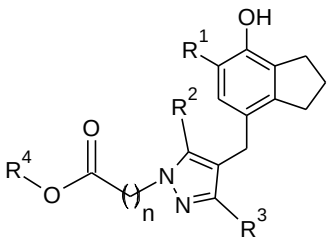
CLAIMS

1. A method for producing substituted pyrazole compound of Formula (I):



(I)

wherein:

R^1, R^2 and R^3 are each independently selected from H, C_{1-6} alkyl, ~~C_{1-6} alkoxy, or halogen~~;

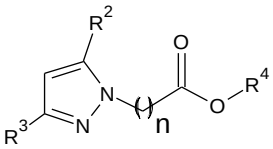
R^4 is selected from H, C_{1-10} saturated ~~or unsaturated~~ alkyl, ~~C_{1-10} substituted or unsubstituted arylalkyl, C_{3-10} cycloalkyl, aryl, heteroaryl, C_{1-10} alkyl silyl, C_{1-10} alkyl silyl ethers, substituted or unsubstituted haloalkyl, or C_{1-20} alkyl tricyclic~~;

n is 2~~1 to 5~~;

or its pharmaceutically acceptable salts~~, solvates, co-crystals, and hydrates~~ thereof;

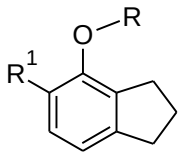
comprising

condensing a compound of Formula (XIX),



(XIX)

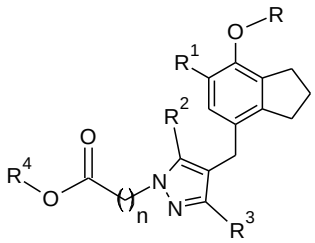
wherein R^2, R^3, R^4 and n are as defined above; with a compound of Formula (XX),



(XX)

wherein R is H or Pg^1;

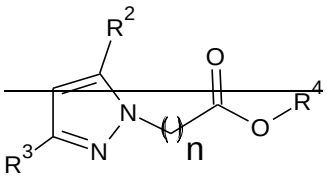
wherein Pg^1 is hydroxy protecting group, and R^1 is as defined above; in the presence of a condensing agent to obtain a compound of Formula (VIIIa),



(VIIIa)

wherein R, R^1, R^2, R^3, R^4 and n are as defined above; and optionally deprotecting and/or hydrolysing the compound of Formula (VIIIa) to yield substituted pyrazole compound of Formula (I).

2. The method according to claim 1, wherein the substituents R^1, R^2, and R^3 are methyl; R^4 is H or C_{1-6} alkyl; n is 2; and when R is Pg^1 then Pg^1 is methyl or benzyl.
3. The method according to claim 1, wherein the condensing agent is selected from the group comprising formaldehyde, paraformaldehyde, 1,3,5-trioxane, or mixtures thereof.
4. The method according to claim 1, wherein the condensation of a compound of Formula (XIX) with a compound of Formula (XX) is carried out optionally in the presence of acid catalyst selected from hydrochloric acid, sulphuric acid, p-toluenesulfonic acid, zinc chloride, or tin(II) chloride.
5. The method according to claim 1, wherein the condensation reaction is carried out in the presence of a solvent selected from acetic acid, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, dimethylsulphoxide, acetonitrile, *N*-methylpyrrolidone, cyclohexane, toluene, xylene or benzene.
6. The method according to claim 1, wherein the deprotection of a compound of Formula (VIIIa) is carried out in the presence of boron tribromide or palladium on carbon.
7. The method according to claim 1, wherein the hydrolysis of a compound of Formula (VIIIa) is carried out in the presence of a base selected from lithium hydroxide, sodium hydroxide, potassium hydroxide, magnesium hydroxide, sodium carbonate, potassium carbonate, cesium carbonate, magnesium carbonate, sodium bicarbonate, and potassium bicarbonate.
8. ~~A method for producing a compound of Formula (XIX),~~



(XIX)

wherein:

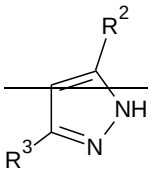
R^2 and R^3 are each independently selected from H, C_{1-6} alkyl, C_{1-6} alkoxy, or halogen;

