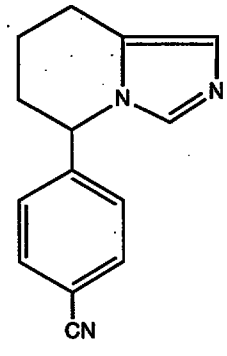
Hemihydrate

The invention relates to a novel crystalline form, containing water of crystallisation, of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride of formula Ia



• HCl (Ia),

to processes for the preparation thereof, to pharmaceutical compositions comprising that crystalline form, and to the use thereof for the therapeutic treatment of the human or animal body or for the preparation of pharmaceutical compositions.

The compound of formula Ia is disclosed, for example, in European Patent Application No. 165 904 as "5-(p-cyanophenyl)-5,6,7,8-tetrahydroimidazo[1,5-a]pyridine hydrochloride" and, on account of its properties inhibiting the enzyme aromatase, is proposed inter alia for the treatment of oestrogen-dependent diseases, especially oestrogen-dependent breast cancer in post-menopausal women.

The above-mentioned patent application also describes the preparation of the compound of formula Ia. In most cases it is effected by dissolving the free base in a small amount of acetone and adding an ethereal HCl solution. One example also describes the direct preparation of the compound of formula Ia by cyclisation of 4-[4-chloro-4-(p-cyanophenyl)-n-butyl]-1H-imidazole dissolved in chloroform. In all cases, the compound of formula Ia is obtained in anhydrous form, as the anhydrate.

It has now been found that the crystals of the anhydrate of formula Ia can be in at least two different crystal modifications. One of those modifications, hereinafter referred to as

"α-anhydrate", is characterised by the following lattice spacings (d values) and relative line intensities (intensity) of its X-ray powder pattern:

d values [in Angstroem (≙ 10^{-10} m)]	Intensity
9.5	very strong
6.8	very weak
6.6	very strong
5.89	medium
5.10	strong
4.87	medium
4.75	weak
4.61	strong
4.30	very weak
4.19	very strong
4.01	medium
3.79	medium
3.61	medium
3.58	medium
3.47	very strong
3.37	very weak
3.30	very strong
3.23	very weak
3.03	very weak

The following remarks relating to the measuring method may be made (they apply analogously to all X-ray powder patterns given below): To determine the lattice spacings = interplanar spacings (d values), the diffraction pattern is recorded on film. The recording is made in transmission using a Guinier camera (Enraf-Nonius FR 552) and copper-$K_{\alpha 1}$ radiation (wavelength $\lambda = 1.54060$ Angstroem). For calibration purposes there is used a pattern of quartz recorded on the same film. The relative line intensities are estimated by visual inspection.

The second crystal modification of the anhydrate of formula Ia, hereinafter designated "β-anhydrate", is characterised by the following X-ray powder pattern:

d values [in Angstroem (≙ 10^{-10} m)]	Intensity
12.1	very strong
7.3	weak
6.6	very strong
6.0	very strong
5.93	very weak
5.83	strong
4.61	strong
4.53	medium
4.46	strong
4.31	medium
4.13	strong
4.03	medium
3.99	weak
3.94	medium
3.66	weak
3.51	very strong
3.48	strong
3.40	strong
3.34	strong
3.28	medium
3.21	strong
3.11	medium
3.01	weak
2.97	medium

The crystals of the anhydrate of formula Ia - both the α- and the β-anhydrate - have the disadvantage that they are hygroscopic, that is to say they take up varying amounts of water as a function of the ambient humidity. Water is adsorbed even from relatively dry air, for example from air having a relative humidity of 33 % or 44 % (see Tables 1 and 2).

