PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IB2018/056732	04.09.2018	05.09.2017

International Patent Classification (IPC) or both national classification and IPC
INV. C07D401/14 C07D213/73 A61P33/06 A61K31/506

Applicant
CADILA HEALTHCARE LIMITED

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Dunet, Guillaume Telephone No. +49 89 2399-0

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/IB2018/056732

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	2-6, 8, 9, 14, 15, 29, 30, 34, 35
	No:	Claims	1, 7, 10-13, 16-28, 31-33, 36, 37
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-37
Industrial applicability (IA)	Yes:	Claims	1-37
	No:	Claims	

2. Citations and explanations

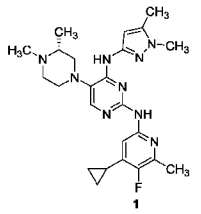
see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

The present application is directed towards a triaminopyrimidine compound of formula 1, solids forms thereof, a process for preparing it, the intermediates involved, as well as processes for preparing said intermediates.



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Item V:

Reference is made to the following documents:

D1 WO 2015/165660 A1 (MEDICINES FOR MALARIA VENTURE MMV [CH]) 5 November 2015 (2015-11-05)cited in the application

D2 SHAHUL HAMEED P. ET AL: "Triaminopyrimidine is a fast-killing and long-acting antimalarial clinical candidate",
NATURE COMMUNICATIONS,
vol. 6, no. 1, 31 March 2015 (2015-03-31), XP055478762,
DOI: 10.1038/ncomms7715

D3 MONICA A FITZGERALD ET AL: "Ni-Catalyzed C-H Functionalization in the Formation of a Complex Heterocycle: Synthesis of the Potent JAK2 Inhibitor BMS-911543",
JOURNAL OF ORGANIC CHEMISTRY,
vol. 80, no. 12, 7 April 2015 (2015-04-07), pages 6001-6011, XP055516661,
ISSN: 0022-3263, DOI: 10.1021/acs.joc.5b00572

D4 CAIRA ED - MONTCHAMP JEAN-LUC: "Crystalline Polymorphism of Organic Compounds",
TOPICS IN CURRENT CHEMISTRY; [TOPICS IN CURRENT CHEMISTRY], SPRINGER, BERLIN, DE,
vol. 198, 1 January 1998 (1998-01-01), pages 163-208, XP008166276,
ISSN: 0340-1022

Preliminary remark: when a compound is disclosed in a document, it is interpreted as being disclosed at all levels of purity.

1. Novelty

1.1. D1 discloses in its example 13 the triaminopyrimidine compound 1 that is obtained as a pure solid and it is also indicated in this document that such a compound is potentially useful for treating malaria. In addition, compound 5 is also disclosed (HCl salt of intermediate V on page 34 of D1). Compound 5b is also implicitly disclosed since intermediate V (in its HCl salt form) is further reacted under basic condition, i.e. the free base will be formed in situ (see for example the preparation of Intermediate Xa performed in the presence of 2 equiv. sodium tert-butoxide). Likewise, free base 2 and its use as intermediate in the preparation of compound 1, is also implicitly disclosed in example 13 of D1 since the HCl salt of compound 2 (obtained in example 2 of D1 is contacted with 2.5 equiv. of DIPEA, i.e. the free base will be formed in situ).

The preparation of compound 5 from compound 3a via intermediates 4a and 2a is also disclosed (see pages 33-34); however, D1 does not mention a crystallisation step at the end of the process.

The preparation of compound 1 from compounds 9 and 10 via intermediates 8, 7, 4 and 2 is also disclosed (see the scheme on page 27,and the preparation of intermediates II, III, IVa, as well as example 2 and 13).

Therefore, D1 seems to be relevant for the novelty of claims 1, 7, 10-13, 21-28, 31-33, 36 and 37 (Art. 33(2) PCT).

1.2. D2 discloses, as in D1, compound 1 (as a solid) , its preparation from compounds 9 and 10 via intermediates 8, 7, 4 and 2 *see Figure 1 on page 2 and the experimental parts on pages 7-8), and its use as a potential anti-malarial agent (see the passages cited in the SR)

Therefore, D2 seems to be relevant for the novelty of claims 1, 12, 13, 21-28, 31-33, 36 and 37 (Art. 33(2) PCT).

1.3. The preparation of compound 6 from a 2-butenenitrile via halogenation and reaction with methyl hydrazine is known from D3 (see in particular Scheme 8 on page 6005). D3 thus seems to be relevant for the novelty of claims 16-20 (Art. 33(2) PCT).

1.4. D4 is concerned with polymorphism in pharmaceutically interesting compounds, but fails to disclose compounds 1, 2, 5 or 6.

