

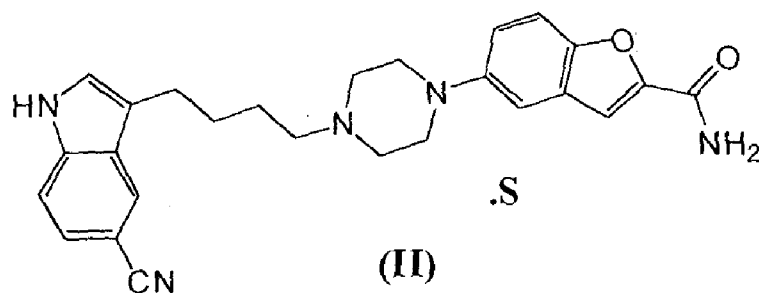
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(54) Title: NOVEL SALTS OF VILAZODONE



(57) Abstract: Novel salts of vilazodone of Formula (II) and process for its preparation are disclosed wherein in S represent the acid selected from the group consisting of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid fumaric acid.

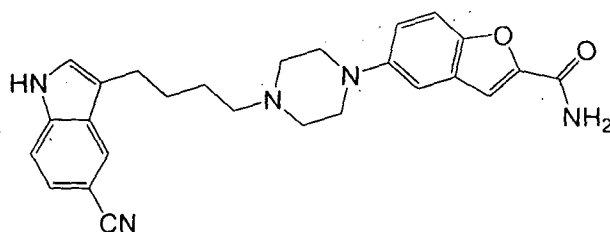
NOVEL SALTS OF VILAZODONE

FIELD OF INVENTION

The invention relates to vilazodone and its pharmaceutically acceptable salts. The invention also relates to improved processes for the preparation of vilazodone and its pharmaceutically acceptable salts. The invention also relates to pharmaceutical compositions that includes the therapeutically effective amount of pharmaceutically acceptable salts of vilazodone.

BACKGROUND OF THE INVENTION

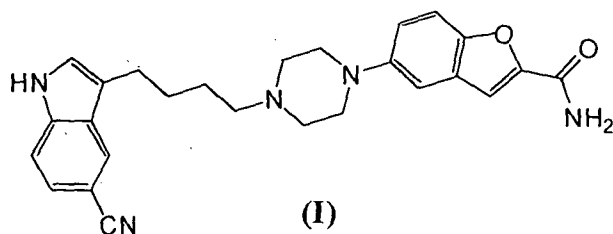
Vilazodone is chemically known as 1-[4-(5-cyanoindol-3-yl)butyl]-4-(2-carbamoyl-benzo furan-5-yl)-piperazine and represented by compound of formula (I)



Vilazodone is known with the trade name of Viibryd in United States. It is a serotonergic antidepressant for the treatment of major depressive disorder.

Vilazodone acts as a serotonin reuptake inhibitor receptor partial agonist. It has negligible affinity for other serotonin receptors.

U.S. patent No. 5,532,241 discloses 5-(4-[4-(5-cyano-1H-indol-3-yl)butyl]piperazin-1-yl) benzofuran -2-carboxamide i.e. vilazodone of formula (I)



or its pharmaceutically acceptable salt. Patent provides process for preparing vilazodone or its pharmaceutically acceptable salt thereof.

U.S. Patent No. 5,977,112 relates to process for preparing intermediate involved in the preparation of vilazodone or its pharmaceutically acceptable salt thereof.

U.S. Patent No. 6,509,475 B1 relates to process for preparing intermediate involved in the preparation of vilazodone or its pharmaceutically acceptable salt thereof.

U.S. Patent No. 7,834,020 B2 claims vilazodone hydrochloride anhydrate in crystalline modification IV (Form IV) characterized by XRD. Patent discloses total 15 crystalline forms of vilazodone HCl designated as crystalline Form-I to Form-XI and Form-XIII to Form-XVI.

5 U.S. Patent No. 7,981,894 B2 claims vilazodone hydrochloride monohydrate in crystalline modification V (Form-V) having characteristic peaks in XRD.

Although vilazodone hydrochloride provides good pharmaceutical activity, it would be beneficial to find other forms of salts of vilazodone since, vilazodone salt forms having advantageous properties for pharmaceutical use.

10 SUMMARY OF THE INVENTION

The object of the present invention is to provide pharmaceutically acceptable salts of vilazodone.

Another object of the present invention is to provide processes for preparing pharmaceutically acceptable salts of vilazodone.

15 Yet another object of the present invention is to provide a pharmaceutical composition comprising pharmaceutically acceptable salts of vilazodone.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG.1: X-ray diffraction pattern of vilazodone hydrobromide crystalline form.

FIG.2: X-ray diffraction pattern of vilazodone sulfate crystalline form.

20 **FIG.3:** X-ray diffraction pattern of vilazodone phosphate crystalline form.

FIG.4: X-ray diffraction pattern of vilazodone oxalate crystalline form.

FIG.5: X-ray diffraction pattern of vilazodone tosylate crystalline form.

FIG.6: X-ray diffraction pattern of vilazodone besylate crystalline form.

FIG.7: X-ray diffraction pattern of vilazodone maleate crystalline form.

25 **FIG.8:** X-ray diffraction pattern of vilazodone succinate crystalline form.

FIG.9: X-ray diffraction pattern of vilazodone malate crystalline form.

FIG.10: X-ray diffraction pattern of vilazodone salicylate crystalline form.

FIG.11: X-ray diffraction pattern of vilazodone tartrate crystalline form.

FIG.12: X-ray diffraction pattern of vilazodone fumarate crystalline form.

30 **FIG.13:** X-ray diffraction pattern of vilazodone malonate crystalline form.

FIG.14: X-ray diffraction pattern of vilazodone pivalate crystalline form.

FIG.15: X-ray diffraction pattern of vilazodone mesylate crystalline form.

DETAILED DESCRIPTION OF THE INVENTION

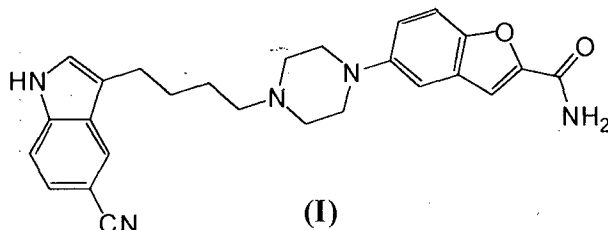
It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention and specific examples provided herein without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention that come
5 within the scope of any claims and their equivalents.

The present inventors have found that by preparing pharmaceutically acceptable salts of vilazodone free base in crystalline form, the formation of impurities can be minimized and better purity and chemical stability can be achieved. The inventors have developed different acid addition salts of vilazodone which exhibit improved
10 physiochemical properties like melting point, solubility, toxicology, and improved stability under various stress conditions.

The term "elevated temperature" used herein means, heating the reaction mixture either heterogeneous or homogeneous at a temperature from about 35°C to boiling point of solvent. In particular, from about 35°C to about 100°C. The term
15 "ambient temperature" used herein means, slurring the reaction mixture either heterogeneous or homogeneous at a temperature from about 0°C to about 35°C of solvent.

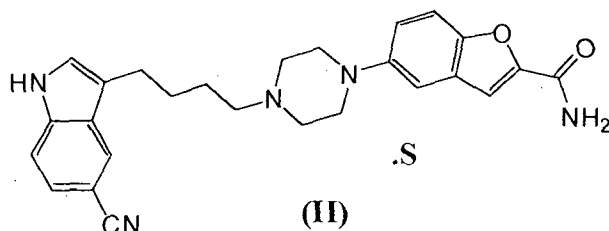
"Suitable solvent" means a single or a combination of two or more solvents.

The present invention relates to vilazodone (I) and its pharmaceutically
20 acceptable salts thereof, to the processes for their preparation and isolation, and to pharmaceutical compositions comprising the same.



The present inventors have prepared certain salt forms of vilazodone and structurally characterized them as described herein. The salts forms are also referred as
25 pharmaceutically acceptable salts of vilazodone. These salts can be hydrobromide, sulfate, phosphate, oxalate, besylate, mesylate, tosylate, maleate, succinate, malate, salicylate, tartrate, fumarate, malonate, pivalate, ascorbate and citrate salts of vilazodone.

In one aspect, the present invention provides pharmaceutically acceptable salts
30 of vilazodone of Formula (II).

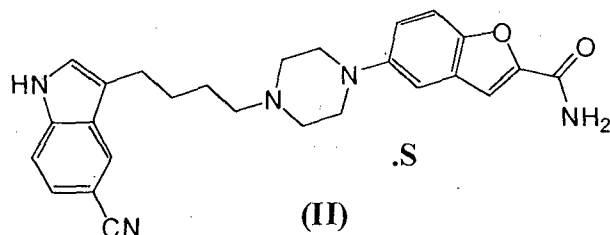


wherein in S represent the acid selected from the group consisting of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid, citric acid; which forms a salt with vilazodone.

The novel pharmaceutically acceptable salts of the invention are expected to provide potential advantages over other reported salts of vilazodone. Without limitations these advantages may include improved purity profile, improved pharmacokinetics properties desirable for modified release, immediate release and injectable dosage forms, ease of pharmaceutical processing, discovery of novel polymorphs, improved stability. In summary, a combination of these improved properties of novel salt of vilazodone is expected to provide improved overall treatment outcomes.

Accordingly in first aspect, the invention relates to new salts of vilazodone, namely vilazodone hydrobromide, vilazodone sulfate, vilazodone phosphate, vilazodone oxalate, vilazodone besylate, vilazodone mesylate, vilazodone tosylate, vilazodone maleate, vilazodone succinate, vilazodone malate, vilazodone salicylate, vilazodone tartrate, vilazodone fumarate, vilazodone malonate, vilazodone pivalate, vilazodone ascorbate, vilazodone citrate or its hydrates. The compound may be isolated and/or purified or it may be part of a composition. The compound may be in solid form including crystalline forms but is not limited thereto. Preferred compounds are in the form of crystalline vilazodone salts or its hydrate.

Another aspect of the present invention relates to the process for preparing novel salt of vilazodone of Formula (II)



wherein in S represent the acid selected from the group consisting of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid, citric acid;

the process comprising the steps of:

i) treating vilazodone free base of Formula (I) with an acid in one or more suitable solvent at a specified temperature;

ii) optionally adding one or more suitable co-solvents;

ii) obtaining salt of vilazodone of Formula (II).

The reaction of acid with vilazodone (I) may be particularly performed in organic solvent or in mixture with water.

The suitable solvents comprise one or more of C₁-C₅ alcohols, ketones, esters, ethers, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the mixture of methanol and methylene dichloride. An co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methylisobutyl ketone, methyl ethyl ketone and the like.

Another aspect of the present invention relates to a pharmaceutical composition comprising therapeutically effective amount of vilazodone salt of Formula (II), a pharmaceutically acceptable excipient. The composition can be an immediate release dosage form or an extended release dosage form and embraces tablets as well as pellets/beads/spheroids or other encapsulated forms.

The compound can be in isolated and/or purified form, but such is not required. The compound includes various physical forms of the salt including dissolved forms, oil or liquid forms, and solid forms including amorphous and crystalline forms.

The vilazodone salts (II) may be isolated, if desired, by precipitation, evaporation, spray drying, or other conventional techniques known in the art.

The novel pharmaceutically acceptable salts of vilazodone are typically in a crystalline form. Crystalline forms include vilazodone salts with inorganic and organic acid such as described above, anhydrides, hydrates, and solvates.

The vilazodone free base can be prepared by known methods in the art e.g. process described in U.S. Patent No. 5,532,241.

In another aspect of the present invention, there is provided a crystalline form of vilazodone hydrobromide.

The crystalline form of vilazodone hydrobromide may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 5.4, 9.4, 10.4, 11.5, 13.0, 13.5, 14.7, 16.0, 18.1, 19.3, 20.9, 21.7, 24.3, 25.1, 27.3, 29.3 and 30.0 degree (2 θ); or Differential scanning calorimetry having two endothermic peaks at about 142°C and 269°C.

The crystalline form of vilazodone hydrobromide may be further characterized by a PXRD pattern substantially as depicted in FIG. 1.

The crystalline form of vilazodone hydrobromide shows water loss of 7.6% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone hydrobromide shows melting point in the range of 205°C to 225°C.

The crystalline form of vilazodone hydrobromide may be characterized by IR spectra having characteristic peaks at about 3458, 3226, 2929, 2700, 2214, 1710, 1672, 1595, 1469, 1224, 1170, 1031, 956, 939, 883, 810, 761, 736, 632, 534 and 501 cm⁻¹.

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone hydrobromide. The process includes suspending vilazodone free base and hydrobromic acid in one or more suitable solvent, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone hydrobromide.

The suitable solvents comprise one or more of C₁-C₅ alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the mixture of methanol and methylene dichloride. An co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methylisobutyl ketone, methyl ethyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone hydrobromide include treating vilazodone free base in mixture of methanol and methylene dichloride with maleic acid solution in acetone at about 25°C to 80°C, for example, at reflux temperature of mixture, followed by cooling to ambient temperature.

The crystalline vilazodone hydrobromide may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

5 In another aspect of the present invention, there is provided vilazodone sulfate. The crystalline form of vilazodone sulfate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 6.7, 10.4, 11.3, 12.2, 14.5, 15.6, 16.1, 16.7, 18.2, 19.7, 20.4, 20.9, 22.9, 23.4, 25.1, 25.6, 26.9 and 28.6 degree (2θ); or Differential scanning calorimetry having endothermic peak at about 244°C.

10 The crystalline form of vilazodone sulfate may be further characterized by a PXRD pattern substantially as depicted in FIG. 2.

The crystalline form of vilazodone sulfate shows water loss of 2.5% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone sulfate shows melting point in the range of
15 234°C to 238°C.

The crystalline form of vilazodone sulfate may be characterized by IR spectra having characteristic peaks at about 3280, 2941, 2216, 1668, 1598, 1469, 1369, 1228, 1122, 1051, 958, 858, 767, 680, 621, 584 and 424 cm^{-1} .