Table 1: Water absorption of the α-anhydrate of formula Ia at 44 % relative humidity and T = 23°C (in a climatic jar) as a function of time

Time [days]	Water content [in %]*)
0	0.62
4	2.43
7	2.82
11	3.12
15	3.19
18	3.28
21	3.32

*) basis: dry weight of the anhydrate

Table 2: Water absorption of the α-anhydrate of formula Ia at 33 % relative humidity and T = 23°C (in a climatic jar) as a function of time

Time [days]	Water content [in %]*)
0	0.62
4	0.75
7	0.85
11	1.00

*) basis: dry weight of the anhydrate

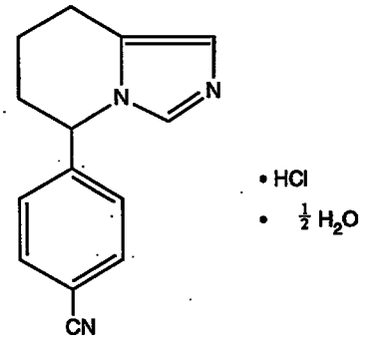
Because the crystals of the anhydrate of formula Ia are hygroscopic, their storage stability is considerably impaired. As a result, it is more difficult to process them into pharmaceutical compositions, especially into dosage forms suitable for oral administration, such as tablets.

Furthermore, there are at least two different crystal modifications of the anhydrate of formula Ia. This complicates the preparation of pharmaceutical compositions, especially of solid compositions, because it is necessary always to reckon with conversion - partial or

complete - of one modification into the other, or to take measures to prevent such conversion. Different crystal modifications can have different properties, for example as regards their micronisability, their general tablet-forming properties or their solubility. If there is inadvertently used instead of a given crystal modification X a different crystal modification Y which has formed from X, or a mixture of X and Y, then serious problems can arise in the preparation of pharmaceutical compositions.

The problem underlying the present invention is therefore to provide a novel crystalline form of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride that does not have the disadvantages mentioned above and that, in particular, is stable even when stored for several years.

A novel crystalline form of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride has now been found which, surprisingly, does not have the disadvantages inherent in the anhydrate of formula Ia and is completely stable to storage under normal ambient conditions. This novel crystalline form is the crystalline form of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride hemihydrate having the formula I:



• HCl

• $\frac{1}{2}$ H_2O (I).

Surprisingly, it has been found that neither varying the relative humidity within a range of from approximately 10 % to approximately 75 % nor heating for 8 days at 35° or 50°C brings about a detectable change in the X-ray powder pattern or the water content of the crystals of the hemihydrate of formula I (see Table 3).

Table 3: Water adsorption and water desorption experiments with the hemihydrate of formula I

Conditions	Duration [days]	T [°C]	Relative humidity [%]	Water content [%][1)]
climatic jar	2)	23	75 ($NaCl$)[3)]	3.74
climatic jar	2)	23	66 (Na_2CrO_4)[3)]	3.59
climatic jar	2)	23	54 ($Na_2Cr_2O_7$)[3)]	3.54
climatic jar	2)	23	33 ($MgCl_2$)[3)]	3.54
climatic jar	2)	23	23 (CH_3COOK)[3)]	3.59
climatic jar	2)	23	12 ($LiCl$)[3)]	3.54
open vessel	8	35	(≙ 21 %)	3.54
open vessel	8	50	(≙ 10 %)	3.44

1) basis: dry weight of the anhydrate; theoretical value for the hemihydrate of formula I: 3.47 %

2) after establishment of equilibrium

3) climate adjustment using corresponding saturated aqueous solutions

Table 3 shows that the crystals according to the invention of the hemihydrate of formula I have unlimited storage stability. This means that they can be stored as bulk goods ("batch") for several years without undergoing any change. In particular, they do not take up any more water, so that the content of active ingredient remains constant during storage and does not - as is the case with the known anhydrate of formula Ia - decrease continuously while the original weight remains the same. This is especially important in view of the extraordinarily high effectiveness of the compound and the consequent low dosage used in humans, which is in the range of only one or a few milligrams (see below).