R^4 is selected from H, C_{1-10} saturated or unsaturated alkyl, C_{1-10} substituted or unsubstituted arylalkyl, C_{3-10} cycloalkyl, aryl, heteroaryl, C_{1-10} alkyl silyl, C_{1-10} alkyl silyl ethers, substituted or unsubstituted haloalkyl, or C_{1-20} alkyl tricyclic;

n is 1 to 5;

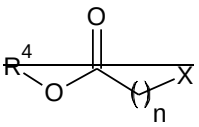
comprising

condensing a compound of Formula (XXI),



(XXI)

wherein R^2 and R^3 are as defined above; with a compound of Formula (VII),



(VII)

wherein R^4 and n are as defined above, and X is a leaving group; to obtain the compound of Formula (XIX).

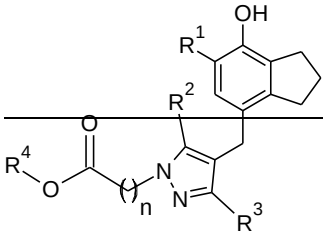
9. The method according to claim 8, wherein the substituents R^2 and R^3 are methyl; R^4 is H or C_{1-6} alkyl; n is 2; and X is Cl or Br.

10. The method according to claim 8, wherein the condensation of a compound of Formula (XXI) with a compound of Formula (VII) is carried out in the presence of a base selected from lithium hydroxide, sodium hydroxide, potassium hydroxide, magnesium hydroxide, sodium carbonate, potassium carbonate, cesium carbonate, magnesium carbonate, sodium bicarbonate, and potassium bicarbonate.

~~11. The method according to claim 8, wherein the condensation reaction is carried out in the presence of a solvent selected from *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, dimethylsulphoxide, acetonitrile, and *N*-methylpyrrolidone.~~

~~12. The method according to claim 8, wherein the condensation reaction is carried out in the presence of phase-transfer catalyst selected from quaternary ammonium salts, phosphonium salts, crown ethers, polyethylene glycols and combinations thereof.~~

~~13. A method for producing substituted pyrazole compound of Formula (I):~~



~~(I)~~

~~wherein:~~

~~R^1, R^2 and R^3 are each independently selected from H, C_{1-6} alkyl, C_{1-6} alkoxy, or halogen;~~

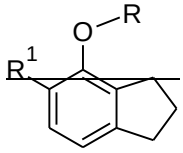
~~R^4 is selected from H, C_{1-10} saturated or unsaturated alkyl, C_{1-10} substituted or unsubstituted arylalkyl, C_{3-10} cycloalkyl, aryl, heteroaryl, C_{1-10} alkyl silyl, C_{1-10} alkyl silyl ethers, substituted or unsubstituted haloalkyl, or C_{1-20} alkyl tricyclic;~~

~~n is 1 to 5;~~

~~or its pharmaceutically acceptable salts, solvates, co-crystals, and hydrates thereof;~~

~~comprising~~

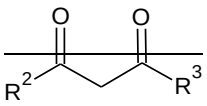
~~condensing a compound of Formula (XX),~~



~~(XX)~~

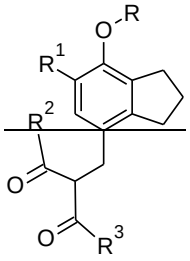
~~wherein R is H or Pg^1,~~

~~wherein Pg^1 is hydroxy protecting group, and R^1 is as defined above; with a compound of Formula (XXII),~~



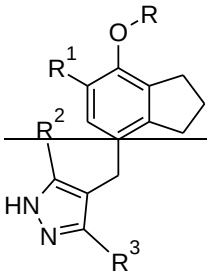
(XXII)

wherein R^2 and R^3 are as defined above; in the presence of a condensing agent to obtain a compound of Formula (VIb),



(VIb)

wherein R, R^1, R^2, and R^3 are as defined above; cyclizing the compound of Formula (VIb) with hydrazine to yield a compound of Formula (VIc),



(VIc)

wherein R, R^1, R^2, and R^3 are as defined above; and converting the compound of Formula (VIc) to substituted pyrazole compound of Formula (I).

