In embodiment 5, the present disclosure provides processes of any of embodiment 1 to 4 wherein the ketoreductase step is performed in an aqueous medium in the presence of organic cosolvent at a temperature between 1 and 50 ^{0}C.

In embodiment 6, the present disclosure provides processes of embodiment 5 wherein the ketoreductase step produces a homogeneous suspension.

In embodiment 7, the present disclosure provides processes of aspect 1 wherein the silyl chloride is *tert*-butyldimethylsilyl chloride, the sulfonyl chloride is methanesulfonyl chloride, the bases in step (d) are DMAP and TEA and the non-polar aprotic solvent is DCM and in step (e) the organic solvent is dioxane.

In embodiment 8, the present disclosure provides processes of aspect 1 wherein $(\mathbf{R}^a)_3Si$ is *tert*-butyldimethylsilyl, $\mathbf{R}^b$ is methyl, and in step (e) the strong base is potassium hexamethyldisilazane and the organic solvent is diglyme.

In embodiment 9, the present disclosure provides processes of aspect 1 wherein in step (a) the metallating agent is *i*-PrMgCl and LiCl and the solvent is THF, in step (c) the ketoreductase is KRED-NADH-112 and step (c) further comprises the cofactor NAD and the cofactor recycling agent glucose dehydrogenase, in step (d) $(\mathbf{R}^a)_3Si$ is *tert*-butyldimethylsilyl, $\mathbf{R}^b$ is methyl, the bases are DMAP and TEA and the non-polar aprotic solvent is DCM, and in step (e) the strong base is potassium hexamethyldisilazane and the organic solvent is diglyme.

In embodiment 10, the present disclosure provides processes of aspect 1 wherein in step (a) the metallating agent is *i*-PrMgCl and LiCl and the solvent is THF, in step (c) the ketoreductase is KRED-NADH-112 and step (c) further comprises the cofactor NAD and the cofactor recycling agent is glucose dehydrogenase, in step (d) $(\mathbf{R}^a)_3Si$ is *tert*-butyldimethylsilyl, $\mathbf{R}^b$ is methyl, the bases are DMAP and TEA and the non-polar aprotic solvent is DCM, in step (e) the strong base is potassium hexamethyldisilazane and the organic solvent is diglyme, and in step (g) the strong base is potassium hexamethyldisilazane and the aprotic solvent is THF.

In embodiment 11, the present disclosure provides processes of aspect 1 wherein in step (a) the metallating agent is *i*-PrMgCl and LiCl and the solvent is THF, in step (c) the ketoreductase is KRED-NADH-112 and step (c) further comprises the cofactor NAD and cofactor recycling agent is glucose dehydrogenase, in step (d) $(\mathbf{R}^a)_3Si$ is *tert*-butyldimethylsilyl, $\mathbf{R}^b$ is methyl, the bases are DMAP and TEA and the non-polar aprotic solvent is DCM, in step (e) the strong base is potassium hexamethyldisilazane and the organic solvent is diglyme, in step (g) the strong base is potassium hexamethyldisilazane and the aprotic solvent is THF, and in step (h) the desilylating agent is methanolic HCl.

In aspect 13, the present invention provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having a DSC pattern substantially as shown in Figure 2.

In aspect 14, the present invention provides pharmaceutical compositions comprising crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate in accordance with any one of aspects 5 to 13 and a pharmaceutically acceptable excipient.

In embodiment 15, the present disclosure provides the compound (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid.

In embodiment 16, the present disclosure provides pharmaceutical compositions comprising (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid and a pharmaceutically acceptable excipient.

In embodiment 17, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid.

In embodiment 18, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form A.

In embodiment 19, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form A having an X-ray powder diffraction pattern comprising peaks at. 5.76 ± 0.2, 13.44 ± 0.2, 15.64± 0.2, 19.40± 0.2 2Θ.

In embodiment 20, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form A having an X-ray powder diffraction pattern substantially as shown in Figure 12.

In embodiment 21, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form A having a DSC pattern substantially as shown in Figure 13.

In embodiment 22, the present disclosure provides pharmaceutical compositions comprising crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form A in accordance with any one of embodiments 17 to 21 and a pharmaceutically acceptable excipient.