The crystals of the hemihydrate of formula I are characterised by the following lattice spacings (d values) and relative line intensities (intensity) of their X-ray powder pattern:

d values [in Angstroem (≙ 10^{-10} m)]	Intensity
13.4	very strong
9.5	medium
8.2	weak
7.5	strong
6.7	very weak
6.5	very strong
5.65	very strong
5.42	strong
5.34	very strong
5.15	medium
4.99	medium
4.84	strong
4.60	strong
4.51	strong
4.20	strong
4.09	medium
4.00	strong
3.83	strong
3.81	medium
3.76	weak
3.74	medium
3.66	medium
3.62	strong
3.56	medium
3.51	medium
3.40	very weak
3.35	medium
3.29	very weak
3.25	strong
3.21	weak
3.19	weak
3.15	medium
3.13	very weak
3.04	strong
3.01	weak

The crystals of the hemihydrate of formula I are further characterised by their elemental analysis, which is in accordance with the values calculated for the molecular formula $C_{14}H_{13}N_3 \cdot HCl \cdot \frac{1}{2}H_2O$ (MW: 268.75):
C 62.57 %; H 5.63 %; N 15.64 %; Cl 13.19 %.

Preferably, the invention relates to the crystals of the hemihydrate of formula I in substantially pure form.

The crystals of the hemihydrate of formula I are prepared in a manner known per se, for example by

(a) reacting 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile with hydrogen chloride in the presence of water, or

(b) treating with water a form of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride that contains less water than does the hemihydrate of formula I to be prepared, or

(c) removing water from a form of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride that contains more water than does the hemihydrate of formula I to be prepared, or

(d) converting a salt of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile other than the hydrochloride into the hydrochloride hemihydrate of formula I in the presence of water.

Process (a): Prior to the reaction, the free base 4-(5,6,7,8-tetrahydroimidazo[1,5-a]-pyridin-5-yl)-benzonitrile used as starting material is preferably dissolved in an organic solvent, for example ethyl methyl ketone or, especially, acetone.

Preferably, the free base is converted into the hydrochloride hemihydrate of formula I using an aqueous hydrogen chloride solution. The concentration of the aqueous hydrogen chloride solution is not critical per se, but, in order to minimise losses in yield, the use of concentrated hydrochloric acid, especially 37 % hydrochloric acid, is preferred.

The reaction temperature is, for example, from 0° to 70°C, advantageously from 20° to 55°C; the reaction is carried out especially at room temperature.

Process (b): The treatment with water of, especially, solid forms of 4-(5,6,7,8-tetrahydro-imidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride that comprise less water than does the hemihydrate of formula I according to the invention, for example of the above-mentioned α- or β-anhydrate of formula Ia, is carried out in customary manner by the action of at least that amount of water required to form the hemihydrate. The water is preferably in the liquid or gaseous state.

In the case of treatment with water in the liquid state, the form of 4-(5,6,7,8-tetrahydro-imidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride having a low water content is suspended or dissolved in water or in an aqueous solvent mixture and then the crystals of the hemihydrate of formula I are isolated in customary manner. In the case of a solution, the hemihydrate of formula I must first be caused to crystallise in customary manner, for example by concentrating the solution, i.e. evaporating off part of the solution, adding a water-miscible solvent in which the hemihydrate of formula I is less soluble than in water, or by reducing the temperature. In a preferred form, crystallisation of the hemihydrate of formula I is initiated or accelerated by inoculation with seed crystals of the hemihydrate of formula I.

In the case of treatment with water in the gaseous state, the starting material is exposed to an atmosphere containing water vapour, e.g. moist air. The exposure time required for the conversion decreases as the relative humidity increases. At room temperature, the relative humidity is preferably approximately from 50 to 70 %.

The product is isolated in customary manner, for example by centrifugation, filtration or pressure filtration (filtration with suction). The product is advantageously dried at 20°-30°C; vacuum drying at 20°C is preferred.

Process (c): Suitable forms of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzo-nitrile hydrochloride are especially those which are solid or liquid, for example moist crystals, aqueous suspensions, aqueous solutions, suspensions in aqueous solvent mixtures, or solutions in aqueous solvent mixtures.

The excess water is removed, for example, by drying, advantageously at 20-30°C and preferably in vacuo at 20°C.

