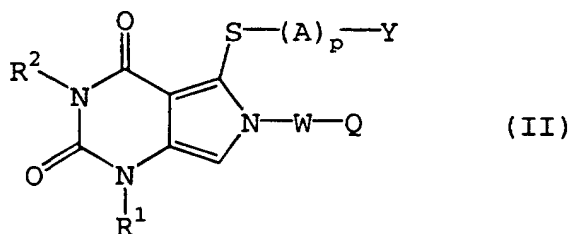
la 6-(2,3-dihydro-1H-indén-2-yl)-5-[(3-hydroxypropyl)sulfinyl]-3-méthyl-1-(1-méthyléthyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione; ou

la 6-(2,3-dihydro-1H-indén-2-yl)-5-[(3-hydroxypropyl)sulfonyl]-3-méthyl-1-(1-méthyléthyl)-1H-pyrrolo[3,4-d]pyrimidine-2,4(3H,6H)-dione; ou

la 5-[(3-hydroxypropyl)sulfinyl]-3-méthyl-1-(1-méthyléthyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; ou
 le 4-[(2,3,4,6-tétrahydro-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanamide; ou
 l'acide 5-(2,3,4,6-tétrahydro-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)pent-3-énoïque; ou
 la 5-(5-hydroxypent-1-ynyl)-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H* pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; ou
 la 5-(5-hydroxypentyl)-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; ou
 la 5-(4-hydroxybut-1-ynyl)-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; ou
 la 5-(4-hydroxybutyl)-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 l'acide 5-(2,3,4,6-tétrahydro-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)pentanoïque;
 le 4-[(2,3,4,6-tétrahydro-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-2,4-dioxo-1*H*-pyrrolo[3,4-*d*]pyrimidin-5-yl)thio]butanenitrile;
 la 5-[(3-{1*H*-tétraazol-5-yl}propyl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 la 3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-5-[(2-pyridinyl)thio]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 la 3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-5-[(2-pyridinyl)sulfinyl]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 la 3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-5-[(4-pyridinyl)thio]-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 la 5-[(3-méthoxyphényl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 la 5-[(3-hydroxyphényl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 la 5-[(4-méthoxyphényl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 la 5-[(4-hydroxyphényl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione;
 la 5-[(2-méthoxyphényl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione; ou
 la 5-[(2-hydroxyphényl)thio]-3-méthyl-1-(2-méthylpropyl)-6-(1-naphtalényméthyl)-1*H*-pyrrolo[3,4-*d*]pyrimidine-2,4(3*H*,6*H*)-dione.

12. Procédé de préparation d'un composé de formule (I) comme défini dans la revendication 1, qui comprend :

(a) lorsque X représente S(O)_n et n est 1 ou 2, l'oxydation d'un composé de formule générale



dans laquelle R¹, R², A, p, Y, W et Q sont comme définis à la revendication 1, y compris les conditions;

(b) lorsque Y représente OR¹¹ et R¹¹ représente un alkyle en C₁-C₅, la réaction d'un composé correspondant de formule (I) dans lequel Y représente OH, avec un halogénure d'alkyle de formule générale



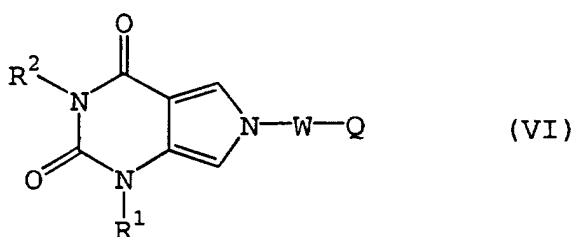
dans laquelle R^{11a} représente un alkyle en C_1-C_5 et Hal représente un atome d'halogène;
 (c) lorsque Y représente CO_2R^{12} et R^{12} représente un alkyle en C_1-C_5 , l'estérification d'un composé correspondant de formule (I) dans lequel Y représente CO_2H avec un alcool de formule générale



dans laquelle R^{12a} représente un alkyle en C_1-C_5 ;
 (d) lorsque Y représente $CONR^{13}R^{14}$, la réaction d'un composé correspondant de formule (I) dans laquelle Y représente CO_2H avec une amine de formule générale



dans laquelle R^{13} et R^{14} sont comme définis à la revendication 1;
 (e) lorsque Y représente CO_2H , l'hydrolyse d'un composé correspondant de formule (I) dans lequel Y représente CO_2R^{12} et R^{12} représente un alkyle en C_1-C_5 ;
 (f) lorsque X représente S, A représente un groupement alkylène en C_1-C_6 , Y représente CO_2R^{12} et R^{12} représente un alkyle en C_1-C_5 , la réaction d'un composé de formule générale



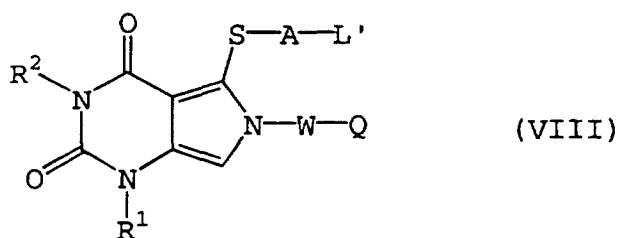
dans laquelle R^1 , R^2 , W et Q sont comme définis à la revendication 1, avec un composé de formule générale



dans laquelle L est un groupement partant et A et R^{12} sont comme définis à la revendication 1, suivie par l'hydrolyse de l'orthoester obtenu;