20 In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone sulfate. The process includes suspending vilazodone free base with sulfuric acid in the presence of one or more suitable solvents, removing the solvents, optionally adding one or more suitable anti-solvents, and obtaining the crystalline form of vilazodone sulfate

The suitable solvents comprise one or more of C_1 - C_5 alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and
25 mixtures thereof. In particular, the mixture of methanol and methylene dichloride. An co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones
30 like acetone, methylisobutyl ketone, methyl ethyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone sulfate include treating vilazodone free base in mixture of methanol and methylene dichloride with maleic acid solution in methanol at about 25°C to 80°C, for

example, at reflux temperature of mixture, followed by removal of solvent. The residue may be treated with mixture of methanol and methylene dichloride followed by addition of anti-solvent like n-hexane to obtain crystalline form of vilazodone sulfate.

In another aspect of the present invention, there is provided a crystalline form of vilazodone phosphate.

The crystalline form of vilazodone phosphate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 7.2, 8.1, 10.3, 10.8, 12.7, 14.5, 15.6, 16.3, 16.7, 17.5, 19.2, 20.1, 20.7, 21.6, 22.6, 23.1, 24.5, 25.2, 26.8 and 29.6 degree (2 θ); or Differential scanning calorimetry having four endothermic peaks at about 81°C, 160°C, 215°C and 235°C.

The crystalline form of vilazodone phosphate may be further characterized by a PXRD pattern substantially as depicted in FIG. 3.

The crystalline form of vilazodone phosphate shows water loss of 3.5% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone phosphate shows melting point in the range of 175°C to 185°C.

The crystalline form of vilazodone phosphate may be characterized by IR spectra having characteristic peaks at about 3441, 3304, 2949, 2353, 2216, 1678, 1668, 1647, 1587, 1552, 1467, 1392, 1224, 1130, 958, 943, 883, 813, 765, 734, 630 and 520 cm⁻¹.

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone phosphate. The process includes suspending vilazodone free base with phosphoric acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone phosphate.

The suitable solvents comprise one or more of C₁-C₅ alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the mixture of methanol and methylene dichloride. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methylisobutyl ketone, methyl ethyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone phosphate include treating vilazodone free base in mixture of methanol and methylene dichloride with lysine at about 25°C to 80°C, for example, at reflux temperature of mixture, followed by addition of co-solvent acetone and again refluxing the obtained reaction mixture followed by cooling to ambient temperature to obtain crystalline vilazodone phosphate.

The crystalline vilazodone phosphate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone oxalate.

The crystalline form of vilazodone oxalate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 8.0, 11.0, 13.5, 14.7, 16.6, 17.5, 18.7, 20.3, 21.1, 21.9, 22.6, 24.3, 25.1, 27.4, 28.6 and 30.4 degree (2θ); or Differential scanning calorimetry having endothermic peaks at about 231°C.

The crystalline form of vilazodone oxalate may be further characterized by a PXRD pattern substantially as depicted in FIG. 4.

The crystalline form of vilazodone oxalate shows no water loss in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone oxalate shows melting point in the range of 222°C to 225°C.

The crystalline form of vilazodone oxalate may be characterized by IR spectra having characteristic peaks at about 3439, 3319, 3005, 2954, 2212, 1728, 1678, 1602, 1577, 1471, 1379, 1242, 1207, 1166, 989, 958, 883, 810, 756, 713, 640 and 495 cm^{-1} .

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone oxalate. The process includes suspending vilazodone free base with oxalic acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone oxalate.

The suitable solvents comprise one or more of C_1 - C_5 alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the mixture of methanol and methylene dichloride. A

co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, alcohols like methanol, ethanol, isopropanol, butanol and the like. In Particular, the co-solvent may be isopropanol.

The embodiments of the process for the preparation of crystalline form of vilazodone oxalate include treating vilazodone free base in mixture of methanol and methylene dichloride with oxalic acid dihydrate solution in isopropanol at about 25°C to 80°C, for example, at reflux temperature of mixture, followed by cooling to ambient temperature to obtain crystalline vilazodone oxalate.

The crystalline vilazodone oxalate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone tosylate.

The crystalline form of vilazodone tosylate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 6.3, 8.5, 10.2, 12.1, 12.7, 13.3, 14.9, 15.6, 16.1, 16.9, 17.4, 18.6, 19.4, 19.8, 21.3, 22.4, 22.7, 23.4, 24.9, 25.5, 26.2 and 27.1 degree (2θ); or Differential scanning calorimetry having two endothermic peaks at about 114°C and 227°C.

The crystalline form of vilazodone tosylate may be further characterized by a PXRD pattern substantially as depicted in FIG. 5.

The crystalline form of vilazodone tosylate shows water loss of 0.5% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone tosylate shows melting point in the range of 220°C to 225°C.

The crystalline form of vilazodone tosylate may be characterized by IR spectra having characteristic peaks at about 3265, 3026, 2727, 2218, 1680, 1591, 1469, 1400, 1323, 1213, 1124, 1003, 1010, 956, 883, 812, 736, 684 and 569 cm^{-1} .

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone tosylate. The process includes suspending vilazodone free base with tosylate in the presence of one or more suitable solvents, optionally

adding one or more suitable anti-solvents, removing the solvents and obtaining the crystalline form of vilazodone tosylate.

The suitable solvents comprise one or more of C₁-C₅ alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. An anti-solvent can be optionally added. The suitable anti-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, alcohols like methanol, ethanol, isopropanol, butanol and the like. In Particular, the anti-solvent may be cyclohexane.

The embodiments of the process for the preparation of crystalline form of vilazodone tosylate include treating vilazodone free base in ethanol with p-toluene sulfonic acid at about 25°C to 80°C, for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with cyclohexane followed by cooling to ambient temperature to obtain crystalline vilazodone tosylate.

The crystalline vilazodone tosylate may have particle size distributions, wherein the 10th volume percentile particle size (D₁₀) is less than about 20 µm, the 50th volume percentile particle size (D₅₀) is less than about 50 µm, or the 90th volume percentile particle size (D₉₀) is less than about 250 µm, or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone besylate.

The crystalline form of vilazodone besylate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 5.4, 7.3, 13.0, 13.3, 14.8, 15.4, 15.9, 16.4, 18.2, 19.1, 19.8, 21.6, 21.9, 23.8, 24.3, 24.6, 25.8, 26.2, 27.6, 28.4 and 33.4 degree (2θ); or Differential scanning calorimetry having three endothermic peaks at about 222°C, 240°C and 248°C.

The crystalline form of vilazodone besylate may be further characterized by a PXRD pattern substantially as depicted in FIG. 6.

The crystalline form of vilazodone besylate shows water loss of 0.5% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone besylate shows melting point in the range of 240°C to 246°C.

The crystalline form of vilazodone besylate may be characterized by IR spectra having characteristic peaks at about 3392, 3300, 3028, 2760, 2222, 1678, 1602, 1469,

1444, 1392, 1222, 1159, 1122, 1014, 997, 956, 883, 837, 810, 729, 629, 613 and 565 cm^{-1} .

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone besylate. The process includes suspending vilazodone free base with besylate in the presence of one or more suitable solvents, optionally adding one or more suitable anti-solvents, removing the solvents and obtaining the crystalline form of vilazodone besylate.

The suitable solvents comprise one or more of C_1 - C_5 alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. An anti-solvent can be optionally added. The suitable anti-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, alcohols like methanol, ethanol, isopropanol, butanol and the like. In Particular, the anti-solvent may be cyclohexane.

The embodiments of the process for the preparation of crystalline form of vilazodone besylate include treating vilazodone free base in ethanol with benzene sulfonic acid at about 25°C to 80°C , for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with cyclohexane followed by cooling to ambient temperature to obtain crystalline vilazodone besylate.

The crystalline vilazodone besylate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about $20\ \mu\text{m}$, the 50th volume percentile particle size (D_{50}) is less than about $50\ \mu\text{m}$, or the 90th volume percentile particle size (D_{90}) is less than about $250\ \mu\text{m}$, or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone maleate.

The crystalline form of vilazodone maleate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 8.4, 10.8, 11.5, 12.9, 13.9, 15.1, 16.8, 17.9, 18.4, 19.7, 20.2, 20.9, 21.7, 22.3, 23.2, 23.7, 25.0, 25.9, 27.0, 28.0, 28.5, and 31.1° (2θ); or Differential scanning calorimetry having two endothermic peaks at about 119°C and 189°C .

The crystalline form of vilazodone maleate may be further characterized by a PXRD pattern substantially as depicted in FIG. 7.

The crystalline form of vilazodone maleate shows water loss of 1.2% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone maleate shows melting point in the range of 188°C to 195°C.

5 The crystalline form of vilazodone maleate may be characterized by IR spectra having characteristic peaks at about 3468, 3282, 2945, 2709, 2218, 1680, 1598, 1535, 1502, 1485, 1469, 1382, 1228, 1099, 1028, 958, 939, 875, 810, 734 and 563 cm^{-1} .

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone maleate. The process includes suspending vilazodone
10 free base with maleic acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone maleate.

The suitable solvents comprise one or more of C_1 - C_5 alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and
15 mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent
20 may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone maleate include treating vilazodone free base in mixture of methanol and methylene dichloride with maleic acid at about 25°C to 80°C, for example, at reflux
25 temperature of solvent, followed by removal of solvent, and treating the residue with acetone followed by cooling to ambient temperature to obtain crystalline vilazodone maleate.

The crystalline vilazodone maleate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume
30 percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone succinate.

The crystalline form of vilazodone succinate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 6.2, 8.1, 12.8, 13.6,

14.3, 15.2, 16.1, 16.5, 18.0, 19.0, 19.6, 20.4, 21.1, 21.6, 23.1, 23.5, 24.9, 25.7, 27.4 and 28.7 degree (2 θ); or Differential scanning calorimetry having two endothermic peaks at about 215°C and 221°C.

The crystalline form of vilazodone succinate may be further characterized by a
5 PXRD pattern substantially as depicted in FIG. 8.

The crystalline form of vilazodone succinate shows water loss of 0.5% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone succinate shows melting point in the range of 210°C to 220°C.

10 The crystalline form of vilazodone succinate may be characterized by IR spectra having characteristic peaks at about 3321, 2943, 2353, 2212, 1678, 1585, 1552, 1467, 1388, 1220, 1168, 1101, 962, 941, 885, 810, 680, 651 and 501 cm⁻¹.

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone succinate. The process includes suspending
15 vilazodone free base with succinic acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone succinate.

The suitable solvents comprise one or more of C₁-C₅ alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and
20 mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent
25 may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone succinate include treating vilazodone free base in mixture of methanol and methylene dichloride with succinic acid at about 25°C to 80°C, for example, at reflux
30 temperature of solvent, followed by removal of solvent, and treating the residue with acetone followed by cooling to ambient temperature to obtain crystalline vilazodone succinate.

The crystalline vilazodone succinate may have particle size distributions, wherein the 10th volume percentile particle size (D₁₀) is less than about 20 μ m, the 50th

volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone malate.

The crystalline form of vilazodone malate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 8.2, 10.5, 12.7, 14.3, 15.1, 15.5, 16.6, 19.3, 19.8, 20.3, 21.1, 22.3, 23.0, 23.6, 25.1, 25.7, 28.2, 28.7 and 31.1 degree (2θ); or Differential scanning calorimetry having four endothermic peaks at about 84°C, 190°C, 201°C and 233°C.

The crystalline form of vilazodone malate may be further characterized by a PXRD pattern substantially as depicted in FIG. 9.

The crystalline form of vilazodone malate shows water loss of 2.9% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone malate shows melting point in the range of 192°C to 202°C.

The crystalline form of vilazodone malate may be characterized by IR spectra having characteristic peaks at about 3441, 2854, 2603, 2492, 2214, 1728, 1672, 1600, 1469, 1396, 1367, 1325, 1274, 1222, 1184, 1087, 958, 889, 815, 734, 636, 534 and 422 cm^{-1} .

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone malate. The process includes suspending vilazodone free base with malic acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone malate.

The suitable solvents comprise one or more of C_1 - C_5 alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone malate include treating vilazodone free base in mixture of methanol and methylene dichloride with succinic acid at about 25°C to 80°C, for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with acetone followed by cooling to ambient temperature to obtain crystalline vilazodone succinate.

The crystalline vilazodone malate may have particle size distributions, wherein the 10th volume percentile particle size (D₁₀) is less than about 20 µm, the 50th volume percentile particle size (D₅₀) is less than about 50 µm, or the 90th volume percentile particle size (D₉₀) is less than about 250 µm, or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone salicylate.

The crystalline form of vilazodone salicylate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 6.8, 8.0, 10.6, 12.0, 13.7, 14.8, 15.8, 16.6, 17.4, 18.0, 19.9, 21.3, 22.1, 25.5 and 27.6 degree (2θ); or Differential scanning calorimetry having three endothermic peaks at about 136°C, 189°C and 209°C.

The crystalline form of vilazodone salicylate may be further characterized by a PXRD pattern substantially as depicted in FIG. 10.

The crystalline form of vilazodone salicylate shows water loss of 4.2% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone salicylate shows melting point in the range of 155°C to 160°C.

The crystalline form of vilazodone salicylate may be characterized by IR spectra having characteristic peaks at about 3298, 3130, 2852, 2212, 1668, 1591, 1487, 1384, 1296, 1222, 1168, 1029, 956, 883, 862, 806, 765, 686, 667, 630 and 501 cm⁻¹.

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone salicylate. The process includes suspending vilazodone free base with salicylic acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone salicylate.

The suitable solvents comprise one or more of C₁-C₅ alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be

optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent
5 may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone salicylate include treating vilazodone free base in mixture of methanol and methylene dichloride with succinic acid at about 25°C to 80°C, for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with
10 acetone followed by cooling to ambient temperature to obtain crystalline vilazodone salicylate.

The crystalline vilazodone salicylate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume
15 percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone tartrate.

The crystalline form of vilazodone tartrate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 9.5, 12.2, 13.3, 13.5,
20 14.5, 16.6, 17.4, 18.1, 19.2, 20.3, 20.9, 21.7, 22.5, 24.7, 25.4, 28.0 and 30.5 degree (2θ); or Differential scanning calorimetry having endothermic peak at about 237°C.

The crystalline form of vilazodone tartrate may be further characterized by a PXRD pattern substantially as depicted in FIG. 11.