In the case of solutions or suspensions, the crystals of the hemihydrate of formula I are preferably isolated before drying, for example as indicated in process (b) by crystallisation and/or centrifugation, filtration or pressure filtration. However, the solutions or suspensions may also be concentrated directly by evaporation in vacuo, for example at 20-30°C.

Process (d): A salt other than the hydrochloride is preferably a pharmaceutically accept-

able salt.

Process (d) is known per se; for example, the salt other than the hydrochloride is dissolved in a water-containing solvent or solvent mixture, and an excess of chloride ions or, especially, hydrogen chloride is added. Preferably, the solvent selected is one in which the hydrochloride is less soluble than is the salt used as starting material.

The salt other than the hydrochloride that is required as starting material is prepared, for example, by reacting the free base 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile with the corresponding acid.

The present invention relates also to pharmaceutical compositions that comprise the crystals of the hemihydrate of formula I as active ingredient. Compositions for enteral, especially oral, administration are especially preferred. The compositions comprise the active ingredient on its own or, preferably, together with one or more pharmaceutically acceptable carriers. The dosage of the active ingredient depends upon the disease to be treated, and upon the species, its age, weight and individual condition, and upon the mode of administration.

The pharmaceutical compositions comprise from approximately 0.1 % to approximately 40 % active ingredient, dosage forms that are in single dose form preferably comprising from approximately 0.1 % to approximately 20 % active ingredient, and dosage forms that are not in single dose form preferably comprising from approximately 0.1 % to approximately 10 % active ingredient. Unit dose forms, such as dragées, tablets or capsules, comprise from approximately 0.1 mg to approximately 20 mg, preferably from approximately 1 mg to approximately 4 mg, of active ingredient.

The pharmaceutical compositions of the present invention are prepared in a manner known per se, for example by means of conventional mixing, granulating, confectioning, dissolving or lyophilising processes. For example, pharmaceutical compositions for oral administration can be obtained by combining the active ingredient with one or more solid carriers, optionally granulating a resulting mixture, and processing the mixture or granules, if desired and/or if appropriate by the addition of additional excipients, to form tablets or dragée cores.

Suitable carriers are especially fillers, such as sugars, for example lactose, saccharose,

mannitol or sorbitol, cellulose preparations and/or calcium phosphates, for example tri-calcium phosphate or calcium hydrogen phosphate, and also binders, such as starches, for example corn, wheat, rice or potato starch, methylcellulose, hydroxypropylmethyl-cellulose, sodium carboxymethylcellulose and/or polyvinylpyrrolidone, and/or, if desired, disintegrators, such as the above-mentioned starches, also carboxymethyl starch, cross-linked polyvinylpyrrolidone, alginic acid or a salt thereof, such as sodium alginate.

Additional excipients are especially flow conditioners and lubricants, for example silicic acid, talc, stearic acid or salts thereof, such as magnesium or calcium stearate, and/or polyethylene glycol, or derivatives thereof.

Dragée cores can be provided with suitable, optionally enteric, coatings, there being used inter alia concentrated sugar solutions which may contain gum arabic, talc, polyvinyl-pyrrolidone, polyethylene glycol and/or titanium dioxide, or coating solutions in suitable organic solvents or solvent mixtures or, for the preparation of enteric coatings, solutions of suitable cellulose preparations, such as acetylcellulose phthalate or hydroxypropyl-methylcellulose phthalate. Dyes or pigments may be added to the tablets or dragée coatings, for example for identification purposes or to indicate different doses of active ingredient.

Pharmaceutical compositions for oral administration are also dry-filled capsules consisting of gelatin, and soft sealed capsules consisting of gelatin and a plasticiser, such as glycerol or sorbitol. The dry-filled capsules may comprise the active ingredient in the form of granules, for example in admixture with fillers, such as corn starch, binders and/or glidants, such as talc or magnesium stearate, and optionally stabilisers. In soft capsules, the active ingredient is preferably dissolved or suspended in suitable liquid excipients, such as fatty oils, paraffin oil or liquid polyethylene glycols, it likewise being possible to add stabilisers.