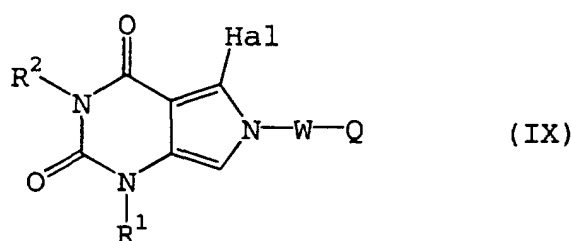
(g) lorsque X représente S, A représente un groupement alkylène en C_2-C_6 , Y représente $NR^{15}R^{16}$ et R^{15} et R^{16} sont comme définis à la revendication 1, la réduction d'un composé correspondant de formule (II) comme défini ci-dessus dans le présent mémoire dans lequel A représente un groupement alkylène en C_1-C_5 , Y représente $CONR^{13}R^{14}$ et R^{13} et R^{14} sont respectivement égaux à R^{15} et R^{16} ;

(h) lorsque X représente S, A représente un groupement alkylène en C_1-C_6 , Y représente $NR^{15}R^{16}$ et R^{15} et R^{16} sont comme définis à la revendication 1, la réaction d'un composé correspondant de formule générale



dans laquelle L' représente un groupement partant et R^1 , R^2 , A, W et Q sont comme définis à la revendication 1, avec un composé de formule (V) dans laquelle R^{13} et R^{14} sont respectivement égaux à R^{15} et R^{16} ;

(j) lorsque X représente C≡C, CH=CH ou CH₂CH=CH, la réaction d'un composé de formule générale



dans laquelle Hal représente un atome d'halogène et R¹, R², W et Q sont comme définis à la revendication 1, avec un composé de formule générale (X), H-X'-(A)_p-Y, dans laquelle X' représente C≡C, CH=CH ou CH=CHCH₂ et A, p et Y sont comme définis à la revendication 1, en présence d'un catalyseur de palladium, et facultativement, l'hydrogénation du composé de formule (I) obtenu dans laquelle X représente C≡C ou CH=CH en présence d'un catalyseur de palladium sur carbone pour produire un autre composé de formule (I) dans laquelle X représente (CH₂)₂;

(k) lorsque X représente S, A représente un groupement alkylène en C₁-C₆ et Y représente CN, la réaction d'un composé de formule (VIII) comme défini ci-dessus dans le présent mémoire avec du cyanure de sodium;

(l) lorsque X représente S, A représente un groupement alkylène en C₁-C₆ et Y représente NHSO₂R¹⁷, la réaction d'un composé correspondant de formule (I) dans laquelle Y représente NH₂ avec un composé de formule générale (XI), R¹⁷SO₂Cl, dans laquelle R¹⁷ est comme défini à la revendication 1;

(m) lorsque X représente S, A représente un groupement alkylène en C₁-C₆ et Y représente NHCOR¹⁸, la réaction d'un composé correspondant de formule (I) dans laquelle Y représente NH₂ avec un composé de formule générale (XII), R¹⁸COCl, dans laquelle R¹⁸ est comme défini à la revendication 1;

(n) lorsque X représente S et Y représente un groupement aryle ou hétéroaryle facultativement substitué, la réaction d'un composé de formule (VI) comme défini ci-dessus dans le présent mémoire avec un composé de formule générale



dans laquelle Y' représente un groupement aryle ou hétéroaryle facultativement substitué, et p et A sont comme définis à la revendication 1; ou

(p) lorsque X représente S, A représente un groupement alkylène en C₁-C₆ et Y représente un groupement tétrazolyle, la réaction d'un composé de formule (I) dans laquelle X représente S, A représente un groupement alkylène en C₁-C₆ et Y représente CN, avec un azide de trialkylétain;

et facultativement la formation d'un dérivé pharmaceutiquement acceptable de celui-ci.

40 **13.** Composition pharmaceutique comprenant un composé de formule (I) ou un dérivé pharmaceutiquement acceptable de celui-ci comme défini à la revendication 1, en mélange avec un adjuvant, diluant ou vecteur pharmaceutiquement acceptable.

45 **14.** Procédé pour la préparation d'une composition pharmaceutique selon la revendication 13, qui comprend le mélange d'un composé de formule (I) ou d'un dérivé pharmaceutiquement acceptable de celui-ci comme défini à la revendication 1, avec un adjuvant, diluant ou vecteur pharmaceutiquement acceptable.

50 **15.** Composé de formule (I) ou un dérivé pharmaceutiquement acceptable de celui-ci comme défini à la revendication 1 pour une utilisation en thérapie.

16. Utilisation d'un composé de formule (I) ou d'un dérivé pharmaceutiquement acceptable de celui-ci comme défini à la revendication 1 dans la fabrication d'un médicament pour une utilisation en thérapie.

55 **17.** Utilisation selon la revendication 16, dans laquelle le médicament est utilisé dans un procédé pour réaliser une immunosuppression qui comprend l'administration à un patient d'une quantité efficace sur le plan thérapeutique d'un composé de formule (I) ou d'un dérivé pharmaceutiquement acceptable de celui-ci comme défini à la reven-

dication 1.

- 5 **18.** Utilisation selon la revendication 16, dans laquelle le médicament est utilisé dans un procédé de traitement, ou de réduction du risque, d'une maladie obstructive réversible des voies aériennes chez un patient souffrant de ladite maladie, ou étant à risque pour celle-ci, qui comprend l'administration au patient d'une quantité efficace sur le plan thérapeutique d'un composé de formule (I) ou d'un dérivé pharmaceutiquement acceptable de celui-ci comme défini à la revendication 1.

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