The crystalline form of vilazodone tartrate shows water loss of 2.1% in thermal
25 gravimetric analysis (TGA).

The crystalline form of vilazodone tartrate shows melting point in the range of 233°C to 236°C.

The crystalline form of vilazodone tartrate may be characterized by IR spectra having characteristic peaks at about 3464, 3278, 2906, 2351, 2218, 1680, 1600, 1471,
30 1442, 1382, 1246, 1222, 1166, 958, 887, 813, 727, 682, 630 and 497 cm^{-1} .

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone tartrate. The process includes suspending vilazodone free base with tartaric acid in the presence of one or more suitable solvents, optionally

adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone tartrate.

The suitable solvents comprise one or more of C₁-C₅ alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone tartrate include treating vilazodone free base in mixture of methanol and methylene dichloride with tartaric acid at about 25°C to 80°C, for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with acetone followed by cooling to ambient temperature to obtain crystalline vilazodone tartrate.

The crystalline vilazodone tartrate may have particle size distributions, wherein the 10th volume percentile particle size (D₁₀) is less than about 20 µm, the 50th volume percentile particle size (D₅₀) is less than about 50 µm, or the 90th volume percentile particle size (D₉₀) is less than about 250 µm, or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone fumarate.

The crystalline form of vilazodone fumarate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 6.2, 8.1, 12.9, 14.3, 15.2, 16.1, 18.0, 19.0, 19.5, 20.4, 21.1, 21.7, 23.0, 23.6, 24.9, 25.8, 27.5 and 28.7 degree (2θ); or Differential scanning calorimetry having two endothermic peaks at about 243 °C and 249°C.

The crystalline form of vilazodone fumarate may be further characterized by a PXRD pattern substantially as depicted in FIG. 12.

The crystalline form of vilazodone fumarate shows water loss of 0.2% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone fumarate shows melting point in the range of 228°C to 236°C.

The crystalline form of vilazodone fumarate may be characterized by IR spectra having characteristic peaks at about 3319, 2943, 2210, 1678, 1583, 1469, 1452, 1363, 1220, 1168, 1101, 1010, 962, 941, 885, 810, 736, 669, 634 and 501 cm^{-1} :

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone fumarate. The process includes suspending vilazodone free base with fumaric acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone fumarate.

The suitable solvents comprise one or more of $\text{C}_1\text{-C}_5$ alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone fumarate include treating vilazodone free base in mixture of methanol and methylene dichloride with fumaric acid at about 25°C to 80°C , for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with acetone followed by cooling to ambient temperature to obtain crystalline vilazodone fumarate.

The crystalline vilazodone fumarate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone malonate.

The crystalline form of vilazodone malonate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 8.7, 10.8, 14.1, 14.7, 16.1, 17.6, 18.9, 20.2, 20.5, 20.9, 22.9, 23.8, 24.0, 26.1, 26.8, 27.8, 28.8, 29.5 and 30.2 degree (2θ); or Differential scanning calorimetry having two endothermic peaks at about 179°C and 209°C .

The crystalline form of vilazodone malonate may be further characterized by a PXRD pattern substantially as depicted in FIG. 13.

The crystalline form of vilazodone malonate shows no water loss in thermal gravimetric analysis (TGA).

5 The crystalline form of vilazodone malonate shows melting point in the range of 178°C to 182°C.

The crystalline form of vilazodone malonate may be characterized by IR spectra having characteristic peaks at about 3425, 3126, 2904, 2694, 2353, 2210, 1741, 1668, 1578, 1452, 1394, 1334, 1244, 1226, 1184, 1112, 975, 958, 912, 808, 734, 682, 632,
10 586,, 547 and 468 cm^{-1} .

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone malonate. The process includes suspending vilazodone free base with malonic acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and
15 obtaining the crystalline form of vilazodone malonate.

The suitable solvents comprise one or more of C_1 - C_5 alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic
20 ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of
25 vilazodone malonate include treating vilazodone free base in mixture of methanol and methylene dichloride with tartaric acid at about 25°C to 80°C, for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with acetone followed by cooling to ambient temperature to obtain crystalline vilazodone tartrate.

30 The crystalline vilazodone malonate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone pivalate.

The crystalline form of vilazodone pivalate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 5.7, 6.1, 10.3, 10.9, 11.5, 12.0, 13.3, 13.7, 14.2, 15.1, 15.7, 16.8, 17.3, 18.4, 19.7, 20.7, 21.3, 21.8, 23.1, 24.1, 25.6, 27.6 and 31.08 degree (2 θ); or Differential scanning calorimetry having two endothermic peaks at about 168°C and 209°C.

The crystalline form of vilazodone pivalate may be further characterized by a PXRD pattern substantially as depicted in FIG. 14.

The crystalline form of vilazodone pivalate shows water loss of 10.7% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone pivalate shows melting point in the range of 170°C to 189°C.

The crystalline form of vilazodone pivalate may be characterized by IR spectra having characteristic peaks at about 3581, 3483, 3169, 2904, 2779, 2220, 1662, 1585, 1473, 1392, 1323, 1219, 1166, 1016, 960, 939, 881, 804, 738, 630, 590 and 495 cm⁻¹.

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone pivalate. The process includes suspending vilazodone free base with pivalic acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone pivalate.

The suitable solvents comprise one or more of C₁-C₅ alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone pivalate include treating vilazodone free base in mixture of methanol and methylene dichloride with pivalic acid at about 25°C to 80°C, for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with

acetone followed by cooling to ambient temperature to obtain crystalline vilazodone pivalate.

The crystalline vilazodone pivalate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the present invention, there is provided a crystalline form of vilazodone mesylate.

The crystalline form of vilazodone mesylate may be characterized by X-ray powder diffraction pattern having characteristic peaks at about 6.9, 11.7, 14.9, 16.2, 17.6, 18.2, 19.5, 20.3, 20.7, 21.7, 22.4, 22.7, 23.6, 24.4, and 26.6 degree (2θ); or Differential scanning calorimetry having endothermic peak at about 285°C.

The crystalline form of vilazodone mesylate may be further characterized by a PXRD pattern substantially as depicted in FIG. 15.

The crystalline form of vilazodone mesylate shows water loss of 0.9% in thermal gravimetric analysis (TGA).

The crystalline form of vilazodone mesylate shows melting point in the range of 260°C to 270°C.

The crystalline form of vilazodone mesylate may be characterized by IR spectra having characteristic peaks at about 3479, 3323, 3010, 2711, 2216, 1685, 1593, 1469, 1361, 1209, 1170, 1043, 958, 887, 806, 777, 630 and 553 cm^{-1} .

In another aspect of the invention there is provided a process for the preparation of crystalline form of vilazodone mesylate. The process includes suspending vilazodone free base with tartaric acid in the presence of one or more suitable solvents, optionally adding one or more suitable co-solvents, removing the solvents and obtaining the crystalline form of vilazodone mesylate.

The suitable solvents comprise one or more of C_1 - C_5 alcohol solvents, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the solvent may be ethanol. A co-solvent can be optionally added. The suitable co-solvent comprises from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and the like, hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like. In Particular, the co-solvent may be acetone.

The embodiments of the process for the preparation of crystalline form of vilazodone mesylate include treating vilazodone free base in mixture of methanol and methylene dichloride with tartaric acid at about 25°C to 80°C, for example, at reflux temperature of solvent, followed by removal of solvent, and treating the residue with acetone followed by cooling to ambient temperature to obtain crystalline vilazodone mesylate.

The crystalline vilazodone mesylate may have particle size distributions, wherein the 10th volume percentile particle size (D_{10}) is less than about 20 μm , the 50th volume percentile particle size (D_{50}) is less than about 50 μm , or the 90th volume percentile particle size (D_{90}) is less than about 250 μm , or any combination thereof.

In another aspect of the invention, there is provided a process for the preparation of crystalline vilazodone acid addition salts comprising:

- (a) suspending vilazodone free base in a suitable organic solvent,
- (b) adding suitable acid,
- (c) heating the reaction mixture,
- (d) optionally adding suitable anti-solvent or co-solvent, and
- (e) obtaining crystalline vilazodone acid addition salts.

In general, the suitable organic solvent comprises one or more of alcoholic solvent like methanol, ethanol, isopropanol, n-butanol, heptanol, decanol, dodecanol and the like, hydrocarbon solvents like toluene, xylene, methylene dichloride, chlorobenzene and the like. In particular, the suitable organic solvent is one or more of methanol, isopropanol, acetone, toluene, methylene dichloride and methyl tert-butyl ether or mixture thereof. More particular, the suitable solvent may be mixture of methanol and methylene dichloride.

Further the process parameters includes addition of suitable anti-solvent or co-solvent comprises from one or more of hydrocarbons like n-hexane, heptane, cyclohexane and the like, ethers like diisopropylether, methyltert-butyl ether, tetrahydrofuran and the like, ketonic solvents like acetone, methyl ethyl ketone, methyl isobutyl ketone and the like, esters like ethyl acetate, butyl acetate, isopropyl acetate and the like. In particular, n-hexane, n-heptane, cyclohexane, acetone and the like may be used as anti-solvent or co-solvent based on the solubility of vilazodone salts.

The embodiments include suspending vilazodone freebase in suitable solvent comprises from methanol, isopropanol, methylene dichloride, toluene and methyl tert-butyl ether or mixture thereof. The suitable acid is added to the vilazodone freebase

solution in suitable solvent and heated the reaction mixture. The reaction mixture can be heated from about 35°C to about 90°C, particularly at about reflux temperature of solvent.

In general, the suitable acid comprises from one or more of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid, citric acid and the like.

Optionally, the heated solution of vilazodone freebase and suitable acid can be treated with suitable antisolvent selected from the group consisting of hydrocarbon solvent, ethers, ketones or esters. Hydrocarbon comprises one or more of toluene, xylene, ethylbenzene, n-hexane, heptane, cyclohexane and the like, ketones comprises one or more of acetone, methyl ethyl ketone, methyl isobutyl ketone and the like ethers comprises one or more of diisopropylether, methyltert-butyl ether, tetrahydrofuran and the like, esters comprises one or more of ethyl acetate, butyl acetate, isopropyl acetate and the like.

Further, the obtained crystalline vilazodone acid addition salts, can be isolated by the known techniques reported in the art followed by drying.

The present invention also provides a process for preparing crystalline form of vilazodone hydrobromide, which comprises treating vilazodone with hydrobromic acid.

The reaction is preferably carried out in suitable solvent. The solvent system is preferably selected so as to facilitate the salt reaction and to allow subsequent separation of the resulting maleate. Advantageously, both vilazodone and hydrobromic acid are dissolvable, at least partly, in the solvent system, at least at elevated temperatures. In the process, a mixture, slurry, or solution of vilazodone and a solvent may be contacted with a hydrobromic acid, or conversely, a mixture, slurry, or solution of hydrobromic acid and a solvent may be contacted with vilazodone. In another embodiment, both partners may be combined with a solvent system prior to being contacted together, whereby the solvent system used for hydrobromic acid may be identical with or different from the solvent system used for the vilazodone. The solvent system can be comprised of a single solvent or a mixture of solvents. When two or more solvents are used, a two phase reaction scheme may be used wherein the vilazodone and hydrobromic acid are primarily reacted in one phase and the resulting

vilazodone hydrobromide compound is primarily present in the other phase due to, inter alia, solubility differences, etc. Suitable solvents include water, a lower alcohol (C₁-C₆) such as methanol, ethanol, isopropanol, n-propanol, n-butanol, iso-butanol, tert-butanol; ester such as ethyl acetate, isopropyl acetate, butyl acetate, iso-butyl acetate; ketone such as acetone, methyl ethyl ketone, methyl tert-butyl ketone; ether such as tetrahydrofuran, diethyl ether, diisopropyl ether, dioxane; chlorinated solvent like methylene dichloride, ethylene dichloride, chloroform, chlorobenzene, hydrocarbon solvents like toluene, xylene, hexane, cyclohexane, heptanes; polar solvents like dimethyl formamide, N-methyl pyrrolidone, N,N-dimethyl acetamide, dimethyl sulfoxide and the like.

The temperature of contact of vilazodone and hydrobromic acid in the solvent system is from ambient to the boiling point of the solvent system, with elevated temperatures, but generally less than the boiling point, being preferred. It is not required that a complete solution is formed in this step, *i.e.*, a slurry or two phase solution are also possible, though a single solution is generally preferred.

The vilazodone hydrobromide compound can be isolated or recovered from the salt forming reaction by any convenient means. For example, the vilazodone hydrobromide compound can be precipitated out of a solution or reaction mixture. The precipitation may be spontaneous depending upon the solvent system used and the conditions. Alternatively, the precipitation can be induced by reducing the temperature of the solvent, especially if the initial temperature at contact is elevated. The precipitation may also be facilitated by reducing the volume of the solution/solvent or by adding a contra solvent, *i.e.* a liquid miscible with the solvent in which the vilazodone hydrobromide is less soluble. Seed crystals of vilazodone hydrobromide may also be added to help induce precipitation. The precipitated vilazodone hydrobromide compound can be isolated by conventional methods such as filtration or centrifugation, optionally washed and dried, preferably under diminished pressure.

Alternatively, vilazodone hydrobromide can be isolated by evaporating the solvent and collecting residue. Such a method generally leads to an oil or solid amorphous form of vilazodone hydrobromide. Similarly, an amorphous solid form of the vilazodone hydrobromide compound can be recovered by spray drying a solution containing the vilazodone hydrobromide compound.

In the preferred embodiment, vilazodone freebase (I) is dissolved in mixture of methanol and methylene dichloride and treated with hydrobromic acid solution in acetone to solid form of vilazodone hydrobromide.

The present invention also provides a process for preparing acid addition salts of vilazodone in the similar manner as described for the preparation of vilazodone hydrobromide.

The novel salts and process for its preparation described in the present invention is demonstrated in examples illustrated below. These examples are provided as illustration only and therefore should not be construed as limitation of the scope of invention.

In another general aspect, there is provided pharmaceutically acceptable salts of vilazodone having purity greater than about 99% by area percentage of HPLC, wherein the pharmaceutically acceptable salts are selected from hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid, citric acid and the like.