Suitable rectally administrable pharmaceutical compositions are, for example, suppositories that consist of a combination of the active ingredient with a suppository base material. Suitable suppository base materials are, for example, natural or synthetic tri-glycerides, paraffin hydrocarbons, polyethylene glycols or higher alkanols.

The invention relates also to a method of treating diseases in mammals, including humans, which respond to an inhibition of the activity of the enzyme aromatase or suppression of

oestrogen synthesis, for example oestrogen-dependent diseases, especially oestrogen-dependent tumours, for example oestrogen-dependent breast cancer (mammary tumours), or gynaecomastia. The hemihydrate of the present invention can be administered prophylactically or therapeutically. In a warm-blooded animal having a body weight of approximately 70 kg, a daily dose of from approximately 0.1 mg to approximately 20 mg, preferably from approximately 1 mg to approximately 4 mg, of the hemihydrate of the present invention is administered.

The following Examples serve to illustrate the present invention, but are not intended to limit the scope thereof in any way. Temperatures are given in degrees Celsius.

Example 1: 4-(5,6,7,8-Tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride hemihydrate

33 kg of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile are introduced at 20-25° into 200 l of acetone, with stirring. As soon as everything has dissolved, 1.56 l of water and 1.8 kg of active carbon, made into a slurry with 6 l of acetone, are added. After stirring for 45 minutes at 20-25°, the batch is filtered and the residue is washed with 138 l of acetone. Approximately 12.5 l of hydrochloric acid (37 %) are introduced into the combined filtrates, with stirring at 20-25°, until pH 2.5-1.0 is reached. The resulting suspension is then stirred for 3 hours at 20-25° and centrifuged, and the residue is washed in portions with a total of 80 l of acetone. Vacuum drying at 20° yields the title compound in the form of a white crystalline powder.

X-ray powder pattern: lattice spacings/intensities as given above;

IR (Nujol): 3430 (strong), 3375 (strong), 2225 (strong) cm^{-1};

Elemental analysis: $C_{14}H_{13}N_3 \cdot HCl \cdot \frac{1}{2}H_2O$ (MW: 268.75)

calculated: C 62.57 %; H 5.63 %; N 15.64 %; Cl 13.19 %

found: C 62.53 %; H 5.57 %; N 15.66 %; Cl 13.21 %

Determination of water content (according to Karl-Fischer):

calculated: 3.35 %[1)]

found: 3.43 %.

[1)] The theoretical water content calculated here (based on the molecular weight of the hemihydrate of formula I) is not at variance with the theoretical water content of the hemihydrate of formula I given in Table 3, which is based on the dry weight (= molecular weight) of the anhydrate.

The free base used as starting material is prepared as described in EP-A-165 904, especially by ring closure of 5-(3-chloropropyl)-1-(p-cyanophenylmethyl)-1H-imidazole with potassium tert-butoxide in tetrahydrofuran (see Example 1 of EP-A-165 904).

Example 2: 4-(5,6,7,8-Tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride hemihydrate

5.3 kg of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride (α-anhydrate) are introduced into a stirred mixture of 1.5 l of water and 42 l of acetone. The mixture is heated and stirred at 50-55° until a clear solution is obtained. The solution is then cooled to 30° and inoculated with 5 g of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]-pyridin-5-yl)-benzonitrile hydrochloride hemihydrate. When crystallisation has begun, the mixture is cooled to 0° within a period of 45 minutes. 35 l of acetone are metered in at 0-5° within a period of 1 hour. The suspension is then stirred for 2 hours at 0-5° and centrifuged, and the crystalline residue is washed with 8 l of acetone. Drying in vacuo at 20° yields the title compound.

