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- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the  
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(54) Title: METHOD FOR LIQUID AUTHENTICATION BY DETECTION OF FLAVONOID DERIVATIVES

(57) Abstract: A Liquid, comprising an hydrophobic flavonoid derivative electrochemically non-active, that is capable of restoring its electrochemical activity, the concentration of the flavonoid derivative being 10 ppm by weight or less, and an organic substance in an amount of 90% by weight or more.



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# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |                                                                              |                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------------|-----------------------|
| Applicant's or agent's file reference<br>184 158 aa/ea                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>FOR FURTHER ACTION</b>                                |                                                                              | See Form PCT/IPEA/416 |
| International application No.<br>PCT/EP2015/072109                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | International filing date (day/month/year)<br>25.09.2015 | Priority date (day/month/year)<br>30.09.2014                                 |                       |
| International Patent Classification (IPC) or national classification and IPC<br>INV. B01J19/00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                          |                                                                              |                       |
| Applicant<br>SICPA HOLDING SA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                          |                                                                              |                       |
| <p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>10</u> sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (sent to the applicant and to the International Bureau) a total of <u>8</u> sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and/or sheets containing rectifications authorized by this Authority, unless those sheets were superseded or cancelled, and any accompanying letters (see Rules 46.5, 66.8, 70.16, 91.2, and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets containing rectifications, where the decision was made by this Authority not to take them into account because they were not authorized by or notified to this Authority at the time when this Authority began to draw up this report, and any accompanying letters (Rules 66.4bis, 70.2(e), 70.16 and 91.2).</p> <p><input type="checkbox"/> superseded sheets and any accompanying letters, where this Authority either considers that the superseding sheets contain an amendment that goes beyond the disclosure in the international application as filed, or the superseding sheets were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in item 4 of Box No. I and the Supplemental Box (see Rule 70.16(b)).</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing, in the form of an Annex C/ST.25 text file, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3ter of Annex C of the Administrative Instructions).</p> |                                                          |                                                                              |                       |
| <p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input checked="" type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned conclusion under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                          |                                                                              |                       |
| Date of submission of the demand<br><br>15.07.2016                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          | Date of completion of this report<br><br>02.02.2017                          |                       |
| Name and mailing address of the international preliminary examining authority:<br> European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0<br>Fax: +49 89 2399 - 4465                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                          | Authorized officer<br><br>Greß, Tobias<br><br>Telephone No. +49 89 2399-7616 |                       |



# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.  
PCT/EP2015/072109

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## Box No. I Basis of the report

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1. With regard to the **language**, this report is based on
- ☒ 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 (under Rules 12.3(a) and 23.1(b))
    - ☐ publication of the international application (under Rule 12.4(a))
    - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a) and (b))
2. With regard to the **elements\*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

### Description, Pages

1-29 as originally filed

### Claims, Numbers

1-22 filed with telefax on 15-12-2016

### Drawings, Sheets

1-5 as originally filed

- ☐ a sequence listing - see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-bis)):
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
5. ☐ This report has been established:
- ☐ taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rules 66.1(d-bis) and 70.2(e)).
  - ☐ without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91(Rules 66.4bis and 70.2(e)).

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/EP2015/072109

6. ☒ With regard to top-up searches (Rules 66.1 *ter* and 70.2(f)):
- ☒ A top-up search was carried out by this Authority on 08.08.2016 (all discovered documents are listed in the Supplemental Box Relating to Top-up Search).
  - ☐ Additional relevant documents have been discovered during the top-up search.
  - ☐ No top-up search was carried out by this Authority because it would serve no useful purpose.
7. ☐ Supplementary international search report(s) from Authority(ies) has/have been received and taken into account in establishing this report (Rule 45bis.8(b) and (c)).

\* If item 4 applies, some or all of those sheets may be marked "superseded".

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**Box No. IV Lack of unity of invention**

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1. ☒ In response to the invitation to restrict or pay additional fees, the applicant has, within the applicable time limit:
- ☐ restricted the claims.
  - ☒ paid additional fees.
  - ☐ paid additional fees under protest and, where applicable, the protest fee.
  - ☐ paid additional fees under protest but the applicable protest fee was not paid.
  - ☐ neither restricted the claims nor paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is:
- ☐ complied with.
  - ☒ not complied with for the following reasons:  
**see separate sheet**
4. Consequently, this report has been established in respect of the following parts of the international application:
- ☒ all parts.
  - ☐ the parts relating to claims Nos. .