In another general aspect there is provided a pharmaceutical composition comprising a therapeutically effective amount of crystalline vilazodone hydrobromide and one or more pharmaceutically acceptable carriers, excipients or diluents, wherein crystalline vilazodone hydrobromide is characterized by having X-ray powder diffraction pattern substantially as depicted in FIG.1.

In another general aspect, there is provided a pharmaceutical composition comprising a therapeutically effective amount of a pharmaceutically acceptable salt of vilazodone, and one or more pharmaceutically acceptable carriers, excipients or diluents, wherein the pharmaceutically acceptable salt is selected from hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid and citric acid.

In another general aspect, there is provided use of pharmaceutically acceptable salts of vilazodone for the treatment of major depressive disorder by administering to a patient a therapeutically effective amount of pharmaceutically acceptable salts of vilazodone, wherein the pharmaceutically acceptable salts is selected from hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane

sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid and citric acid.

The vilazodone pharmaceutically acceptable salts and process for its preparation described in the present invention is demonstrated in examples illustrated below. These examples are provided as illustration only and therefore should not be construed as limitation of the scope of invention.

Working Examples:

Example-1: Preparation of vilazodone hydrobromide

Vilazodone free base (3 gm) was added in acetone (60 ml) at 25-30°C. The reaction mass was heated to 50-55°C and hydrobromic acid (1.85 gm) in acetic acid (29%) solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone hydrobromide.

Example-2: Preparation of vilazodone sulfate

Vilazodone free base (3 gm) was added in acetone (60 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.6 gm of sulfuric acid in 5 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone sulfate.

Example-3: Preparation of vilazodone phosphate

Vilazodone free base (3 gm) was added in acetone (60 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.63 g phosphoric acid in 5 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone phosphate.

Example-4: Preparation of vilazodone oxalate

Vilazodone free base (3 gm) was added in acetone (60 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.85 g oxalic acid in 5 ml of acetone solution

was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone oxalate.

5 **Example-5: Preparation of vilazodone tosylate**

Vilazodone free base (3 gm) was added in acetone (60 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.972 g p-toluene sulfonic acid in 5 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was
10 filtered and washed with acetone (10 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone tosylate.

Example-6: Preparation of vilazodone besylate

Vilazodone free base (3 gm) was added in acetone (60 ml) at 25-30°C. The
15 reaction mass was heated to 50-55°C and 0.64 g benzene sulfonic acid in 5 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone
20 besylate.

Example-7: Preparation of vilazodone maleate

Vilazodone free base (2.5 gm) was added in acetone (50 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.65 g maleic acid in 5 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-
25 30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone maleate.

Example-8: Preparation of vilazodone succinate

Vilazodone free base (2.5 gm) was added in acetone (50 ml) at 25-30°C. The
30 reaction mass was heated to 50-55°C and 0.66 g succinic acid in 25 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (10 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone succinate.

Example-9: Preparation of vilazodone malate

Vilazodone free base (2.5 gm) was added in acetone (50 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.76 g malic acid in 20 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone malate.

Example-10: Preparation of vilazodone salicylate

Vilazodone free base (2.5 gm) was added in acetone (50 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.80 g salicylic acid in 10 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (10 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone salicylate.

Example-11: Preparation of vilazodone tartrate

Vilazodone free base (2.5 gm) was added in acetone (50 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.85 g L(+)-Tartaric acid in 5 ml of methanol solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with methanol (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone tartrate.

Example-12: Preparation of vilazodone fumarate

Vilazodone free base (2.5 gm) was added in acetone (50 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.65 g fumaric acid in 20 ml of methanol solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (10 ml) and slurry wash with methanol (25 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone fumarate.

Example-13: Preparation of vilazodone malonate

Vilazodone free base (2.5 gm) was added in acetone (50 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.59 g malonic acid in 10 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered

and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone malonate.

Example-14: Preparation of vilazodone pivalate

Vilazodone free base (2.5 gm) was added in acetone (50 ml) at 25-30°C. The
5 reaction mass was heated to 50-55°C and 0.58 g pivalic acid in 5 ml of methanol solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone pivalate.

10 **Example-15: Preparation of vilazodone mesylate**

Vilazodone free base (2.0 gm) was added in acetone (40 ml) at 25-30°C. The reaction mass was heated to 50-55°C and 0.65 g methanesulfonic acid in 4 ml of acetone solution was added. The reaction mass was stirred for 30 minutes followed by cooling at 25-30°C. The reaction mass was stirred for 1 hour. The reaction mass was
15 filtered and washed with acetone (5 ml) and slurry wash with acetone (5 ml). The product was air dried followed by drying in oven for 12 hours resulted in vilazodone mesylate.

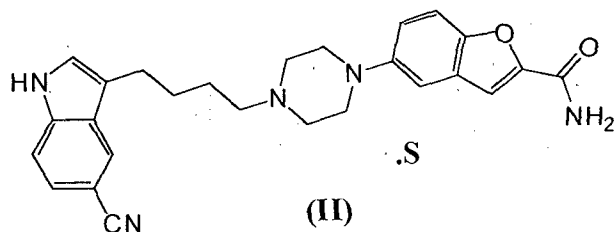
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We Claim:

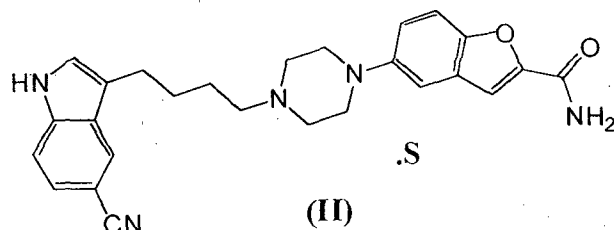
1. A novel salts of vilazodone of Formula (II).



5 wherein in S represent the acid selected from the group consisting of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid, citric acid, which forms a salt with vilazodone.

10

2. A process for preparing novel salts of vilazodone of Formula (II)



15 wherein in S represent the acid selected from the group consisting of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid, citric acid;

the process comprising the steps of:

- 20 i) treating vilazodone free base of Formula (I) with an acid in one or more suitable solvent at a specified temperature;
- ii) optionally adding one or more suitable co-solvents;
- ii) obtaining salt of vilazodone of Formula (II).

3. The process as claimed in claim 2, wherein acid may be selected from the group consisting of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid,

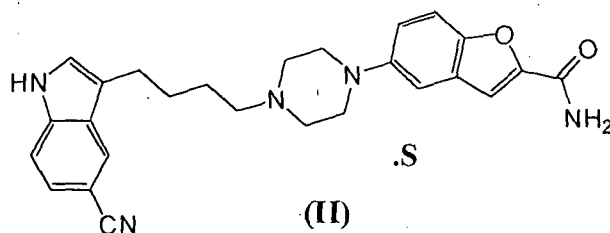
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malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid and citric acid.

4. The process as claimed in claim 2, wherein suitable solvents is selected from one or more of C₁-C₅ alcohols, ketones, esters, ethers, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof. In particular, the mixture of methanol and methylene dichloride.

5. The process as claimed in claim 2, wherein co-solvent may be selected from one or more of aliphatic ethers like methyl tert-butyl ether, diisopropyl ether, and hydrocarbons like cyclohexane, hexane, heptane, toluene, xylene, and the like, ketones like acetone, methylisobutyl ketone and methyl ethyl ketone.

6. A process for the preparation of crystalline vilazodone acid addition salt of Formula (II)



wherein in S represent the acid selected from the group consisting of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid, citric acid; the process comprising the steps of:

- (a) suspending vilazodone free base of Formula (I) in a suitable organic solvent,
- (b) adding suitable acid,
- (c) heating the reaction mixture,
- (d) optionally adding suitable anti-solvent or co-solvent, and
- (e) obtaining crystalline vilazodone acid addition salt of Formula (II).

7. The process as claimed in claim 6, wherein suitable organic solvent may be selected from one or more of C₁-C₅ alcohols, ketones, esters, ethers, hydrocarbons like toluene, xylene, methylene dichloride, chlorobenzene, water and mixtures thereof.

5 8. The process as claimed in claim 6, wherein acid may be selected from the group consisting of hydrobromic acid, sulfuric acid, phosphoric acid, oxalic acid, benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, maleic acid, succinic acid, malic acid, salicylic acid, tartaric acid, fumaric acid, malonic acid, pivalic acid, ascorbic acid and citric acid.

10

9. The process as claimed in claim 6, wherein reaction mixture may be heated from about 35°C to about 90°C.

15

10. The process as claimed in claim 6, wherein co-solvent or anti-solvent may be selected from hydrocarbons such as n-hexane, heptane, cyclohexane, ethers such as diisopropylether, methyltert-butyl ether, tetrahydrofuran; ketonic solvents such as acetone, methyl ethyl ketone, methyl isobutyl ketone and the like, esters such as ethyl acetate, butyl acetate and isopropyl acetate.

20

11. A crystalline form of vilazodone hydrobromide is characterized by one or more of the following properties:

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 1.

ii) a powder X-ray diffraction pattern having peaks at about 5.4, 9.4, 10.4, 11.5, 13.0, 13.5, 14.7, 16.0, 18.1, 19.3, 20.9, 21.7, 24.3, 25.1, 27.3, 29.3 and 30.0 degree (2θ);

25

iii) a differential scanning calorimetry (DSC) having two endotherm peaks at about 142°C and 269°C.

12. A crystalline form of vilazodone sulfate is characterized by one or more of the following properties:

30

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 2.

ii) a powder X-ray diffraction pattern having peaks at about 6.7, 10.4, 11.3, 12.2, 14.5, 15.6, 16.1, 16.7, 18.2, 19.7, 20.4, 20.9, 22.9, 23.4, 25.1, 25.6, 26.9 and 28.6 degree (2θ);

iii) a differential scanning calorimetry (DSC) having a peak at about 244°C.

13. A crystalline form of vilazodone phosphate is characterized by one or more of the following properties:

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 3.

5 ii) a powder X-ray diffraction pattern having peaks at about 7.2, 8.1, 10.3, 10.8, 12.7, 14.5, 15.6, 16.3, 16.7, 17.5, 19.2, 20.1, 20.7, 21.6, 22.6, 23.1, 24.5, 25.2, 26.8 and 29.6 degree (2θ);

iii) a differential scanning calorimetry (DSC) having four peaks at about 81°C, 160°C, 215°C and 235°C.

10

14. A crystalline form of vilazodone oxalate is characterized by one or more of the following properties:

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 4.

15 ii) a powder X-ray diffraction pattern having peaks at about 8.0, 11.0, 13.5, 14.7, 16.6, 17.5, 18.7, 20.3, 21.1, 21.9, 22.6, 24.3, 25.1, 27.4, 28.6 and 30.4 degree (2θ);

iii) a differential scanning calorimetry (DSC) having a peak at about 231°C.

15. A crystalline form of vilazodone tosylate is characterized by one or more of the following properties:

20 i) a powder X-ray diffraction pattern substantially in accordance with FIG. 5.

ii) a powder X-ray diffraction pattern having peaks at about 6.3, 8.5, 10.2, 12.1, 12.7, 13.3, 14.9, 15.6, 16.1, 16.9, 17.4, 18.6, 19.4, 19.8, 21.3, 22.4, 22.7, 23.4, 24.9, 25.5, 26.2 and 27.1 degree (2θ);

25 iii) a differential scanning calorimetry (DSC) having two peaks at about 114°C and 227°C.

16. A crystalline form of vilazodone besylate tosylate is characterized by one or more of the following properties:

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 6.

30 ii) a powder X-ray diffraction pattern having peaks at about 5.4, 7.3, 13.0, 13.3, 14.8, 15.4, 15.9, 16.4, 18.2, 19.1, 19.8, 21.6, 21.9, 23.8, 24.3, 24.6, 25.8, 26.2, 27.6, 28.4 and 33.4 degree (2θ);

iii) a differential scanning calorimetry (DSC) having three peaks at about 222°C, 240°C and 248°C.

17. A crystalline form of vilazodone maleate is characterized by one or more of the following properties:

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 7.

5 ii) a powder X-ray diffraction pattern having peaks at about 8.4, 10.8, 11.5, 12.9, 13.9, 15.1, 16.8, 17.9, 18.4, 19.7, 20.2, 20.9, 21.7, 22.3, 23.2, 23.7, 25.0, 25.9, 27.0, 28.0, 28.5, and 31.1 degree (2 θ);

iii) a differential scanning calorimetry (DSC) having two peaks at about 119°C and 189°C.

10

18. A crystalline form of vilazodone succinate is characterized by one or more of the following properties:

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 8.

15 ii) a powder X-ray diffraction pattern having peaks at about 6.2, 8.1, 12.8, 13.6, 14.3, 15.2, 16.1, 16.5, 18.0, 19.0, 19.6, 20.4, 21.1, 21.6, 23.1, 23.5, 24.9, 25.7, 27.4 and 28.7 degree (2 θ);

iii) a differential scanning calorimetry (DSC) having two peaks at about 215°C and 221°C.

20 19. A crystalline form of vilazodone malate is characterized by one or more of the following properties:

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 9.

25 ii) a powder X-ray diffraction pattern having peaks at about 8.2, 10.5, 12.7, 14.3, 15.1, 15.5, 16.6, 19.3, 19.8, 20.3, 21.1, 22.3, 23.0, 23.6, 25.1, 25.7, 28.2, 28.7 and 31.1 degree (2 θ);

iii) a differential scanning calorimetry (DSC) having four peaks at about 84°C, 190°C, 201°C and 233°C.

30 20. A crystalline form of vilazodone salicylate is characterized by one or more of the following properties:

i) a powder X-ray diffraction pattern substantially in accordance with FIG. 10.

ii) a powder X-ray diffraction pattern having peaks at about 6.8, 8.0, 10.6, 12.0, 13.7, 14.8, 15.8, 16.6, 17.4, 18.0, 19.9, 21.3, 22.1, 25.5 and 27.6 degree (2 θ);

iii) a differential scanning calorimetry (DSC) having three peaks at about 136°C, 189°C and 209°C.