1.5. As a consequence, only claims 2-6, 8, 9, 14, 15, 29, 30, 34 and 35 seem to be novel (Art. 33(2) PCT).

2. Inventive step

2.1. D1 is seen as the closest prior art. The crystalline forms of claims 2-6 differ from the solid compound disclosed in example 13 of D1 in their internal structure. In the absence of any demonstrated advantage / technical effect associated with the solid forms of the invention, the problem to be solved is seen as the provision of further solid forms of compound 1.

2.2. The biological activity of a compound depends primarily on its molecular structure. To reach its target, it will be at some point in solution (e.g. in body fluids) where all differences among solid forms / polymorphs disappear. The skilled person would thus expect that all solid forms /polymorphs of a given compound (here compound 1) possess, at least to some extent, the same activity (here an anti-malarial activity). From the common technical knowledge, it is known that the systematic investigation of a compound to determine whether it is prone to polymorphism is routine practice in the pharmaceutical industry. It is also known that most substances will reveal more than one polymorph if investigated for a sufficiently long time (see D4, the paragraph bridging pages 165-166). In addition, the methods to scree for polymorphs are well known in the art (see paragraph 3.1. of D4). The skilled person interested in the therapeutic application of compound 1 would thus routinely screen for solid forms / polymorphs. If such routine work yields another solid form / polymorph which does not display any substantiated unexpected property, then its provision is an obvious solution of the underlying technical problem, and no inventive step can be acknowledged for said further solid form / polymorph.

Consequently, none of the solid forms of claims 2-6, and their use in therapy, is seen as involving an inventive step (Art. 33(3) PCT).

2.3. Regarding the crystalline compounds 5 of claims 8 and 9 , the problem to be solved can be seen as the provision of a further solid form of compound 5. Again, compound is known to be solid, it would thus be trivial for the skilled person looking for an alternative form of the known intermediate to consider trying to crystallise it by known methods (e.g. those described in D4). Consequently, none of the solid forms of clams 8 and 9 is seen as involving an inventive step (Art. 33(3) PCT).

2.4. For the same reasons, it would be an obvious alternative for the skilled person to envision trying to crystallise compound 5 at the end of an already known reaction sequence, i.e. the process of claim 14 is also considered to lack inventiveness (Art. 33(3) PCT).

2.5. Similarly, the process of claim 30 is not seen as inventive either insofar as it would be a trivial alternative for the skilled person looking for a further form of a compound known to be solid (as evidenced from the first step of example 13 in D1) to envision trying to crystallise it using standard methods (like those described in D4).

2.6. Finally, the features of claim 35 are not seen as involving an inventive step either in view of D4 since they correspond to the use of standard solvents for testing the presence of polymorph of a known substance, as already suggested in D4.

2.7. All in all, known of claims 1-37 is seen as involving an inventive step (Art. 33(3) PCT).

Item VIII:

3.1. claim 4: a) the claim contains a reference to the to the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here; b) the use of the term "substantially same", without any precise definition of its meaning, renders the exact scope of protection sought unclear (Art. 6 PCT).

3.2. claim 6: a) the claim contains a reference to the to the drawings. According to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here; b) the use of the term "substantially same", without any precise definition of ots meaning, renders the exact scope of protection sought unclear (Art. 6 PCT).

3.3. Claim 11: the use of the term "substantially free", without any precise definition of its meaning, renders the exact scope of protection sought unclear (Art. 6 PCT).

3.4. Claim 21: the nature / structure of "compound 1" is missing, thus rendering the exact scope of protection sought unclear (Art. 6 PCT).

3.5. Claim 22: the use of the term "substantially free", without any precise definition of its meaning, renders the exact scope of protection sought unclear (Art. 6 PCT).

3.6. Claims 23-25: the nature / structure of "compound 1" is missing, thus rendering the exact scope of protection sought unclear (Art. 6 PCT).

3.7. Claim 30: the nature / structure of "free base compound 2" is missing, thus rendering the exact scope of protection sought unclear (Art. 6 PCT).

3.8. Claim 31: the nature / structure of "compound 1" and "compound 2" is missing, thus rendering the exact scope of protection sought unclear (Art. 6 PCT).

3.9. Claims 34-37: the nature / structure of "compound 1" is missing, thus rendering the exact scope of protection sought unclear (Art. 6 PCT).

3.10. Claim 36: the use of the term "substantially pure", without any precise definition of its meaning, renders the exact scope of protection sought unclear (Art. 6 PCT).

3.11. Claims 27 and 28: it is not clear to which step of he process of claim 25 the limitation of the nature of the base and acid applies to (Art. 6 PCT)..

3.12. Claim 30: it is not clear what has to be crystallised in order to obtain free base compound 2 (Art. 6 PCT).

3.13. Claim 34: it is not clear what has to be crystallised in order to obtain compound 1 (Art. 6 PCT).

3.14. Finally, the use of the term "about" throughout the claims, without a precise definition of its meaning, renders the exact scope of protection sought unclear (Art. 6 PCT).