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

|                               |             |               |
|-------------------------------|-------------|---------------|
| Novelty (N)                   | Yes: Claims | <u>1-20</u>   |
|                               | No: Claims  | <u>21, 22</u> |
| Inventive step (IS)           | Yes: Claims | <u>1-20</u>   |
|                               | No: Claims  | <u>21, 22</u> |
| Industrial applicability (IA) | Yes: Claims | <u>1-22</u>   |
|                               | No: Claims  |               |

2. Citations and explanations (Rule 70.7):

**see separate sheet**

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**Box No. VII Certain defects in the international application**

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The following defects in the form or contents of the international application have been noted:

**see separate sheet**

1 Reference is made to the following documents:

- D1 Isidro Hermosín-Gutiérrez ET AL: "Flavonol Profiles for Grape and Wine Authentication"  
In: "Cellulose Solvents: For Analysis, Shaping and Chemical Modification", 1 January 2011 (2011-01-01), American Chemical Society, Washington, DC, XP055198980,  
ISSN: 0097-6156  
ISBN: 978-0-84-120007-4  
vol. 1081, pages 113-129, DOI: 10.1021/bk-2011-1081.ch008,
- D2 WO 2008/086897 A1 (AJINOMOTO OMNICHEM S A [BE]; VAN BRUSSEL WILLY [BE]; SCHELKENS GEERT []) 24 July 2008 (2008-07-24)
- D3 US 5 984 983 A (ASGAONKAR ANJALI [US] ET AL) 16 November 1999 (1999-11-16)
- D4 A.C. WAISS ET AL: "NMR study of trimethylsilyl ethers of flavonoid compounds",  
TETRAHEDRON LETTERS,  
vol. 5, no. 10, 1 January 1964 (1964-01-01), pages 513-518,  
XP055227414,  
GB  
ISSN: 0040-4039, DOI: 10.1016/S0040-4039(00)73265-5
- D5 CN 102 993 148 A (UNIV FUDAN) 27 March 2013 (2013-03-27)
- D6 KEIZO HAYASHIYA: "Studies on Flavonoid. Part V",  
NIPPON NOGEI KAGAKUKAISHI - JOURNAL OF THE AGRICULTURAL CHEMICAL SOCIETY OF JAPAN,  
vol. 33, no. 12, 1 January 1959 (1959-01-01), pages 1065-1068, XP055227473,  
JP  
ISSN: 0002-1407, DOI: 10.1271/nogeikagaku1924.33.12\_1065

- D7 Pavel Hanustiak ET AL: "ELECTROCHEMICAL BEHAVIOUR OF FLAVONIDS ON A SURFACE OF A CARBON PASTE ELECTRODE",  
Papers, 1 January 2005 (2005-01-01), XP055243195,  
Retrieved from the Internet:  
URL:[http://web2.mendelu.cz/af\\_239\\_nanotech/data/pub/hanubm.pdf](http://web2.mendelu.cz/af_239_nanotech/data/pub/hanubm.pdf)  
[retrieved on 2016-01-20]
- D8 US 6 699 384 B1 (LIN YUEHE [US] ET AL) 2 March 2004  
(2004-03-02)
- D9 JP 2006 337221 A (SHARP KK) 14 December 2006  
(2006-12-14)
- D10 US 2014/120521 A1 (ABI-SAMRA KAMEEL [US] ET AL) 1  
May 2014 (2014-05-01)
- D11 Francesca Mainini ET AL: "Synthesis, Molecular  
Characterization and Preliminary Antioxidant Activity  
Evaluation of Quercetin Fatty Esters",  
JOURNAL OF THE AMERICAN OIL CHEMISTS' SOCIETY  
(JAOCS),  
vol. 90, no. 11, 6 September 2013 (2013-09-06), pages  
1751-1759, XP055221995,  
DE  
ISSN: 0003-021X, DOI: 10.1007/s11746-013-2314-0
- D12 G. I. Samokhvalov ET AL: "7-alkyl ethers of quercetin and  
their antioxidant efficiency",  
BULLETIN OF THE ACADEMY OF SCIENCES OF THE  
USSR, DIVISION OF CHEMICAL SCIENCES.,  
vol. 12, no. 9, 1 September 1963 (1963-09-01), pages  
1475-1478, XP055294381,  
US  
ISSN: 0568-5230, DOI: 10.1007/BF00844096

