A plant for producing virgin olive oil comprises at least one crushing device, configured for producing an oily paste, at least one kneading tank, configured for carrying out a gradual heating and a continuous remixing of the oily paste, at least one decanter, configured for carrying out the separation of the oily paste into an oily phase and into a solid and aqueous phase, and at least one separator, configured for carrying out a final removal of the water and solid residues from the oily phase. The plant also comprises at least one first thermal conditioner configured to instantly cool the oily paste provided by the crushing device to a first temperature value in order to reduce degradation of phenolic compounds and/or to increase the formation of volatile compounds influencing the aroma of the virgin olive oil.
The present invention refers to a plant and a process for producing virgin olive oil. The first process, more conventional and discontinuous, includes a first step of crushing the olives with granite mill stones, a second step of kneading, followed by the extraction of the oil by means of pressure, and a subsequent centrifugal separation of the light solids from the oil.

A second process, more modern, uses continuous mechanical mills of various types in order to obtain the paste of ground olives. This second process, also called "continuous cycle", involves the use of several machines connected in series with each other and prevents any interruption in the processing. Usually one or more of each of the following four different types of machines are connected with each other: a continuous mechanical mill (such as for example a hammer mill or disc mill) or pitter, a kneading tank, a centrifuge with horizontal axis with continuous unloading of the solids (decanter) and a centrifuge with vertical axis provided with separation discs (separator).

The reduction of the olives into paste occurs in the mill or pitter and, already in this step, there is a first, even if partial, separation of the oil from the paste. The olive paste thus produced, however, due to the breakage of the fruit with rotating members, undergoes an uncontrolled heat increase.

The olive paste is then pumped or thrust, through a screw system, which is positioned within one or more kneading tanks provided with respective chambers. Hot water circulates within the chamber(s) for the gradual heating of the paste to a final kneading temperature (generally 25°C-35°C and, more specifically, 28°C-32°C). At the same time, in each kneading tank the olive paste is continuously mixed. The gradual heating and continuous mixing is usually performed for a period of about 30-60 minutes. A kneading tank therefore has the object, through a mechanical and biochemical action in a temperature-controlled environment, to carry out the extraction of the oil from the olive paste by means of remixing, which facilitates the action of the endogenous enzymes of the olives capable of hydrolyzing the cell wall of the tissues containing the oil, thus freeing the oil from the paste. The heating of the olive paste, however, occurs over long time periods (usually about 30-60 minutes as mentioned above), due to the poor heat exchange efficiency of the kneading tanks and of the heat inertia tied to the product mass to be treated with respect to the quantity of water necessary for the heating itself.

Thus, inside each kneading tank, the combined effect of the time, the temperature and the remixing allows obtaining the breakage, mechanically and enzymatically, of the cell membranes or, more precisely, the lysis of the lipoprotein membranes that enclose the minute oil drops in the vacuoles. There is therefore the consequent outflow of oil, water and other components, e.g. phenolic compounds and pigments, which are dispersed in the mass, while the oil drops are enlarged and are aggregated via coalescence, being enriched with volatile and phenolic compounds that constitute the most precious part of unsaponifiable fraction of virgin olive oil, which confer aroma taste and health properties.

A kneading tank normally comprises a homogenization tank equipped with rotating mixer blades of suitable shape, usually in screw or worm screw form, moved by a motor. This blade system is commonly known with the name of "reel". The tank is at least partially surrounded by a chamber in which the hot water is made to circulate.

A pump then transfers the kneaded paste to the decanter, which is an extractive centrifuge, normally with horizontal drum, configured for separating the oil from the solid and aqueous phase, so-called olive residues. The oily phase obtained from the decanter is finally centrifuged in a separator, normally with vertical axis, for a final removal of the water and solid residues. The virgin oil thus obtained can be directly sold, with or without a previous filtration step.

In the processes for producing virgin olive oil, the current trend is that of anticipating the conventional fruit harvest period (i.e. the current trend is early harvesting), so as to produce oil with greater quality starting from olives with an early ripening stage. Both in conventional areas of the Mediterranean basin, and in new geographic areas for the cultivation of olives in, for example, South America, South Africa and Australia, the early olive harvest period and conventional olive harvest period may coincide with periods of the year in which the climate is still hot. The collection of olives at high ambient temperatures leads to a high temperature of the collected olives before being processed.