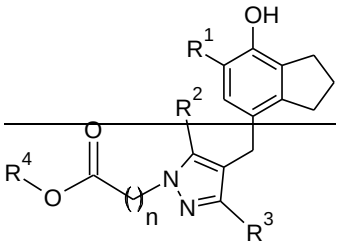
14. The method according to claim 13, wherein the substituents R^1, R^2, and R^3 are methyl; R^4 is H or C_{1-6} alkyl; n is 2; and Pg^1 is methyl or benzyl.

15. The method according to claim 13, wherein the condensing agent is selected from the group comprising formaldehyde, paraformaldehyde, 1,3,5-trioxane, or mixtures thereof.

16. The method according to claim 13, wherein the condensation of a compound of Formula (XX) with a compound of Formula (XXII) is carried out optionally in the presence of acid catalyst selected from hydrochloric acid, sulphuric acid, p-toluenesulfonic acid, zinc chloride, or tin(II) chloride.

17. The method according to claim 13, wherein the condensation reaction is carried out in the presence of a solvent selected from acetic acid, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, dimethylsulphoxide, acetonitrile, *N*-methylpyrrolidone, cyclohexane, toluene, xylene or benzene.

18. A method for producing substituted pyrazole compound of Formula (I):



(I)

wherein:

R^1, R^2 and R^3 are each independently selected from H, C_{1-6} alkyl, C_{1-6} alkoxy, or halogen;

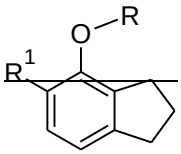
R^4 is selected from H, C_{1-10} saturated or unsaturated alkyl, C_{1-10} substituted or unsubstituted arylalkyl, C_{3-10} cycloalkyl, aryl, heteroaryl, C_{1-10} alkyl silyl, C_{1-10} alkyl silyl ethers, substituted or unsubstituted haloalkyl, or C_{1-20} alkyl tricyclic;

n is 1 to 5;

or its pharmaceutically acceptable salts, solvates, co-crystals, and hydrates thereof;

comprising

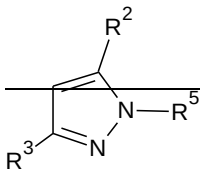
condensing a compound of Formula (XX),



(XX)

wherein R is H or Pg^1;

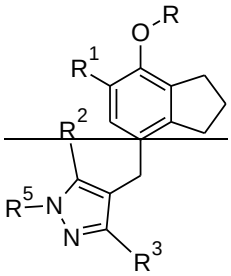
wherein Pg^1 is hydroxy protecting group, and R^1 is as defined above; with a compound of Formula (XXIII),



(XXIII)

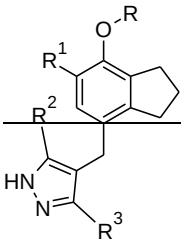
wherein R^1, and R^3 are as defined above and R^5 is H or Pg^3;

wherein Pg^3 is amino protecting group; in the presence of a condensing agent to obtain a compound of Formula (XXIV),



(XXIV)

wherein R, R^1, R^2, R^3, and R^5 are as defined above; optionally deprotecting the compound of Formula (XXIV) to yield a compound of Formula (VIc),



(VIc)

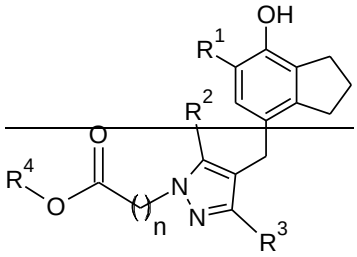
wherein R, R^1, R^2, and R^3 are as defined above; and converting the compound of Formula (VIc) to substituted pyrazole compound of Formula (I).

19. The method according to claim 18, wherein the substituents R^1, R^2, and R^3 are methyl; R^4 is H or C_{1-6} alkyl; n is 2.
20. The method according to claim 18, wherein the condensing agent is selected from the group comprising formaldehyde, paraformaldehyde, 1,3,5-trioxane, or mixtures thereof.
21. The method according to claim 18, wherein the condensation of a compound of Formula (XX) with a compound of Formula (XXIII) is carried out optionally in

the presence of acid catalyst selected from hydrochloric acid, sulphuric acid, p-toluenesulfonic acid, zinc chloride, or tin(II) chloride.