D13                      Werner Heimann ET AL: "Beitrag zur Bildung von Allyläthern in der Flavonreihe und Versuche zur Claisen-Umlagerung mit besonderer Berücksichtigung des Quercetins",  
Chemische Berichte,  
vol. 98, no. 1, 1 January 1965 (1965-01-01), pages 114-119,  
XP055294384,  
DE  
ISSN: 0009-2940, DOI: 10.1002/cber.19650980114

2                      **Re Item IV**

**Lack of unity of invention**

2.1                      This Authority considers that the application does not meet the requirements of unity of invention and that there are 2 inventions covered by the claims indicated as follows:

1.                      claims: 1-12, 19-22

A composition comprising a flavonoid, a use of a flavonoid derivative, a method for authenticating the genuineness and/or origin of a composition containing a flavonoid derivative, a system comprising a flavonoid derivative, and a flavonoid derivative, wherein the flavonoid derivative is obtainable by modifying the hydroxyl groups of a flavonoid with organic groups.

2.                      claims: 13-18

A detection device.

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

There is no common concept linking together the independent claims 1, 5, 7, 13, 19, 21. Claim 13 is directed to a detection device which is merely configured to fully or partially de-derivatize a (generic) flavonoid derivative dissolved in a composition that is a liquid at 20°C and 1 atm pressure and to separate said partially or fully de-derivatized flavonoid from said composition. Claim 13 is silent about any intentional addition of the marker to the composition that is a liquid at 20°C and 1 atm pressure. Claims 1, 5, 7, 19, 21

are linked by a (specific) flavonoid derivative obtainable by modifying the hydroxyl groups of a flavonoid with organic groups. However, the use of a flavonoid derivative as an authenticating marker is known in the art.

- 2.2 Document D1 discloses (the references in parentheses applying to this document):

A method for grape and wine cultivar authentication and differentiation comprising detection of flavonoid structures (e.g. quercetin-derivatives; abstract; fig. 1; tab. 1).

- 2.3 The applicant argued that the common concept of the invention was the use of a flavonoid derivative as an authenticating marker by electrochemical analysis. However, claim 5 is silent about any electrochemical analysis.

In conclusion, the groups of claims are not linked by common or corresponding special technical features and define 2 different inventions not linked by a single general inventive concept.

The application, hence does not meet the requirements of unity of invention as defined in Rules 13.1 and 13.2 PCT.

3 **Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

- 3.1 The subject-matter of claims 21-22 is not new in the sense of Article 33(2) PCT, and therefore the criteria of Article 33(1) PCT are not met.

- 3.1.1 The document D11 discloses (the references in parentheses applying to this document):

Quercetin fatty acid esters (Scheme 1).

The subject-matter of claims 21-22 is therefore not new.

- 3.1.2 The document D12 discloses (the references in parentheses applying to this document):

Quercetin alkyl ethers (p. 1476-1477).

The subject-matter of claims 21-22 is therefore not new.

- 3.1.3 The document D13 discloses (the references in parentheses applying to this document):

Quercetin ally ethers (fig. 2).

The subject-matter of claims 21-22 is therefore not new.

- 3.2 Document D3 is regarded as being the prior art closest to the subject-matter of claims 1, 5, 7, 19.

The document D3 discloses (the references in parentheses applying to this document):

A method of tagging and identifying a petroleum fuel consisting essentially of adding to said petroleum fuel between about 0.25 and about 100 ppm of a carbonyl compound(s) to produce a tagged petroleum fuel and subsequently detecting the presence of said carbonyl compound(s) by measuring the mid-IR absorbency peak(s) of the carbonyl compound(s) said carbonyl compound(s) may be a flavone (claim 1; col. 4, l. 5).

The subject-matter of claims 1, 5, 7, 19 therefore differs from this known D3 in that the marker is a latent marker (protected flavonoid) which may be electrochemically detected after deprotection.