A high temperature of the collected olives may compromise the possibility to produce a high quality virgin olive oil in the conventional continuous cycle extraction process. In particular, a high temperature applied starting from the step of crushing the olives may negatively modify the aromatic composition and reduce the phenolic concentration of the virgin olive oil.

One object of the present invention is therefore to provide a plant and a process for producing virgin olive oil which are capable of resolving the abovementioned drawbacks of the prior art in a simple, inexpensive and particularly effective manner.

Summary of the invention

One object of the present invention is therefore to provide a plant and a process for producing virgin olive oil which are capable of resolving the abovementioned drawbacks of the prior art in a simple, inexpensive and particularly effective manner.
In the first case, a mill device is used which for example may be equipped with rotating hammers or knives which operate by crushing the whole fruits and by only crushing the pulp and the skin of the olives, simultaneously separating the pit.

In detail, one object of the present invention is to provide a plant and a process for producing virgin olive oil in a functional manner.

For these reasons, the plant 10 according to the present invention comprises, downstream of the crushing device 14, at least one first thermal conditioner 16 configured to instantly cool the oily paste to a first temperature value. By the phrase "instantly cool" is herein intended to denote that the first thermal conditioner 16 is configured to cool the paste to the first temperature value within a very short time, i.e. within seconds, after the paste has been fed to the first thermal conditioner 16, in contrast to a gradual temperature adjustment over a longer time, i.e. several minutes. Thus, the paste is then pumped, immediately after the step of crushing, to the first thermal conditioner 16.

Downstream of the at least one washing tank 12, at least one crushing device 14 is placed. With "crushing device" it is herein meant a mill device or a pitter device. The production of the olive paste may in fact be obtained both by crushing the whole fruits and by only crushing the pulp and the skin of the olives, simultaneously separating the pit. In the first case, a mill device is used which for example may be equipped with rotating hammers or knives which operate against a perforated grating, or with two counter-rotating toothed discs. In the second case, a pitter device is used that is equipped with rotating blades which operate against a perforated basket.

However, independent of the type, the crushing device 14 is configured for producing an oily paste. The paste thus obtained undergoes, due to the crushing operation, a thermal heating that has a negative effect on the composition of the aromatic fraction and on the phenolic concentration of the oil that will be obtained at the end of the extraction process. Such negative effect is greater the higher the temperature of the oily paste at the outlet of the crushing device 14. In turn, the temperature of the oily paste at the outlet of the crushing device 14 is higher the higher the temperature of the olives fed to the crushing device 14, which in turn depends on the ambient temperature during harvest and on the method of preservation of the fruits before being processed.
after the step of crushing it is herein meant that no further process steps are present between the step of crushing and
the step of cooling by means of the first thermal conditioner 16, i.e. there are no further process devices between the at
least one crushing device 14 and the at least one first thermal conditioner 16. The immediate thermal lowering of the
paste to a first temperature value after the step of crushing is performed in order to control the endogenous enzymatic
activity so as to reduce the degradation of phenolic compounds and/or to increase the formation of volatile compounds
influencing the aroma of the virgin olive oil.

[0023] The first temperature value is a value in a first temperature range, within which the enzymatic activity of one
or more endogenous enzymes causing degradation of one or more phenolic compounds is reduced or inhibited (compared
to the enzymatic activity before the cooling) and/or within which the enzymatic activity of one or more endogenous
enzymes providing production of one or more volatile compounds is increased (compared to the enzymatic activity before
the cooling).

[0024] The limits of the first temperature range as well as the optimum value of the first temperature depend on a
number of factors including the olive variety being processed, the ripeness of the olives being processed, climate con-
ditions, etc.

[0025] In one embodiment, the first temperature range is 15°C-20°C. In another embodiment, the first temperature
range is 14°C-18°C. In still another embodiment, the first temperature range is 18°C-22°C. In a further embodiment, the
first temperature range is 14°C-24°C. In a still further embodiment, the first temperature range is 14°C-20°C.

[0026] The first thermal conditioner 16 is preferably of tubular type, i.e. a tubular heat exchanger comprising one or
more coil ducts through which the heat exchange occurs in counter-current between the oily paste and a specific heat
exchange fluid (generally cooled or heated water).