21. A crystalline form of vilazodone tartrate is characterized by one or more of the following properties:

- i) a powder X-ray diffraction pattern substantially in accordance with FIG. 11.
- ii) a powder X-ray diffraction pattern having peaks at about 9.5, 12.2, 13.3, 13.5, 14.5, 16.6, 17.4, 18.1, 19.2, 20.3, 20.9, 21.7, 22.5, 24.7, 25.4, 28.0 and 30.5 degree (2 θ);
- iii) a differential scanning calorimetry (DSC) having a peak at about 237°C.

10

22. A crystalline form of vilazodone fumarate is characterized by one or more of the following properties:

- i) a powder X-ray diffraction pattern substantially in accordance with FIG. 12.
- ii) a powder X-ray diffraction pattern having peaks at about 6.2, 8.1, 12.9, 14.3, 15.2, 16.1, 18.0, 19.0, 19.5, 20.4, 21.1, 21.7, 23.0, 23.6, 24.9, 25.8, 27.5 and 28.7 degree (2 θ);
- iii) a differential scanning calorimetry (DSC) having two peaks at about 243 °C and 249°C.

23. A crystalline form of vilazodone malonate is characterized by one or more of the following properties:

- i) a powder X-ray diffraction pattern substantially in accordance with FIG. 13.
- ii) a powder X-ray diffraction pattern having peaks at about 8.7, 10.8, 14.1, 14.7, 16.1, 17.6, 18.9, 20.2, 20.5, 20.9, 22.9, 23.8, 24.0, 26.1, 26.8, 27.8, 28.8, 29.5 and 30.2 degree (2 θ);
- iii) a differential scanning calorimetry (DSC) having two peaks at about 179°C and 209°C.

24. A crystalline form of vilazodone pivalate is characterized by one or more of the following properties:

- i) a powder X-ray diffraction pattern substantially in accordance with FIG. 14.
- ii) a powder X-ray diffraction pattern having peaks at about 5.7, 6.1, 10.3, 10.9, 11.5, 12.0, 13.3, 13.7, 14.2, 15.1, 15.7, 16.8, 17.3, 18.4, 19.7, 20.7, 21.3, 21.8, 23.1, 24.1, 25.6, 27.6 and 31.08 degree (2 θ);

iii) a differential scanning calorimetry (DSC) having two peaks at about 168°C and 209°C.

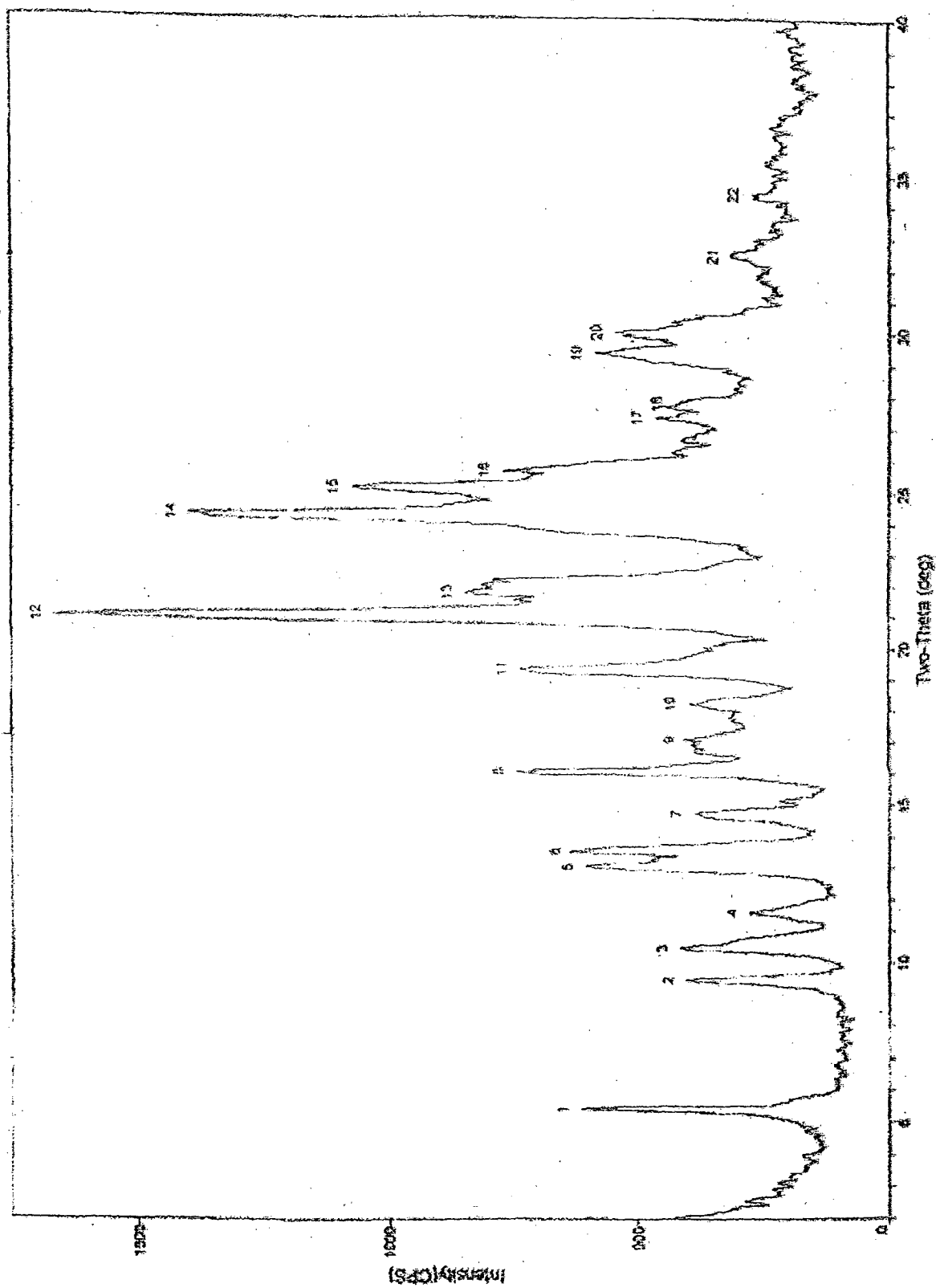
25. A crystalline form of vilazodone mesylate is characterized by one or more of the following properties:

- i) a powder X-ray diffraction pattern substantially in accordance with FIG. 15.
- ii) a powder X-ray diffraction pattern having peaks at about 6.9, 11.7, 14.9, 16.2, 17.6, 18.2, 19.5, 20.3, 20.7, 21.7, 22.4, 22.7, 23.6, 24.4, and 26.6 degree (2 θ);
- iii) a differential scanning calorimetry (DSC) having a peak at about 285°C.

26. A pharmaceutical composition comprising the novel salt of Vilazodone of Formula (II) as claimed in claim 1 and one or more pharmaceutically acceptable carriers, excipients or diluents.

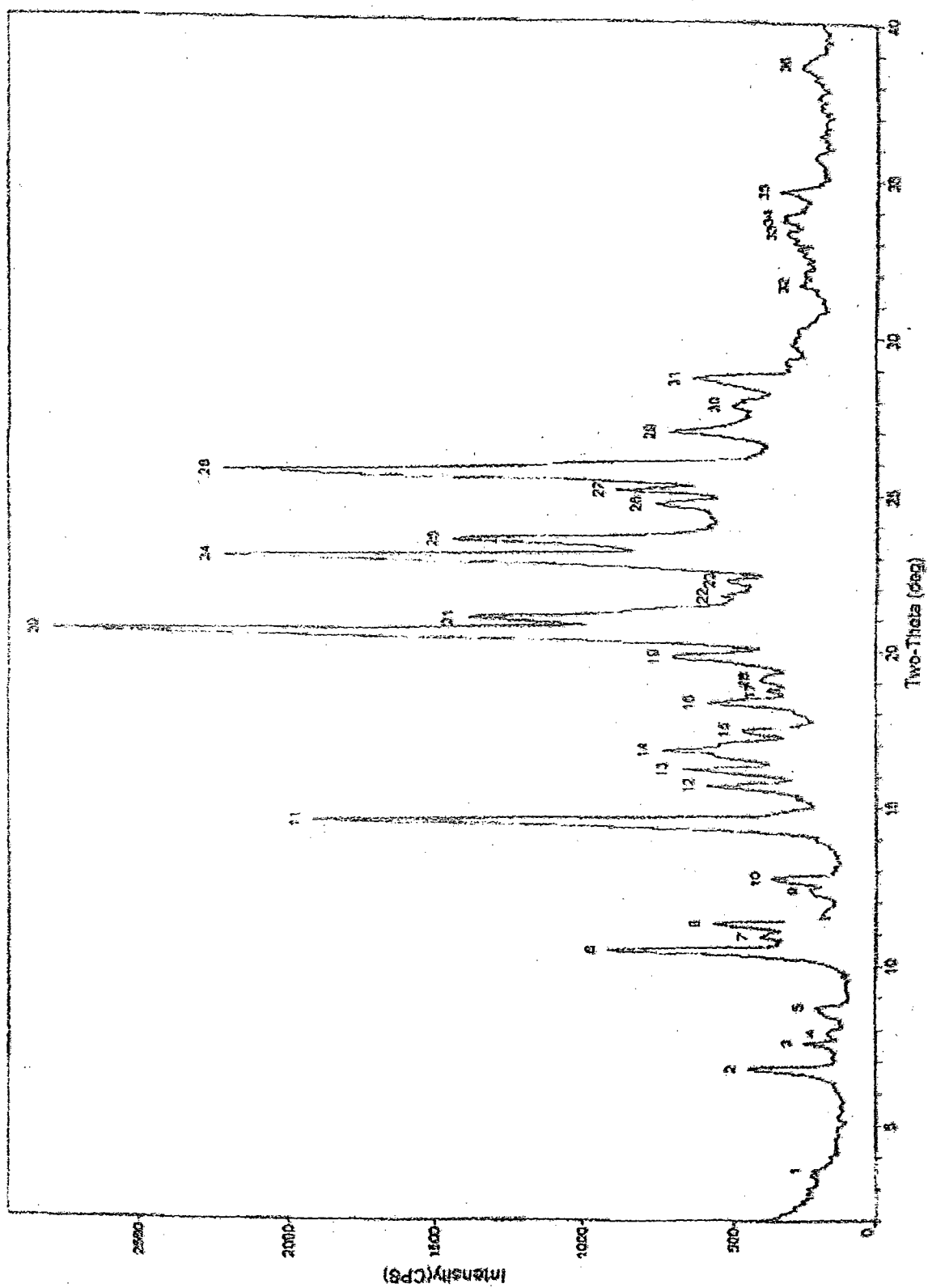
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FIG.1



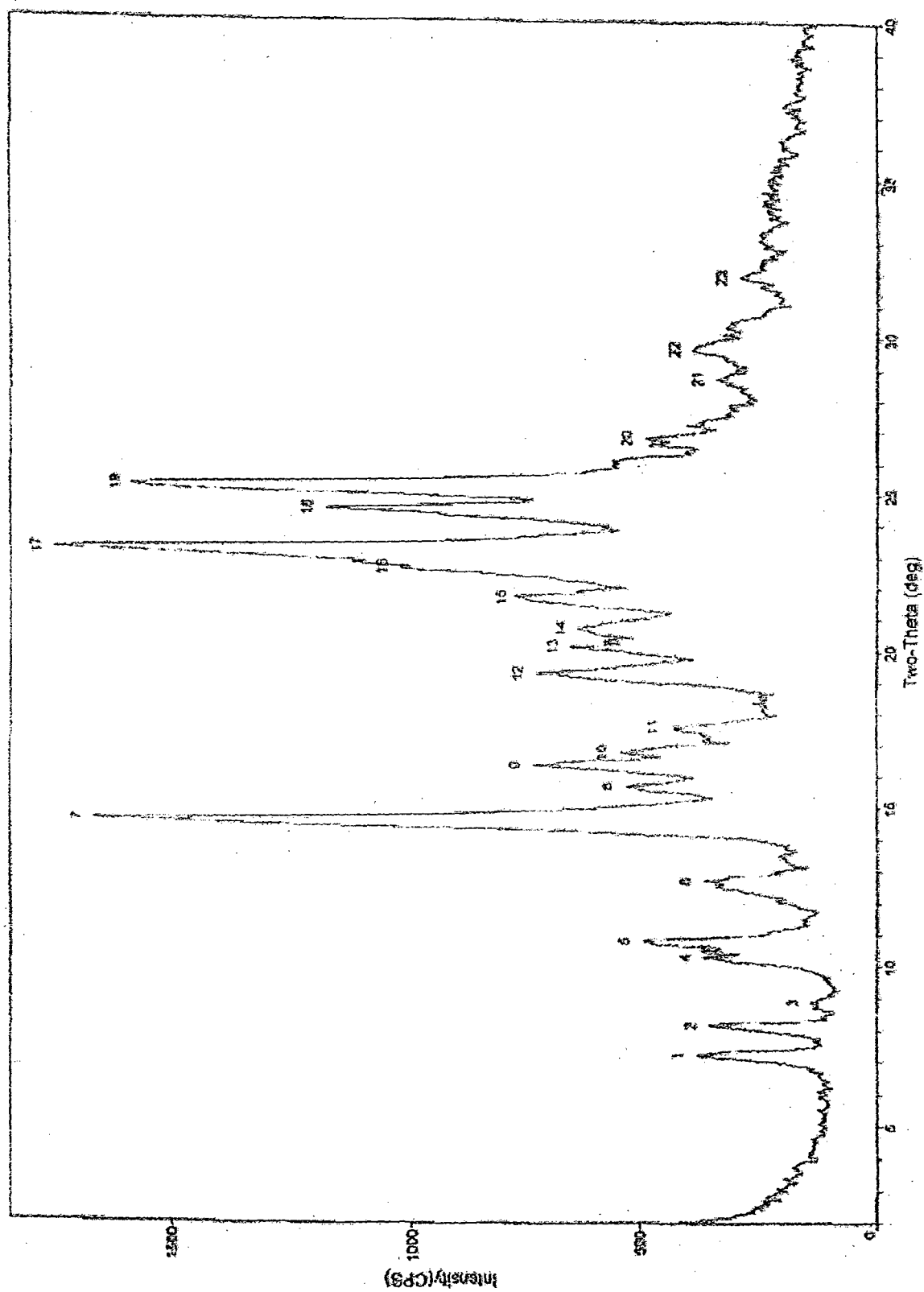
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FIG.2