Albeit it is known in the art that flavonoids may be electrochemically detected (cf. D7: abstract), none of the available prior art includes any pointers to protect flavonoids and use them as latent markers.

- 3.3 Claims 2-4, 12 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
- 3.4 Claims 6, 12 are dependent on claim 5 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
- 3.5 Claims 8-12 are dependent on claim 7 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
- 3.6 Claims 20 is dependent on claim 19 and as such also meets the requirements of the PCT with respect to novelty and inventive step.
- 3.7 Document D8 is regarded as being the prior art closest to the subject-matter of claim 13.

The document D8 discloses (the references in parentheses applying to this document):

A compact electrochemical sensor system comprising a first entry and a first fluid reservoir for a sample, a second entry and a second reservoir for an electrolyte solution, a mixing/ reaction channel, and a electrochemical cell (claim 1; fig. 2; ex. 1).

The subject-matter of claim 13 therefore differs inter alia from this known D8 in the separate micro-fluidic reaction chamber and in the mixing channel configured to establish a laminar side-by-side flow and is therefore new (Article 33(2) PCT).

None of the available prior art includes any pointers to a combination of a micro-fluidic reaction chamber, a mixing channel configured to establish a laminar side-by-side flow, and a electrochemical detection chamber.

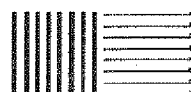
Thus, claim 13 of the present application is considered as involving an inventive step (Article 33(3) PCT).

- 3.8 Claims 14-18 are dependent on claim 13 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

4 **Re Item VII**

**Certain defects in the international application**

Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1, D3, D7, D8 is not mentioned in the description, nor are these documents identified therein.



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Munich, December 15, 2016

**Our Ref.: 184 158 n9/aro**  
**International Application PCT/EP2015/072109**  
**SICPA HOLDING SA**

The Applicant thanks the Substantive Examiner for the telephone call conducted on December 13, 2016, wherein possibly remaining objections against the set of claims as filed on October 26, 2016 were discussed.

In view of this telephone discussion, the Applicant herewith files a new set of claims 1 to 22, and it is respectfully requested that the IPRP be issued on the basis of these claims. These claims correspond exactly to those as filed on October 26, 2016, except that it is specified in claim 5 that the flavonoid derivative/marker is a substance that is not naturally occurring in the composition that is liquid at 20°C and 1 atm pressure. Support for the introduction of this feature can be found on page 8, at the end of the penultimate paragraph, of the application as filed.

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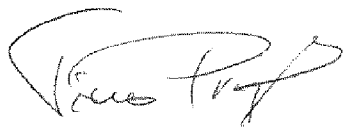
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It is trusted that in view of this amendment to the claims, the novelty objection on the basis of document D1 (analyzing naturally occurring species in a wine) will no longer be maintained, and that therefore an IPRP acknowledging novelty and inventive step for the subject matter of claims 1 to 20 can be issued.

As further indicated, the objections against the further claims and the unity objection will be dealt with during the national/regional phases.



DR. TIMO PRÜß

European Patent Attorney

Hoffmann Eitle PartmbB

Association No. 151

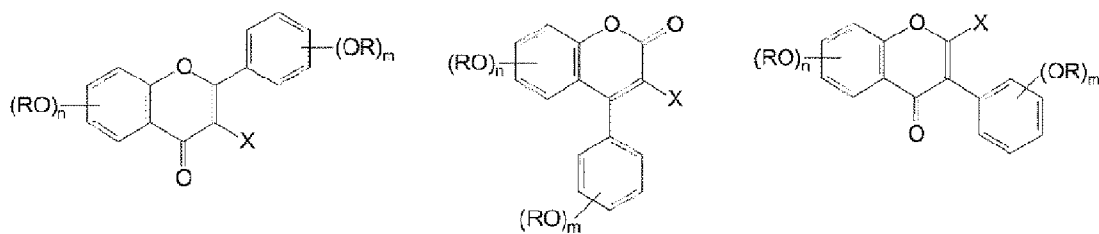
**Enclosure:** new set of claims 1 to 22