X-ray powder pattern: lattice spacings/intensities as given above;

IR (Nujol): 3430 (strong), 3375 (strong), 2225 (strong) cm^{-1};

Elemental analysis: $C_{14}H_{13}N_3 \cdot HCl \cdot \frac{1}{2}H_2O$ (MW: 268.75)

calculated:	C 62.57 %;	H 5.63 %;	N 15.64 %;	Cl 13.19 %
found:	C 62.63 %;	H 5.58 %;	N 15.67 %;	Cl 13.25 %

Determination of water content (according to Karl-Fischer):

calculated : 3.35 %

found: 3.46 %.

The α-anhydrate used as starting material is prepared as described in EP-A-165 904, that is to say by dissolving the free base in a small amount of acetone and neutralising with ethereal hydrogen chloride (see Example 1 of EP-A-165 904).

Example 3: 10 000 100 mg tablets are prepared, each comprising 2 mg of active ingredient:

Composition:

4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride hemihydrate	20.70 g
colloidal silica	2.00 g
microcrystalline cellulose	100.00 g

lactose, spray-dried	817.30 g
magnesium stearate	10.00 g
sodium carboxymethylcellulose	50.00 g
	1000.00 g

All the constituents of the tablet core are mixed together. When a homogeneous mixture has been obtained, it is compressed to form tablet cores.

Example 4: 10 000 100 mg tablets are manufactured, each comprising 1 mg of active ingredient:

Composition:

4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride hemihydrate	10.35 g
crystalline lactose	739.65 g
microcrystalline cellulose	230.00 g
colloidal silica	10.00 g
magnesium stearate	10.00 g
	1000.00 g

All the constituents of the tablet core are mixed together. When a homogeneous mixture has been obtained, it is compressed to form tablet cores.

What is claimed is:

1. 4-(5,6,7,8-Tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride in crystalline hemihydrate form.

2. 4-(5,6,7,8-Tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride in crystalline hemihydrate form according to claim 1, the X-ray powder pattern of which (Guinier camera, copper-$K_{\alpha 1}$ radiation) exhibits the following lattice spacings (d values) and relative line intensities (intensity):

d values [in Angstroem (≙ 10^{-10} m)]	Intensity
13.4	very strong
9.5	medium
8.2	weak
7.5	strong
6.7	very weak
6.5	very strong
5.65	very strong
5.42	strong
5.34	very strong
5.15	medium
4.99	medium
4.84	strong
4.60	strong
4.51	strong
4.20	strong
4.09	medium
4.00	strong
3.83	strong
3.81	medium
3.76	weak
3.74	medium
3.66	medium
3.62	strong
3.56	medium
3.51	medium
3.40	very weak
3.35	medium
3.29	very weak
3.25	strong
3.21	weak
3.19	weak
3.15	medium
3.13	very weak
3.04	strong
3.01	weak

3. The crystalline form according to claim 1 in substantially pure form.

4. The crystalline form according to claim 2 in substantially pure form.

5. A pharmaceutical composition comprising 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride in a crystalline form according to claim 1 or 2 and at least one pharmaceutically acceptable carrier.

6. The crystalline form according to any one of claims 1 to 4 for use in a method of therapeutically treating the animal or human body.

7. The crystalline form according to any one of claims 1 to 4 for use in the treatment of diseases that respond to inhibition of the enzyme aromatase.

8. The use of a crystalline form according to any one of claims 1 to 4 for the preparation of a pharmaceutical composition.

9. The use of a crystalline form according to any one of claims 1 to 4 for the preparation of pharmaceutical compositions for the treatment of diseases that respond to inhibition of the enzyme aromatase.

10. A process for the preparation of a crystalline form according to any one of claims 1 to 4, which comprises

(a) reacting 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile with hydrogen chloride in the presence of water, or

(b) treating with water a form of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride that contains less water than does the hemihydrate of formula I to be prepared, or

(c) removing water from a form of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile hydrochloride that contains more water than does the hemihydrate of formula I to be prepared, or

(d) converting a salt of 4-(5,6,7,8-tetrahydroimidazo[1,5-a]pyridin-5-yl)-benzonitrile other than the hydrochloride into the hydrochloride hemihydrate of formula I in the presence of water.