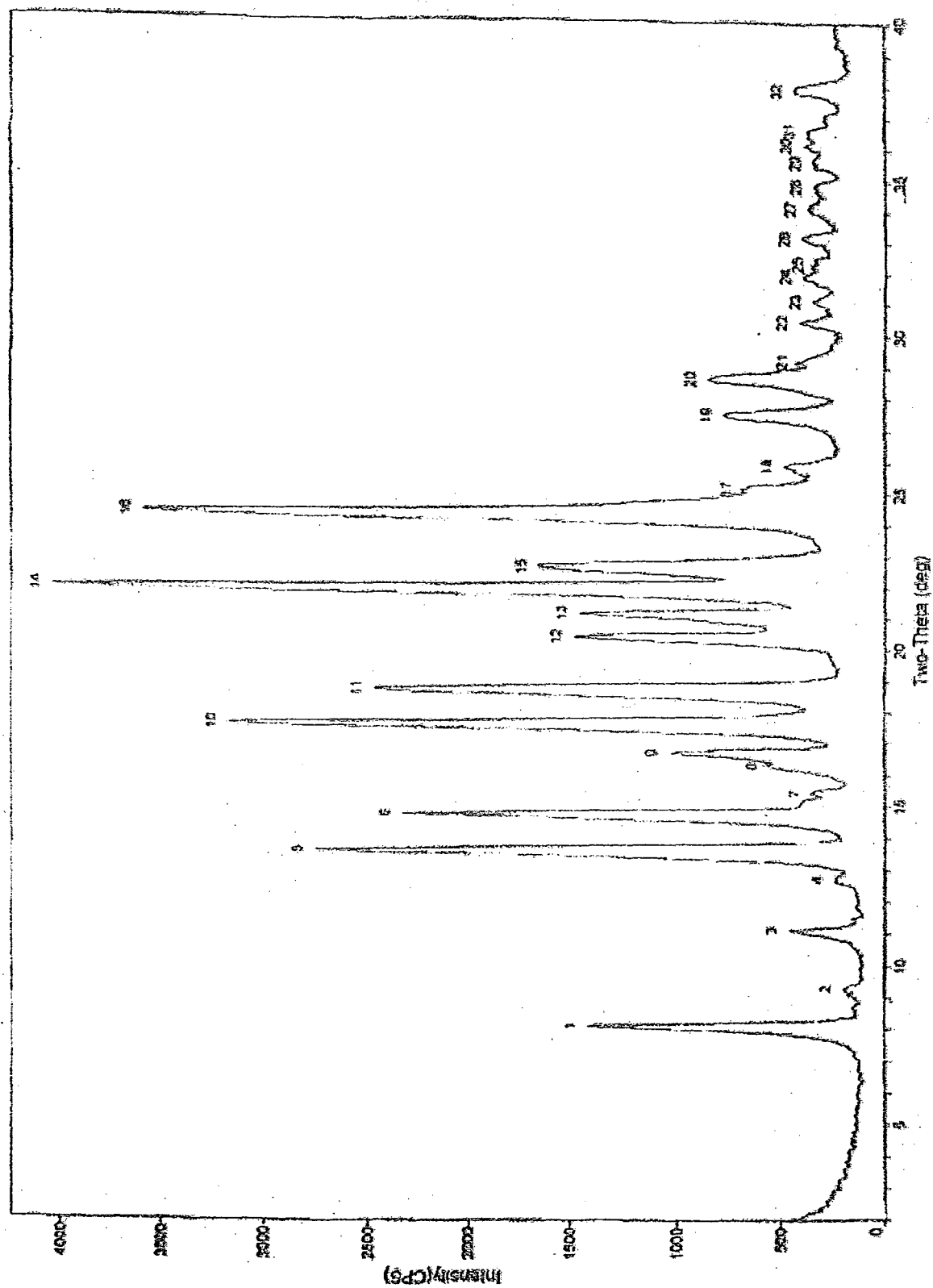
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FIG.3



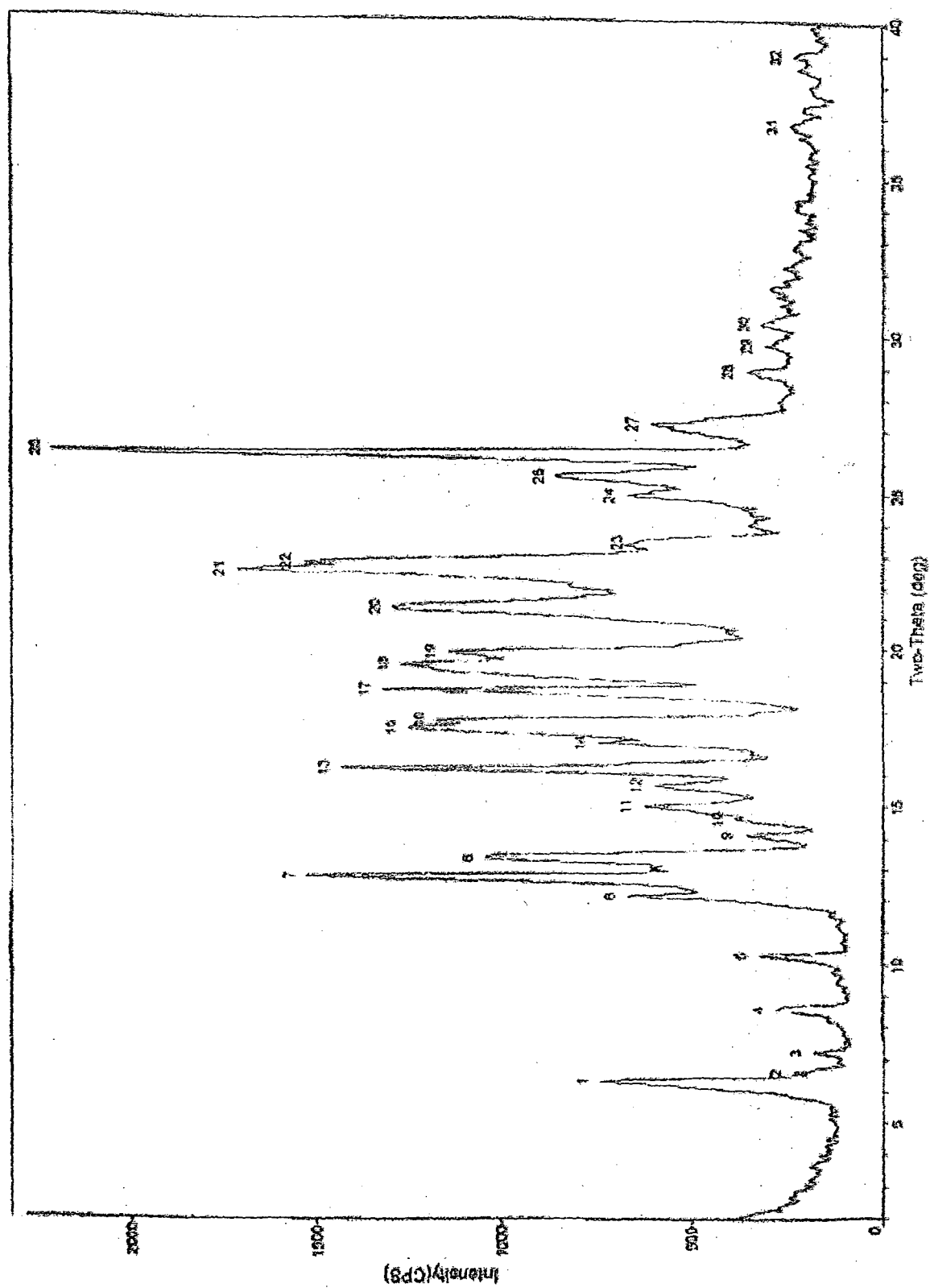
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FIG. 4



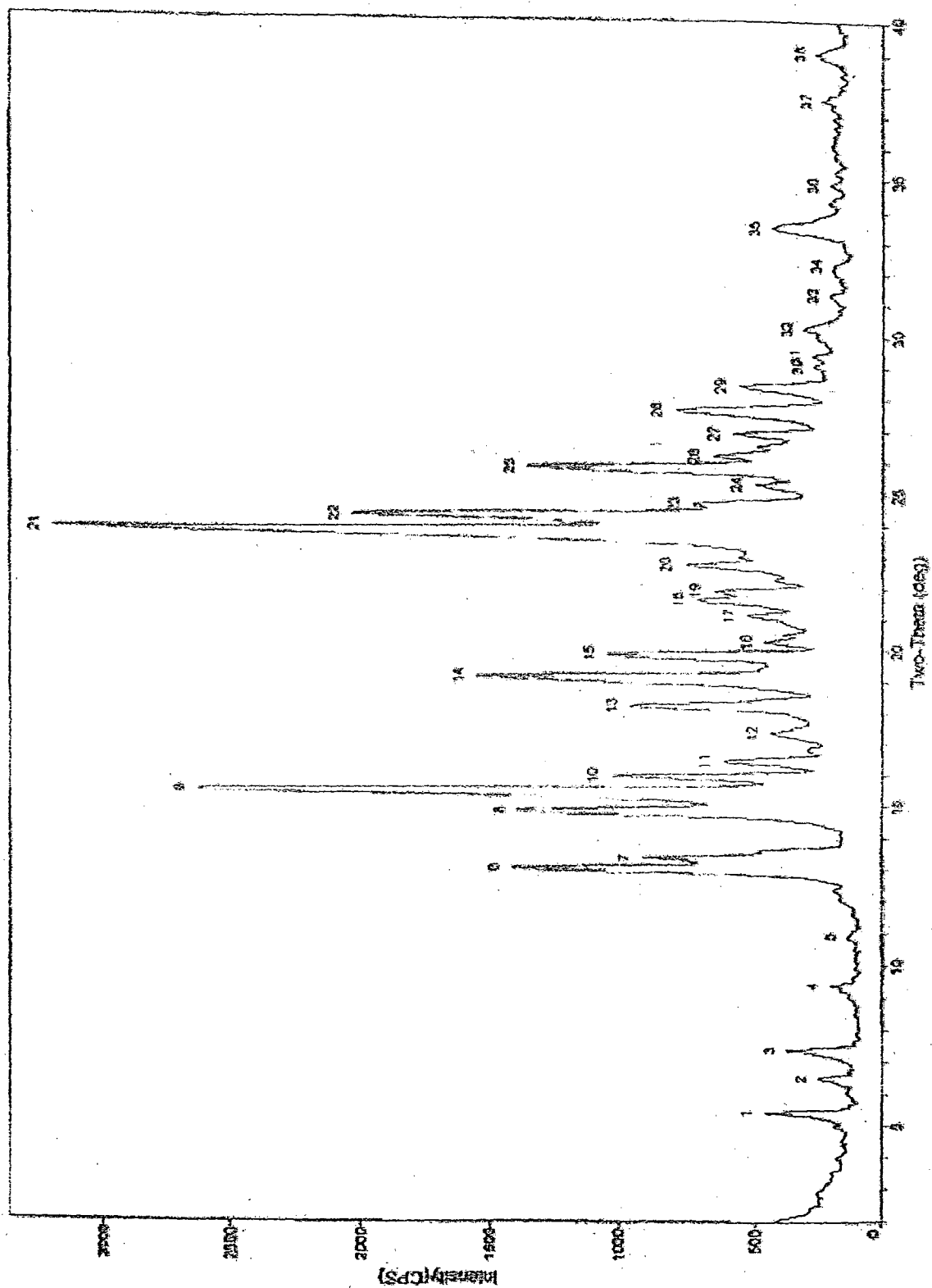
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FIG. 5