22. The method according to claim 18, wherein the condensation reaction is carried out in the presence of a solvent selected from acetic acid, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, dimethylsulphoxide, acetonitrile, *N*-methylpyrrolidone, cyclohexane, toluene, xylene or benzene.

23. A method for producing substituted pyrazole compound of Formula (I):



(I)

wherein:

R^1, R^2 and R^3 are each independently selected from H, C_{1-6} alkyl, C_{1-6} alkoxy, or halogen;

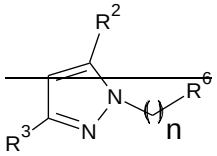
R^4 is selected from H, C_{1-10} saturated or unsaturated alkyl, C_{1-10} substituted or unsubstituted arylalkyl, C_{1-10} alkyl silyl, C_{1-10} alkyl silyl ethers, substituted or unsubstituted haloalkyl, or C_{1-20} alkyl tricyclic;

n is 1 to 5;

or its pharmaceutically acceptable salts, solvates, co-crystals, and hydrates thereof;

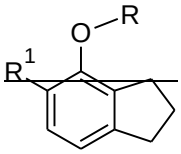
comprising

condensing a compound of Formula (XXV),



(XXV)

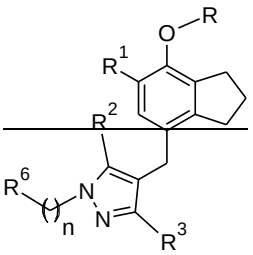
wherein R^2, R^3 and n are as defined above, and R^6 is selected from mono or di-carboxylic acid, acid chloride, ester, nitrile, aldehyde, alcohol, amide, alkyl, alkenyl, alkynyl, alkyl halide, or keto group; with a compound of Formula (XX),



~~(XX)~~

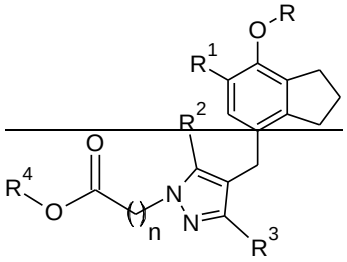
~~wherein R is H or Pg^1,~~

~~wherein Pg^1 is hydroxy protecting group, and R^1 is as defined above; in the presence of a condensing agent to obtain a compound of Formula (XVIIIa),~~



~~(XVIIIa)~~

~~wherein R, R^1, R^2, R^3, R^4, R^6 and n are as defined above; optionally converting the compound of Formula (XVIIIa) to a compound of Formula (VIIIa),~~



~~(VIIIa)~~

~~wherein R, R^1, R^2, R^3, R^4, and n are as defined above; and optionally deprotecting and/or hydrolysing the compound of Formula (VIIIa) to yield substituted pyrazole compound of Formula (I).~~

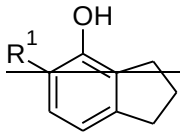
~~24. The method according to claim 23, wherein the substituents R^1, R^2, and R^3 are methyl; R^4 is H or C_{1-6} alkyl; n is 2; and Pg^1 is methyl or benzyl.~~

~~25. The method according to claim 23, wherein the condensing agent is selected from the group comprising formaldehyde, paraformaldehyde, 1,3,5-trioxane, or mixtures thereof.~~

26. The method according to claim 23, wherein the condensation of a compound of Formula (XXV) with a compound of Formula (XX) is carried out optionally in the presence of acid catalyst selected from hydrochloric acid, sulphuric acid, p-toluenesulfonic acid, zinc chloride, or tin(II) chloride.

27. The method according to claim 23, wherein the condensation reaction is carried out in the presence of a solvent selected from acetic acid, *N*,*N*-dimethylformamide, *N*,*N*-dimethylacetamide, dimethylsulphoxide, acetonitrile, *N*-methylpyrrolidone, cyclohexane, toluene, xylene or benzene.