In embodiment 23, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form B.

In embodiment 24, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form B. having an X-ray powder diffraction pattern comprising peaks at 7.02 ± 0.2, 16.30 ± 0.2, 17.30 ± 0.2, 21.86 ± 0.2 2Θ.

In embodiment 25, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form B having an X-ray powder diffraction pattern substantially as shown in Figure 15.

In embodiment 26, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form B having a DSC pattern substantially as shown in Figure 16.

In embodiment 27, the present disclosure provides pharmaceutical compositions comprising crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one *p*-toluenesulfonic acid Form B in accordance with any one of embodiments 23 to 26 and a pharmaceutically acceptable excipient.

In embodiment 28, the present disclosure provides the compound (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid.

In embodiment 29, the present disclosure provides pharmaceutical compositions comprising (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid and a pharmaceutically acceptable excipient.

In embodiment 30, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid.

In embodiment 31, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form I.

In embodiment 32, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form I having an X-ray powder diffraction pattern comprising peaks at 12.50 ± 0.2, 13.86 ± 0.2 2Θ.

In embodiment 33, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form I having an X-ray powder diffraction pattern substantially as shown in Figure 6.

In embodiment 34, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form I having a DSC pattern substantially as shown in Figure 7.

In embodiment 35, the present disclosure provide pharmaceutical compositions comprising crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form I in accordance with any one of embodiments 30 to 34 and a pharmaceutically acceptable excipient.

In embodiment 36, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form II.

In embodiment 37, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form II having an X-ray powder diffraction pattern comprising peaks at 12.80 ± 0.2, 22.42 ± 0.2, 24.92 ± 0.2 2Θ.

In embodiment 38, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form II having an X-ray powder diffraction pattern substantially as shown in Figure 8.

In embodiment 39, the present disclosure provides crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form II having a DSC pattern substantially as shown in Figure 9.

In embodiment 40, the present disclosure provides pharmaceutical compositions comprising crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one naphthalenedisulfonic acid Form II in accordance with any one of embodiments 36 to 39 and a pharmaceutically acceptable excipient.

In embodiment 41, the present disclosure provides amorphous (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate.

In embodiment 42, the present disclosure provides amorphous (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having an X-ray powder diffraction pattern substantially as shown in Figure 21.

In embodiment 43, the present disclosure provides amorphous (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having a DSC pattern substantially as shown in Figure 22.

In embodiment 44, the present disclosure provides pharmaceutical compositions comprising amorphous (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate in accordance with any one of embodiments 41 to 43 and a pharmaceutically acceptable excipient.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows the XRPD pattern of VIII crystalline besylate form A.

Figure 2 shows the DSC and TGA analysis of VIII crystalline besylate form A.

Figure 3 shows the single crystal structure analysis of VIII crystalline besylate form A.

Figure 4 shows the XRPD pattern of VIII free base.

Figure 5 shows the DSC analysis of VIII free base.

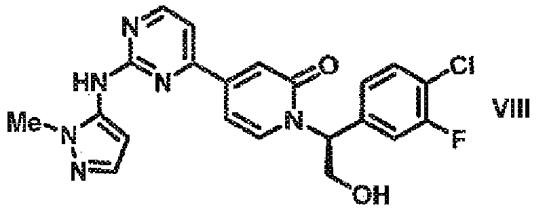
Figure 6 shows the XRPD pattern of VIII naphthalenedisulfonic acid form I.

Figure 7 shows the DSC analysis of VIII naphthalenedisulfonic acid form I.

CLAIMS

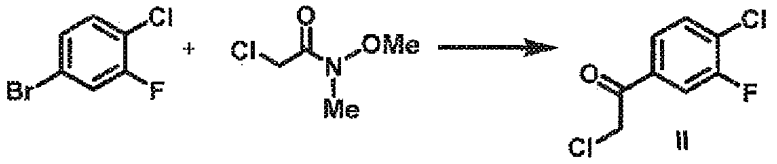
What is claimed is:

1. A process for the preparation of a compound of formula **VIII**, the process comprising the steps of:



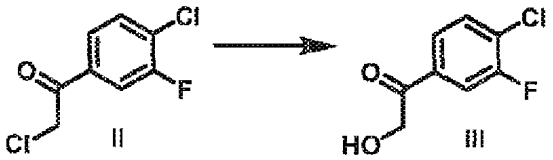
VIII

(*a*) contacting 4-bromo-1-chloro-2-fluorobenzene with a metallating agent in an aprotic organic solvent to afford an organomagnesium compound, which is reacted with 2-chloro-N-methoxy-N-methylacetamide to afford 2-chloro-1-(4-chloro-3-fluorophenyl)ethanone (**II**);



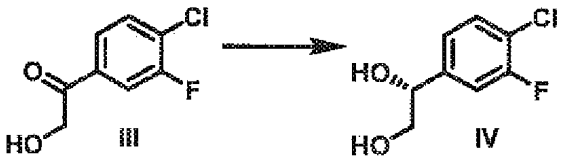
II

(*b*) contacting **II** with sodium formate and formic acid in aqueous ethanol to afford 1-(4-chloro-3-fluorophenyl)-2-hydroxyethanone (**III**)



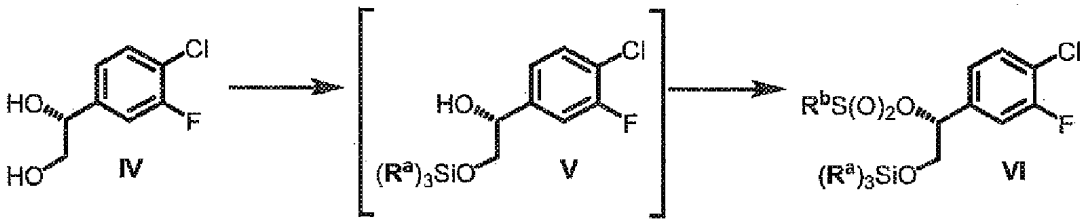
II **III**

(*c*) contacting **III** with a ketoreductase to afford (*R*)-1-(4-chloro-3-fluorophenyl)ethane-1,2-diol (**IV**);

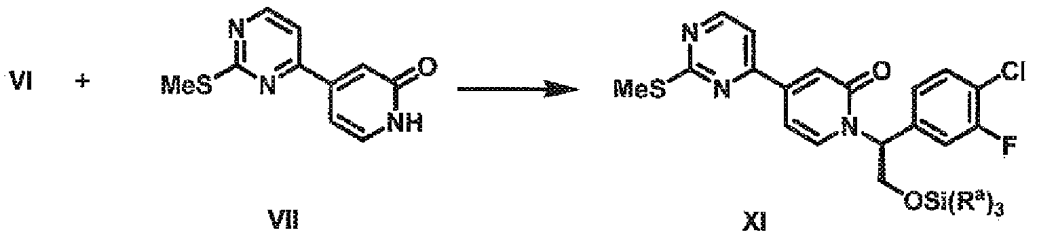


III **IV**

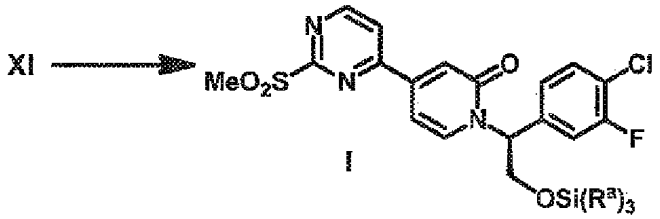
(*d*) contacting **IV** with a silyl chloride $(R^a)_3SiCl$ and at least one base in a non-polar aprotic solvent to afford (**V**), and subsequently adding sulfonylchloride $R^bS(O)_2Cl$ to afford **VI**, wherein R^a is independently in each occurrence C_{1-6} alkyl or phenyl and R^b is selected from C_{1-4} alkyl or phenyl, optionally substituted with 1 to 3 groups independently selected from C_{1-3} alkyl, halogen, nitro, cyano, or C_{1-3} alkoxy;