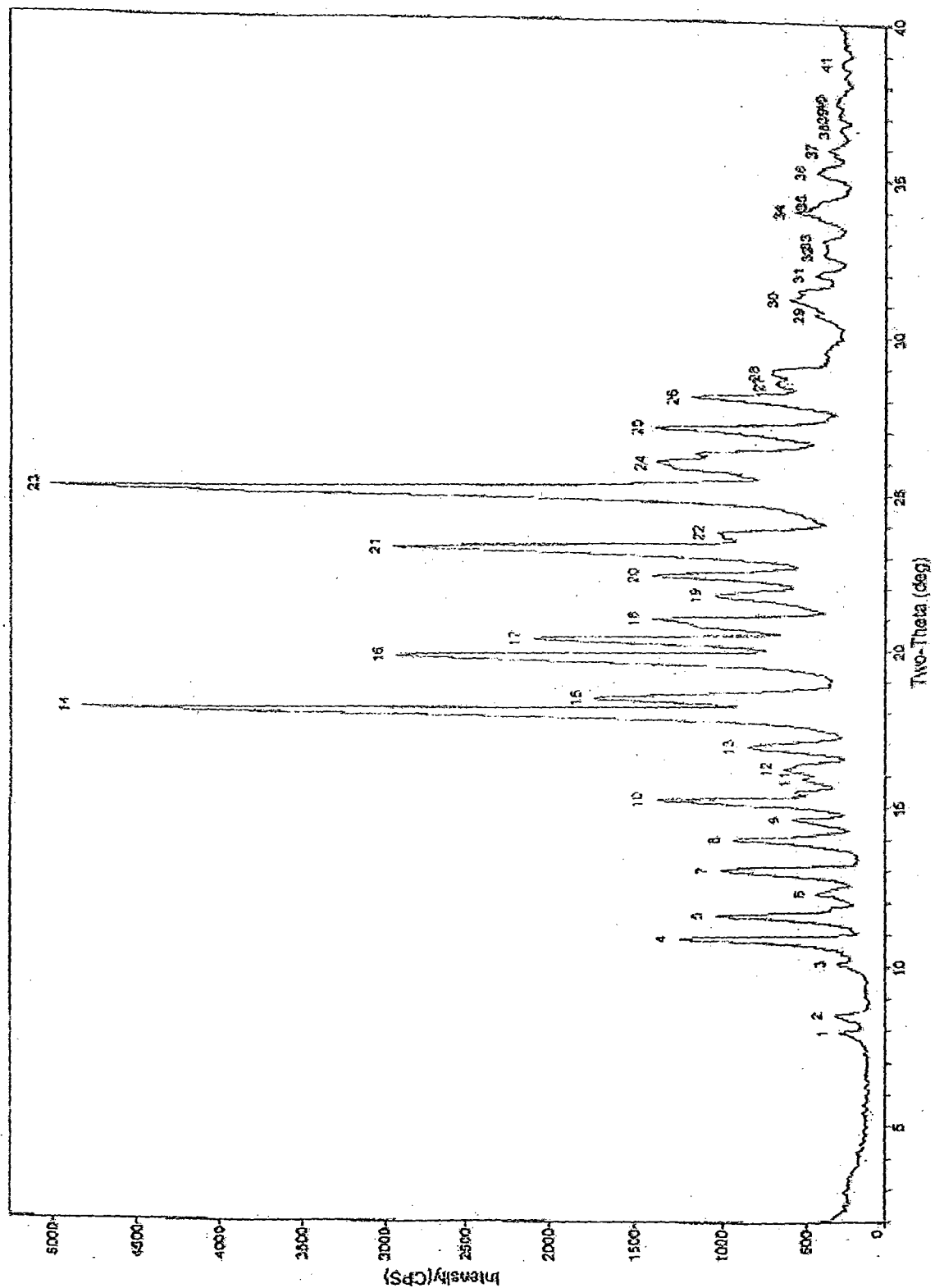
6/15

FIG. 6



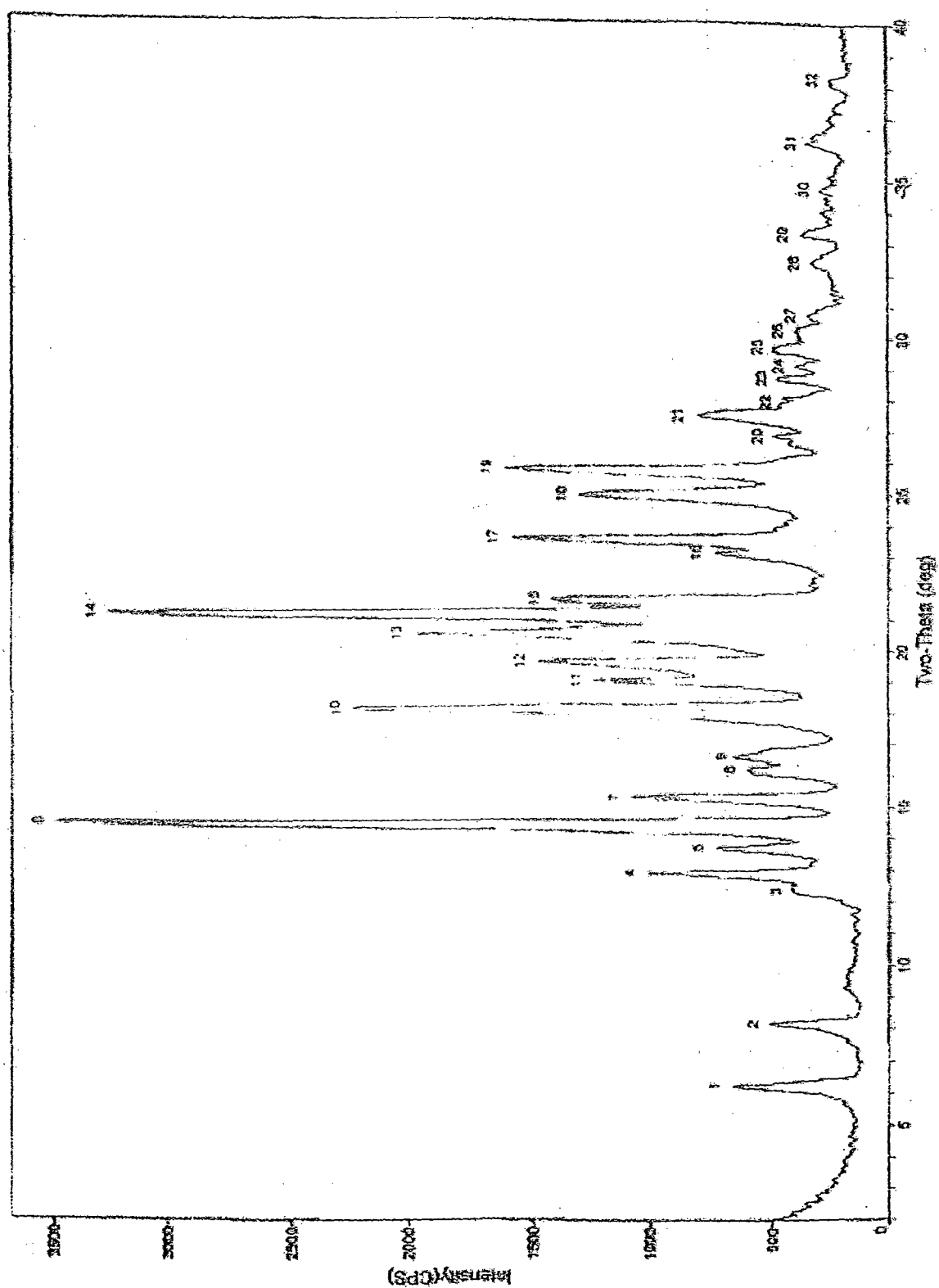
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FIG. 7



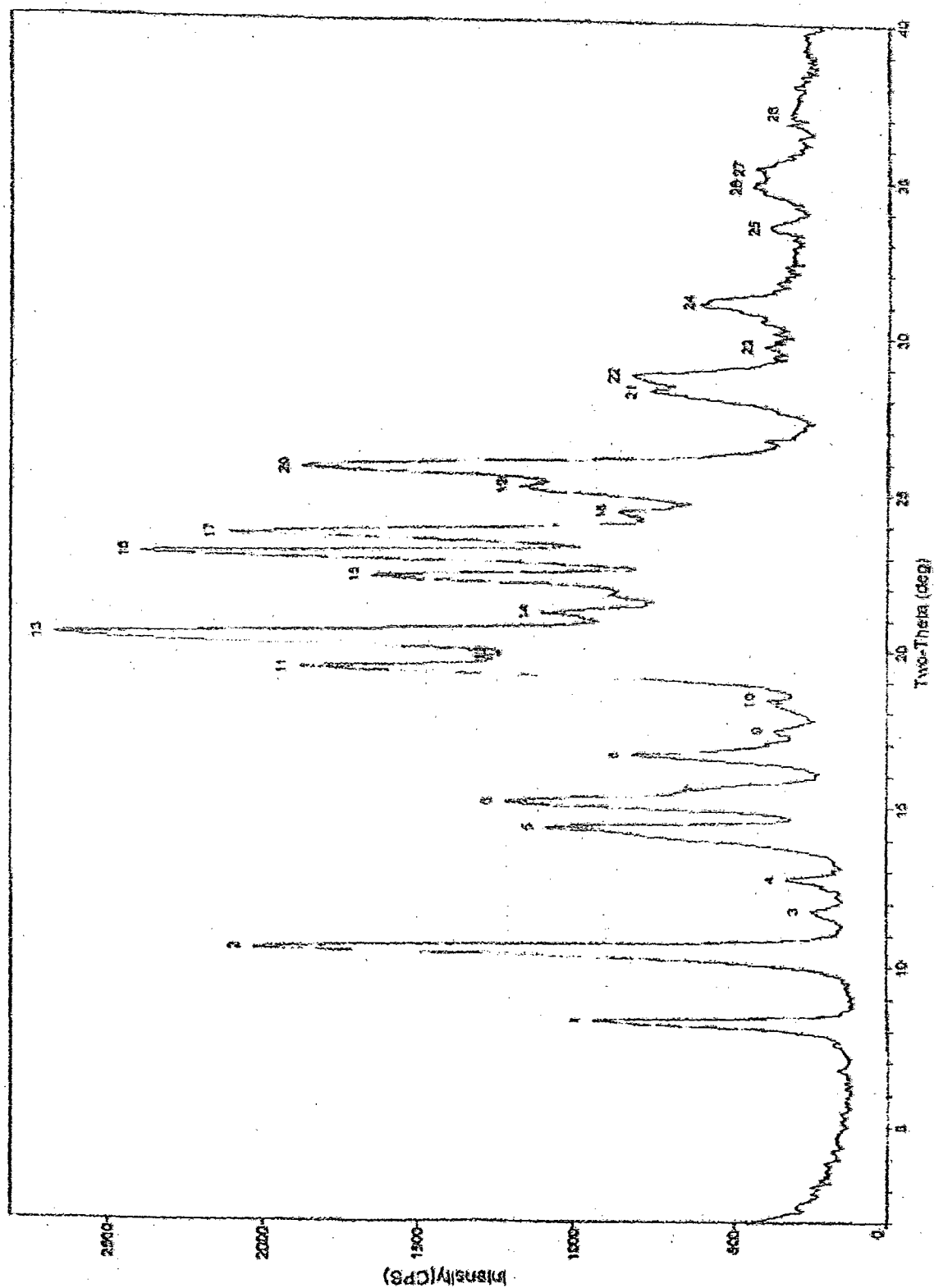
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FIG. 8



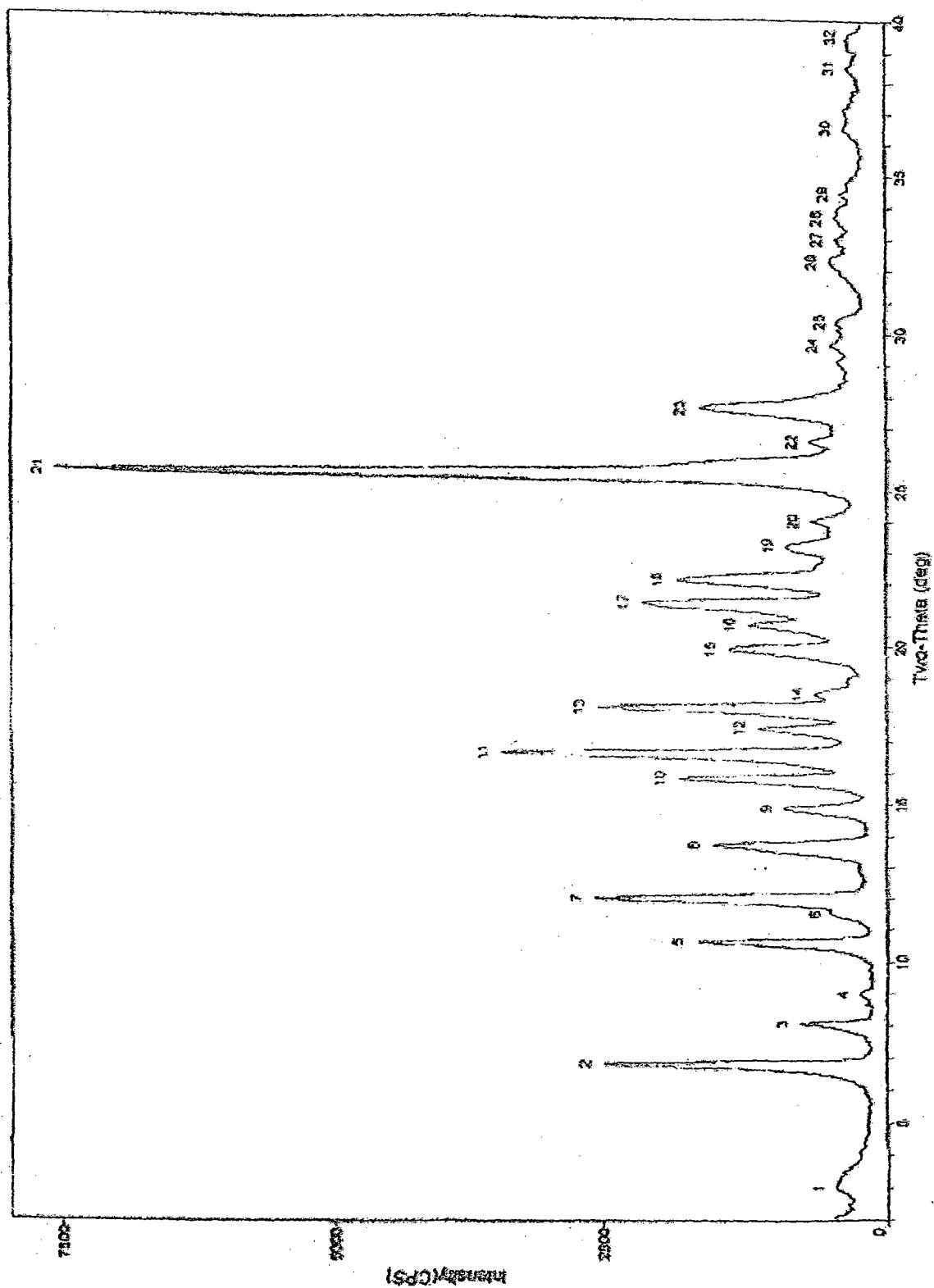
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FIG. 9