International Patent Application No. PCT/EP2015/072109  
SICPA HOLDING SA

184 158 n9  
December 15, 2016

### New Claims

1. A composition that is a liquid at 20 °C and 1 atm pressure, comprising
  - a) a flavonoid derivative obtainable by modifying the hydroxyl groups of a flavonoid with organic groups, the concentration of the flavonoid derivative being 100 ppm by weight or less, and
  - b) an organic substance in an amount of 90% by weight or more.
2. The composition that is a liquid at 20 °C and 1 atm pressure according to claim 1, which is a fuel and wherein the organic substance is present in an amount of equal to or greater than 95% by weight and is one or more hydrocarbons having 6 to 22 carbon atoms, methanol or ethanol.
3. The composition according to claim 1 or 2, wherein the flavonoid derivative loses some or all of the modifying organic groups upon heating to a temperature of 50 °C or higher.
4. The composition according to any one of claims 1 to 3, wherein the flavonoid derivative obtainable by modifying the hydroxyl groups of a flavonoid with organic groups is represented by any of the following formulae:



where X represents H or OR;

n represents an integer of 0 to 4, and m represents an integer of 0 to 5, provided the sum of m and n is 2 or more, „

several R in one molecule can be the same or different, and each R can be

H,

a branched, linear or cyclic alkyl group having 1 to 50 carbon atoms,

a C(=O)-alkyl group, wherein the alkyl group is defined as above,

a trialkylsilyl group, wherein the alkyl groups each are independently a branched, linear or cyclic alkyl group having 1 to 50 carbon atoms,

a diarylalkylsilyl group having two aryl groups and one alkyl group, wherein the alkyl group is a branched, linear or cyclic alkyl group having 1 to 50 carbon atoms, and the aryl groups are each independently aromatic rings having 6 to 10 carbon atoms,

a dialkylarylsilyl group having one aryl group and two alkyl groups, wherein the alkyl groups and the aryl groups are defined as above for the diarylalkylsilyl group,

an allyl group,

a methylene alkylether group, wherein the alkyl group is defined as above, or

a tetrahydropyranyl group,

with the proviso that at least one of the R groups does not represent hydrogen.

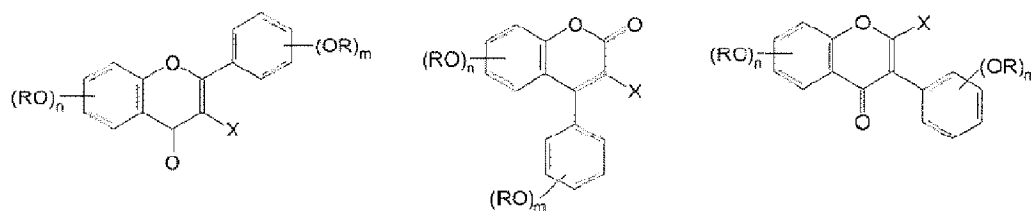
5. Use of a flavonoid derivative obtainable by modifying the hydroxyl groups of a flavonoid with organic groups as an authenticating marker in a composition that is a liquid at 20 °C and 1 atm pressure, wherein the marker is not naturally occurring in the composition that is liquid at 20 °C and 1 atm pressure.
6. Use according to claim 5, wherein the flavonoid derivative is as defined in claim 4.
7. A method for authenticating the genuineness and/or origin of a composition that is a liquid at 20 °C and 1 atm pressure containing a flavonoid derivative obtainable by derivatizing the hydroxyl groups of a flavonoid with organic groups, comprising the steps of
  - mixing said flavonoid derivative with an electrolytic solution to produce a mixture;
  - heating and then cooling the mixture to produce a flavonoid or flavonoid derivative that is electrochemically more active as compared to the flavonoid derivative that is mixed with an electrolytic solution to produce the mixture ;
  - separating said obtained electrochemically more active flavonoid or flavonoid derivative from the mixture, and
  - electrochemical analysis of the obtained electrochemically more active flavonoid or flavonoid derivative.