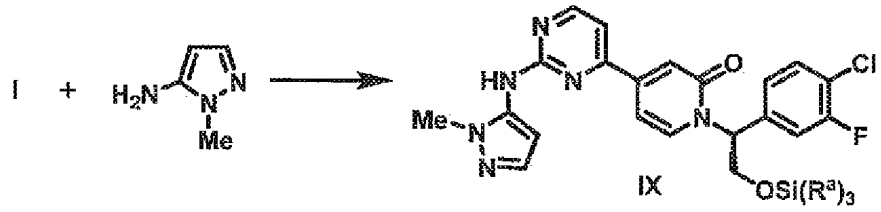
(*e*) contacting 4-(2-(methylsulfonyl)pyrimidin-4-yl)pyridin-2(1H)-one (**VII**) with a strong base in an organic solvent and subsequently adding **VI** to afford **XI**;



(*f*) treating **XI** with an oxidizing agent to afford **I**;



(*g*) treating 1-methyl-1H-pyrazol-5-amine with a strong base in an aprotic solvent at reduced temperature and adding the compound of formula **I** to afford **IX**; and,



(*h*) contacting **IX** with a de-silylating agent to afford **VIII**.

2. The process according to claim 1 wherein the ketoreductase in step (c) affords an enantiomeric excess at least about 98%.

3. The process of claim 2 wherein the ketoreductase in step (c) is KRED-NADH-112.

4. The process of claim 2 wherein step (c) further comprises NADH or NADPH as a cofactor.

5. The process of claim 4 wherein the cofactor is regenerated with a cosubstrate selected from a secondary alcohol or from an additional enzyme selected from alcohol dehydrogenase, glucose dehydrogenase, formatted dehydrogenase, glucose-6-phosphate dehydrogenase, phosphite dehydrogenase or hydrogenase.

6. The process of any of claims 2 to 5 wherein the ketoreductase step is performed in an aqueous medium in the presence of organic cosolvent at a temperature between 1 and 50 ^{0}C.

7. The process of claim 6 wherein the ketoreductase step produces a homogeneous suspension.

8. The process of claim 1 wherein the silyl chloride is *tert*-butyldimethylsilyl chloride, the sulfonyl chloride is methanesulfonyl chloride, the bases in step (d) are DMAP and TEA and the non-polar aprotic solvent is DCM and in step (e) the organic solvent is dioxane.

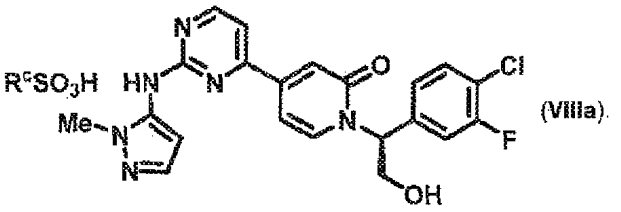
9. The process of claim 1 wherein $(R^a)_3Si$ is *tert*-butyldimethylsilyl, R^b is methyl, and in step (e) the strong base is potassium hexamethyldisilazane and the organic solvent is diglyme.

10. The process of claim 1 wherein in step (a) the metallating agent is *i*-PrMgCl and LiCl and the solvent is THF, in step (c) the ketoreductase is KRED-NADH-112 and step (c) further comprises the cofactor NAD and the cofactor recycling agent glucose dehydrogenase, in step (d) $(R^a)_3Si$ is *tert*-butyldimethylsilyl, R^b is methyl, the bases are DMAP and TEA and the non-polar aprotic solvent is DCM, and in step (e) the strong base is potassium hexamethyldisilazane and the organic solvent is diglyme.

11. The process of claim 1 wherein in step (a) the metallating agent is *i*-PrMgCl and LiCl and the solvent is THF, in step (c) the ketoreductase is KRED-NADH-112 and step (c) further comprises the cofactor NAD and the cofactor recycling agent is glucose dehydrogenase, in step (d) $(R^a)_3Si$ is *tert*-butyldimethylsilyl, R^b is methyl, the bases are DMAP and TEA and the non-polar aprotic solvent is DCM, in step (e) the strong base is potassium hexamethyldisilazane and the organic solvent is diglyme, and in step (g) the strong base is potassium hexamethyldisilazane and the aprotic solvent is THF.