28. A method for producing a compound of Formula (IX),

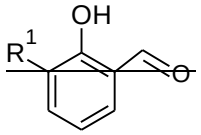


(IX)

wherein R^1 is selected from H, C_{1-6} alkyl, C_{1-6} alkoxy, and halogen;

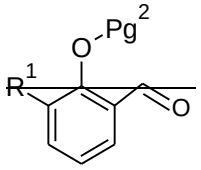
comprising

protecting a compound of Formula (XIII),



(XIII)

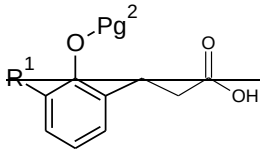
wherein R^1 is as defined above; with a suitable protecting group to obtain a compound of Formula (XIV),



(XIV)

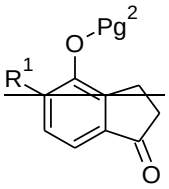
wherein R^1 as defined above and Pg^2 is hydroxy protecting group selected from tosyl or benzoyl;

reacting a compound of Formula (XIV) with 2,2-dimethyl-1,3-dioxane-4,6-dione to obtain a compound of Formula (XV),



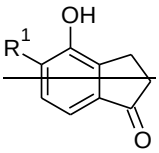
~~(XV)~~

~~wherein R^1 and Pg^2 are as defined above; cyclizing the compound of Formula (XV) to obtain a compound of Formula (XVI),~~



~~(XVI)~~

~~wherein R^1 and Pg^2 are as defined above; deprotecting the compound of Formula (XVI) to obtain a compound of Formula (XVII),~~

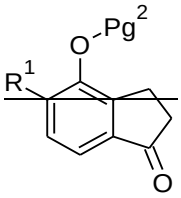


~~(XVII)~~

~~wherein R^1 are as defined above; and reducing the compound of Formula (XVII) to yield a compound of Formula (IX).~~

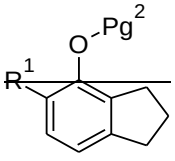
~~[OR]~~

~~reducing the compound of Formula (XVI),~~



~~(XVI)~~

~~wherein R^1 are as defined above; to obtain a compound of Formula (XVIa),~~



(XVIa)

wherein R^1 and Pg^2 are as defined above; and deprotecting the compound of Formula (XVIa) to obtain a compound of Formula (IX).

29. The method according to claim 28, wherein the substituent R^1 is methyl.

30. The method according to claim 28, wherein the protection of a compound of Formula (XIII) is carried out in the presence of a base selected from lithium hydroxide, sodium hydroxide, potassium hydroxide, magnesium hydroxide, sodium carbonate, potassium carbonate, cesium carbonate, magnesium carbonate, sodium bicarbonate and potassium bicarbonate.

31. The method according to claim 28, wherein the reaction of a compound of Formula (XIV) with 2,2-dimethyl-1,3-dioxane-4,6-dione is carried out in the presence of a base selected from pyridine, trimethylamine, triethylamine, diethylamine, diisopropylethylamine, imidazoles, triethanolamine, morpholine, and *N*-methyl morpholine.

32. The method according to claim 28, wherein the cyclization of compound of Formula (XV) is carried out in the presence of thionyl chloride.

33. The method according to claim 28, wherein the cyclization of compound of Formula (XV) is carried out in the presence of Lewis acid selected from zinc chloride, zinc iodide, aluminium chloride, aluminium bromide, and boron trifluoride etherate.

34. The method according to claim 28, wherein the deprotection of compound of Formula (XVI) or (XVIa) is carried out in the presence of a base selected from lithium hydroxide, sodium hydroxide, potassium hydroxide, magnesium hydroxide, sodium carbonate, potassium carbonate, cesium carbonate, magnesium carbonate, sodium bicarbonate, and potassium bicarbonate.

35. The method according to claim 28, wherein the reduction of compound of Formula (XVI) or (XVII) is carried out in the presence of a reducing agent selected from sodium borohydride, sodium triacetoxyborohydride, lithium borohydride, diisobutylaluminium hydride, lithium aluminium hydride, triethylsilane, and palladium on carbon.