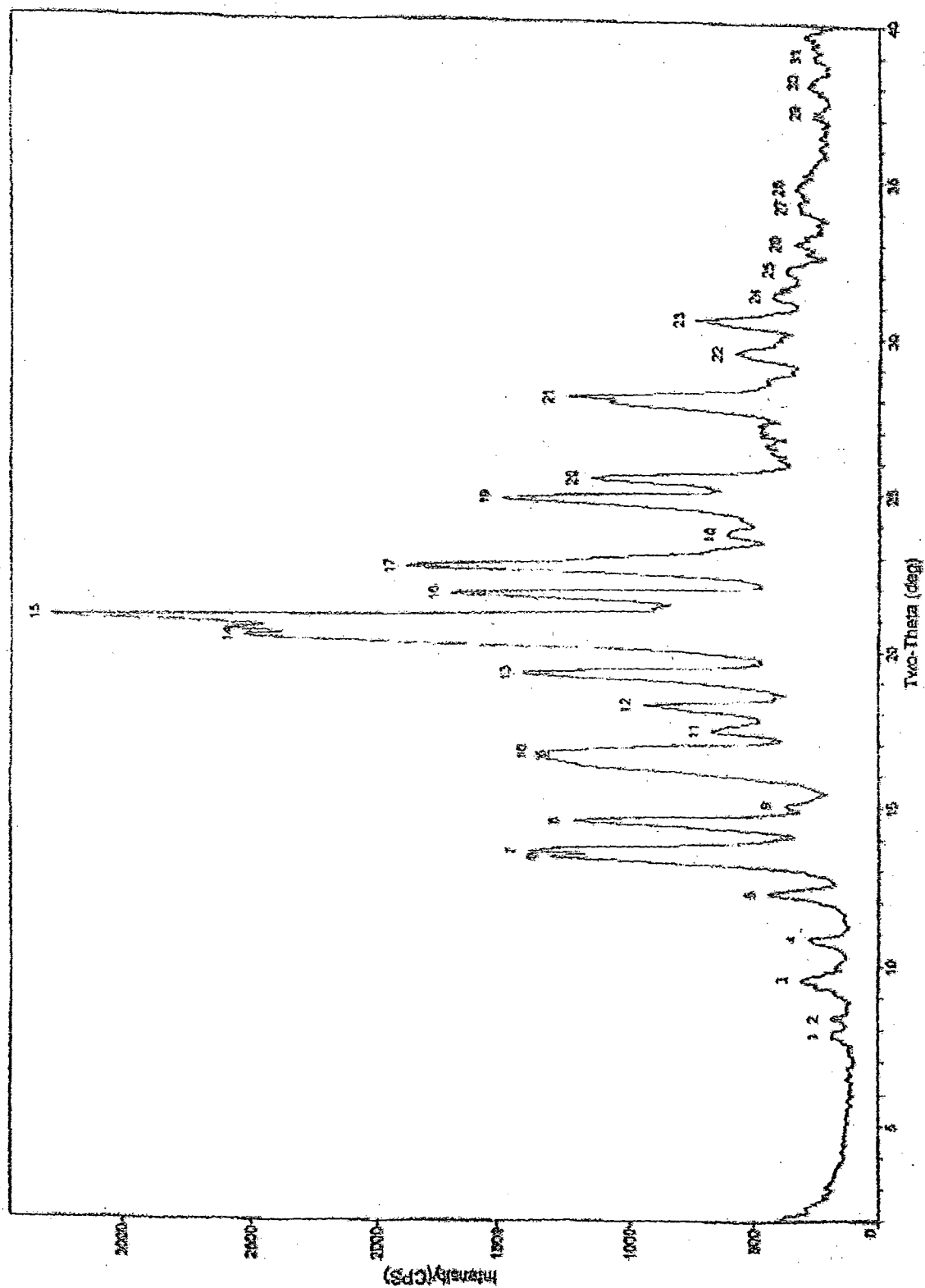
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FIG.10



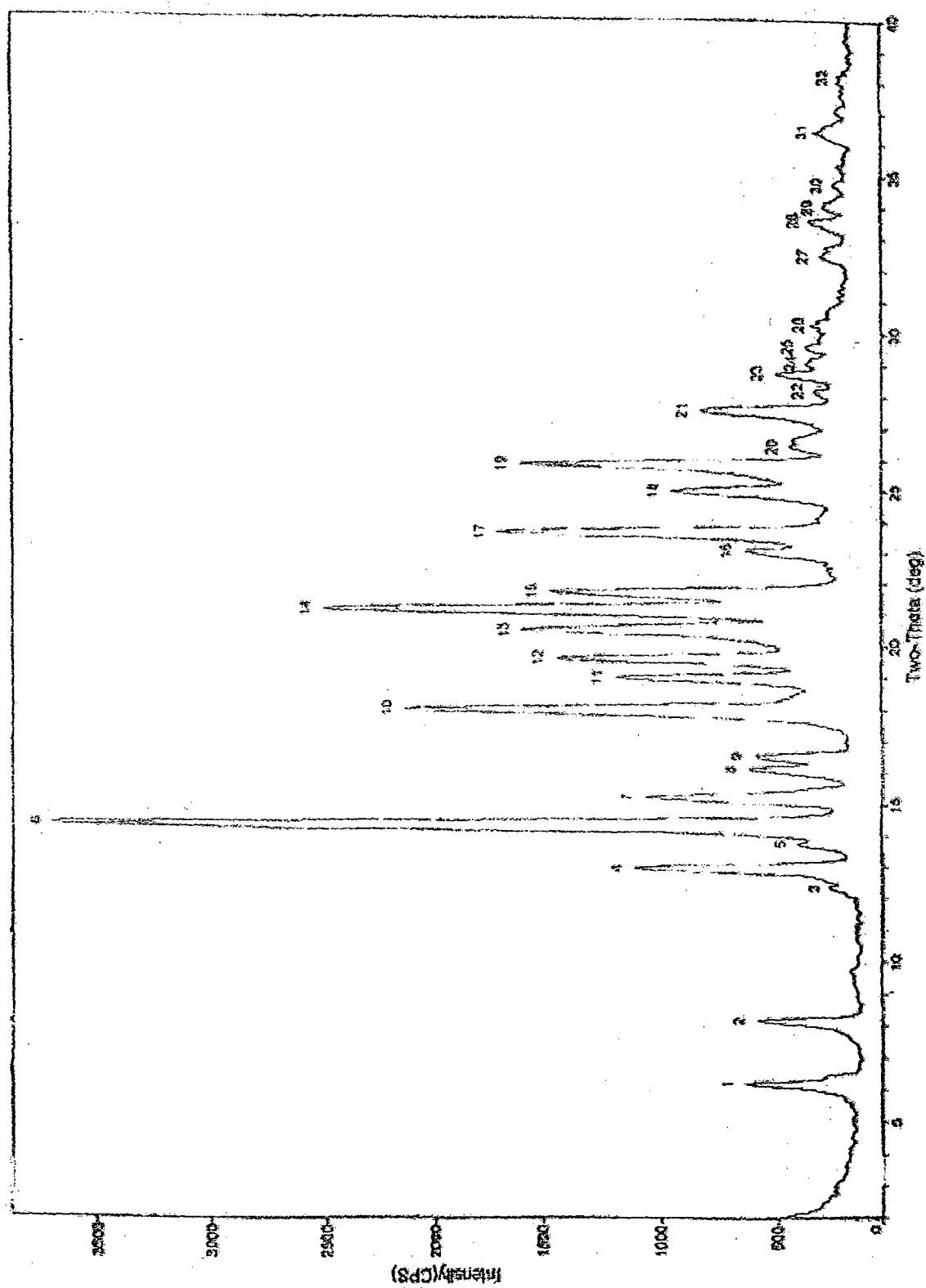
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FIG.11



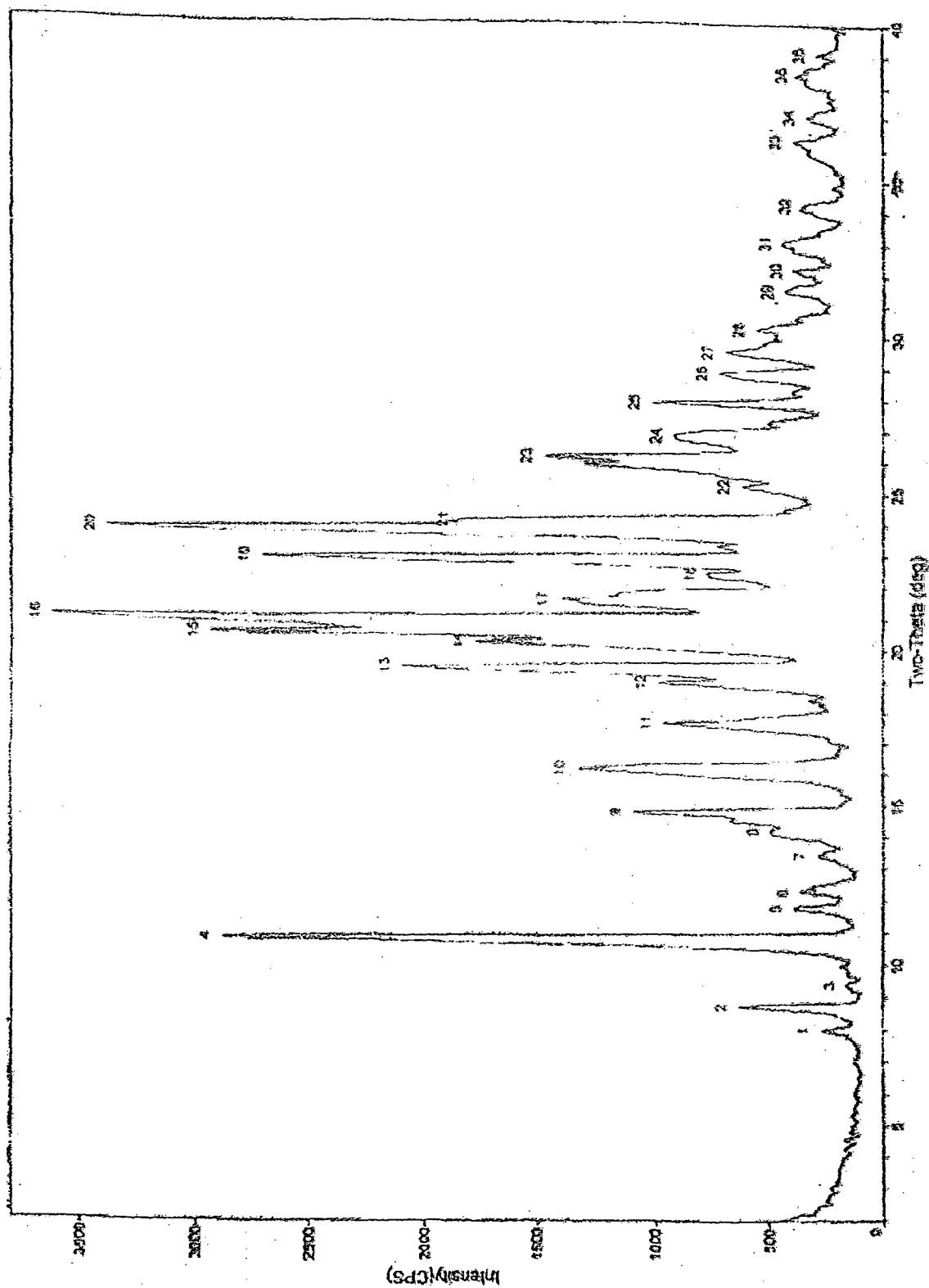
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FIG. 12



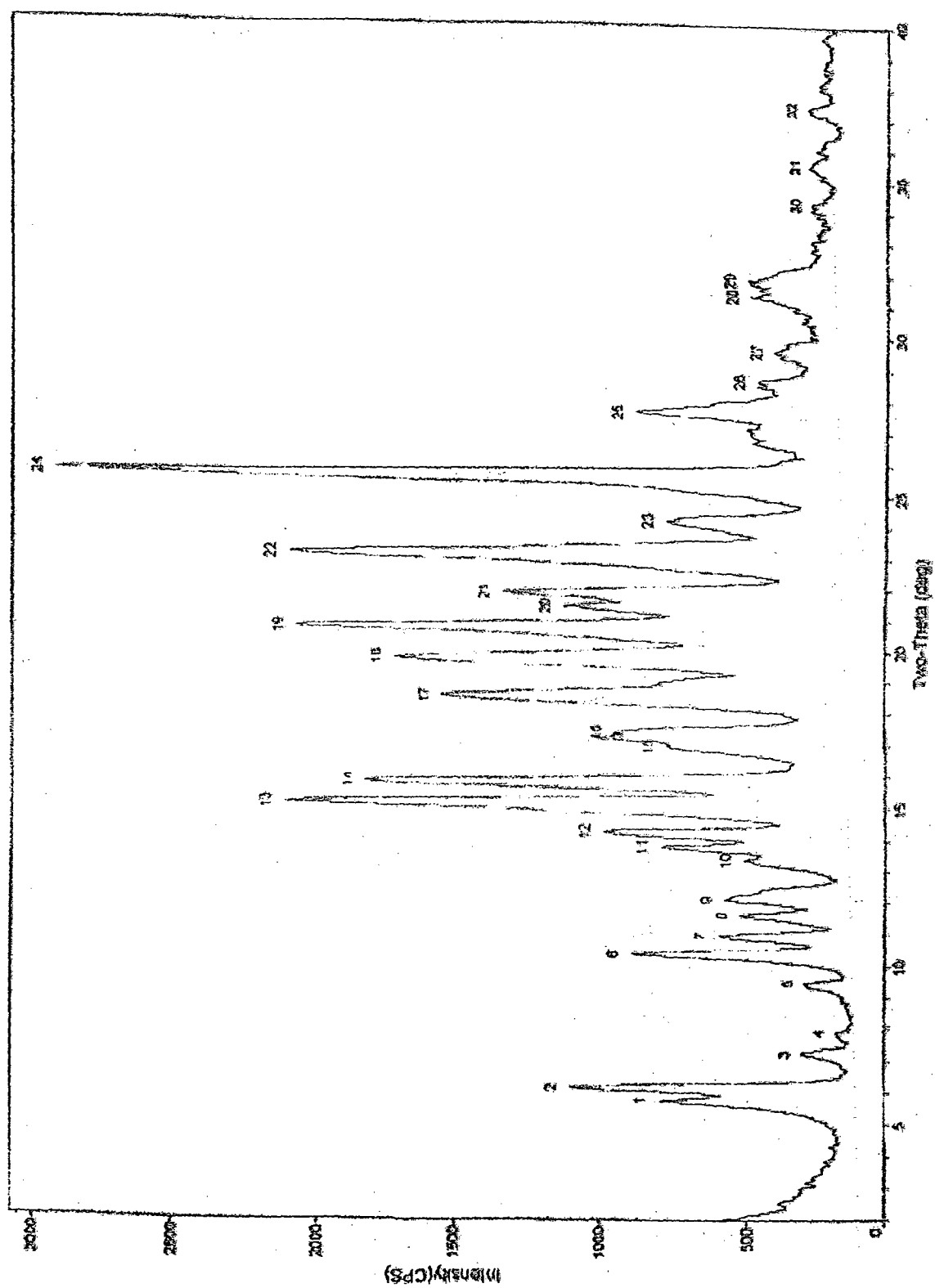
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FIG.13



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FIG.14



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FIG.15