12. The process of claim 1 wherein in step (a) the metallating agent is *i*-PrMgCl and LiCl and the solvent is THF, in step (c) the ketoreductase is KRED-NADH-112 and step (c) further comprises the cofactor NAD and cofactor recycling agent is glucose dehydrogenase, in step (d) $(R^a)_3Si$ is *tert*-butyldimethylsilyl, R^b is methyl, the bases are DMAP and TEA and the non-polar aprotic solvent is DCM, in step (e) the strong base is potassium hexamethyldisilazane and the organic solvent is diglyme, in step (g) the strong base is potassium hexamethyldisilazane and the aprotic solvent is THF, and in step (h) the desilylating agent is methanolic HCl.

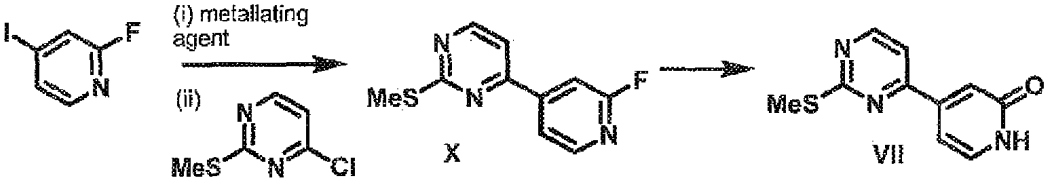
13. The process according to claim 1 wherein the compound **VIII** from step h is contacted with a sulfonicacid in an organic solvent and water to afford a salt of **VIIIa** where R^c is an aryl sulfonic acid



(VIIIa)

14. A process according to claim 13 wherein R^cSO_3H is benzenesulfonic acid and the solvent is methyl ethyl ketone and water to afford the besylate salt **VIIIb**.

15. A process for the preparation of 4-(2-(methylsulfonyl)pyrimidin-4-yl)pyridin-2(1H)-one (**VII**) comprising the steps of:



(*a*) contacting 2-fluoro-4-iodopyridine with a metallating agent in an aprotic organic solvent to afford an organomagnesium compound, which is reacted with 4-chloro-2(methylthio)pyrimidine in the presence of a palladium catalyst to afford 4-(2-fluoropyridin-4-yl)-2-(methylthio)pyrimidine (**X**);

(b) treating **X** with potassium *tert*-butoxide in THF and subsequently with an aqueous acid to afford 4-(2-(methylsulfonyl)pyrimidin-4-yl)pyridin-2(1H)-one (**VII**).

16. The process according to claim 15 wherein the palladium catalyst is (1,3-diisopropylimidazol-2-ylidene)(3-chloropyridyl)palladium(II) dichloride, the metallating agent is *i*-PrMgCl and LiCl, and the aprotic solvent is THF.

17. The compound (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate.

18. A pharmaceutical composition comprising (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate and a pharmaceutically acceptable excipient.

19. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate.

20. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having an X-ray powder diffraction pattern comprising peaks at 6.16 ± 0.2, 7.46 ± 0.2, 16.36 ± 0.2, 25.76 ± 0.2 and 25.98 ± 0.2 2Θ.

21. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having an X-ray powder diffraction pattern substantially as shown in Figure 1.

22. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having an ^{13}C NMR pattern substantially as shown in Figure 19.

23. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having an ^{19}F NMR pattern substantially as shown in Figure 20.

24. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having an ^{13}C NMR pattern substantially as shown in Figure 19 and a ^{19}F NMR pattern substantially as shown in Figure 20.

25. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having an ^{19}F NMR pattern comprising peaks at -111.1 ± 0.4 ppm and -115.4 ± 0.4 ppm relative to $CFCl_3$ (at 293 K).

26. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having an ^{13}C NMR pattern comprising peaks at 157.7 ± 0.2 ppm, 129.6 ± 0.2 ppm, 125.8 ± 0.2 ppm, and 117.0 ± 0.2 ppm relative to tetramethylsilane (at 293 K).

27. Crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate having a DSC pattern substantially as shown in Figure 2.

28. A pharmaceutical composition comprising crystalline (S)-1-(1-(4-chloro-3-fluorophenyl)-2-hydroxyethyl)-4-(2-((1-methyl-1H-pyrazol-5-yl)amino)pyrimidin-4-yl)pyridin-2(1H)-one benzenesulfonate in accordance with any one of claims 19 to 27 and a pharmaceutically acceptable excipient.