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AMENDED SHEET

8. The method according to claim 7, wherein the composition that is a liquid is a fuel and wherein the concentration of the marker is equal to or less than 10 ppm by weight.
9. The method according to any one of claims 7 and 8, wherein the method is implemented in a portable device.
10. The method according to any one of claims 7 to 9, wherein the separation of the obtained electrochemically more active flavonoid or flavonoid derivative from the composition that is a liquid is achieved with a flow side by side in a mixing channel where also the electrolytic solution is flowing.
11. The method according to any one of claims 7 to 10, which is performed in a lab-on-chip detection device.
12. The composition that is a liquid at 20 °C and 1 atm pressure according to any one of claims 1 to 4, use according to claims 5 or 6 or the method according to any one of claims 7 to 11, wherein the flavonoid derivative obtainable by modifying the hydroxyl groups of a flavonoid with organic groups contains a structural unit derived from quercetin or morin.
13. A detection device configured to fully or partially de-derivatize a flavonoid derivative dissolved in a composition that is a liquid at 20 °C and 1 atm pressure and to separate said partially or fully de-derivatized flavonoid from said composition, comprising:
  - a reaction chamber (100) for holding a reactant and for receiving said composition;
  - a first entry (101) and a microfluidic channel for introducing an amount of said liquid into the reaction chamber (100);
  - a heater (104) for heating up the reaction chamber (100) to a reaction temperature;
  - an electrolytic solution chamber for holding an electrolytic solution;
  - a second entry (102) for introducing an amount of said electrolytic solution into the electrolytic solution chamber (100);

- a mixing channel (110) configured to establish a laminar side-by-side flow of the mixture of said composition and reactant from the reaction chamber (100) and the electrolytic solution from the electrolytic solution chamber; and
  - a detection chamber (120) arranged at the end of said mixing channel (110) and having electrodes for electrochemical analysis.
14. The detection device of claim 13, wherein the device further comprises an active cooling element for cooling said reaction chamber (100).
15. The detection device of claim 13 or 14, wherein the detection chamber (120) comprises hydrophilic surface.
16. The detection device of any one of claims 13 to 15, wherein the detection chamber (120) comprises a working electrode (122), a counter electrode (121), and a reference electrode (123).
17. The detection device of claim 16, wherein the working electrode (122) comprises a microelectrode array.
18. The detection device of any one of claims 13 to 17, further comprising a controller configured to control fluid flow and temperature for performing a method of any one of claims 7 to 12.
19. A system comprising a detection device according to any one of claims 13 to 18, a composition that is a liquid at 20 °C and 1 atm pressure; and a flavonoid derivative obtainable by modifying the hydroxyl groups of a flavonoid with organic groups dissolved in the liquid with a concentration of equal to or less than 10 ppm by weight.
20. The system according to claim 19, wherein the flavonoid derivative contains a structural unit derived from quercetin or morin.
21. A flavonoid derivative represented by any of the following formulae:



where X represents H or OR,

n represents an integer of 0 to 4, and m represents an integer of 0 to 5, provided the sum of m and n is 2 or more,

several R in one molecule can be the same or different, and each R can be

H,

a branched, linear or cyclic alkyl group having 2 to 50 carbon atoms,

a C(=O)-alkyl group, wherein the alkyl group is a branched, linear or cyclic alkyl group having 1 to 50 carbon atoms,

a diarylalkylsilyl group having two aryl groups and one alkyl group wherein the alkyl group is a branched, linear or cyclic alkyl group having 1 to 50, and the aryl groups are each independently aromatic rings having 6 to 10 carbon atoms, ,

an dialkylarylsilyl group having one aryl group and two alkyl groups, wherein the alkyl groups and the aryl groups are defined as above for the diarylalkylsilyl group,

an allyl group,

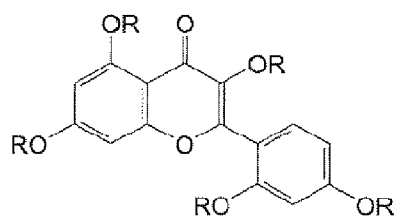
a methylene alkylether group wherein the alkyl group is defined as above, or

a tetrahydropyranyl group,

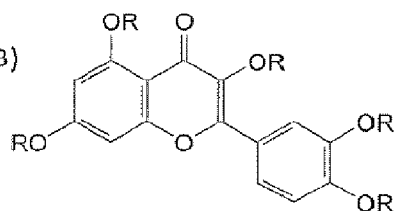
with the proviso that at least one of the R groups does not represent hydrogen.

22. The flavonoid derivative according to claim 21, which is represented by any of the following formulae (A) and (B)

Formula (A)



Formula (B)



wherein the R groups in formula (A) and (B) can be the same or different and are selected from the meanings of R as defined in claim 21.