[0027] Downstream of the at least one first thermal conditioner 16, at least one kneading tank 18 is provided in a per-
se known manner, configured for carrying out a gradual heating to a final kneading temperature (i.e. malaxation tem-
perature), and a continuous mixing of the paste. For example, the final kneading temperature may be within the range
of 25°C-35°C, or within the range of 28°C-32°C, or within the range of 25°C-30°C. The heating is obtained through a
chamber, filled with hot water, which at least partially surrounds the kneading tank 18. The mixing is obtained through a
rotating reel with horizontal axis, provided with suitably shaped blades, placed inside the kneading tank 18. The paste
remains in the kneading tank 18 for a predefined time period (for example about 30-60 minutes), during which an
enzymatic activity occurs that is necessary for the depolymerizing liberation of the oil drops and for the coalescence thereof, which allows the subsequent extraction thereof.

[0028] The predefined time period of the kneading step can even be reduced up to about 50% with respect to con-
ventional kneading times, if - following the cooling of the oily paste carried out in the first thermal conditioner 16 - a
heating of the paste itself is also carried out. Consequently, the plant 10 can be optionally provided, downstream of the
at least one first thermal conditioner 16 and upstream of the at least one kneading tank 18, with at least one second
thermal conditioner (not shown) configured for heating the paste to a second temperature value. The second temperature
value is of course greater than the aforesaid first temperature value. In addition, the second temperature value is lower
than or equal to the above mentioned final kneading temperature. Like the first thermal conditioner 16, also the second
thermal conditioner can be of tubular type, i.e. it can be a tubular heat exchanger comprising one or more coil ducts
through which the heat exchange occurs in counter-current between the oily paste and a specific heat exchange fluid.

[0029] Downstream of the at least one kneading tank 18, the plant 10 comprises at least one horizontal centrifuge or
decanter 20. After the kneading step, the paste is then pumped into the horizontal centrifuge or decanter 20 where the
separation of the paste into an oily phase and into a solid and aqueous phase is carried out.

[0030] The oily phase obtained through the horizontal centrifuge or decanter 20 is finally centrifuged by means of at
least one vertical centrifuge or separator 22. The vertical centrifuge or separator 22 is in fact arranged for carrying out
a final removal of the water and solid residues from the oily phase. The virgin oil thus obtained can be directly sold, with
or without a step of previous filtration that can be carried out in a suitable filtering device 24 placed downstream of the
vertical centrifuge or separator 22.

Examples

[0031] The phenolic composition of virgin olive oils (Table 1) shows a modification due to the pastes cooling after
-crushing. In fact, the rapid temperature lowering of olive pastes at 15°C, caused by the thermal conditioner 16 that
performs a flash thermal conditioning (FTC) in a plant according to Fig. 1, produces an increase of the phenolic con-
centration of the oils obtained, compared to the corresponding control in a plant according to Fig. 1 but without the
thermal conditioner 16. This increase affects the content of oleuropein derivatives (3,4-DHPEA-EDA and 3,4-DHPEA-
EA) and ligstroside (p-HPEA-EDA), whereas the lignans did not show any significant variation. This behavior can be
related to the partial inhibition of the endogenous polyphenoloxidase and peroxidase, responsible for the degradation
of the phenolic compounds, because these enzymes show a low activity at temperatures below 20°C. The composition
of volatiles (Table 2) found in virgin olive oil are positively affected by the cooling of the olive paste increasing the esters
concentration while on the contrary the aldehydes and alcohol are not modified.

Table 1.

<table>
<thead>
<tr>
<th>Phenolic Compounds</th>
<th>Control</th>
<th>FTC 15°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,4-DHPEAZ</td>
<td>1.3 ± 0.1</td>
<td>3.8 ± 0.2</td>
</tr>
<tr>
<td>p-HPEA</td>
<td>4.9 ± 0.2</td>
<td>8.8 ± 0.1</td>
</tr>
<tr>
<td>3,4-DHPEAZ-EDA</td>
<td>255.6 ± 1.6</td>
<td>405.6 ± 9.6</td>
</tr>
<tr>
<td>p-HPEA-EDA</td>
<td>40 ± 0.2</td>
<td>74.5 ± 1.1</td>
</tr>
<tr>
<td>(+)-1-acetoxyphenoxyresinol</td>
<td>17.6 ± 0.04</td>
<td>16.8 ± 0.1</td>
</tr>
<tr>
<td>(+)-phenoxyresinol</td>
<td>15.5 ± 0.0</td>
<td>15.2 ± 0.5</td>
</tr>
<tr>
<td>3,4-DHPEA-EDA</td>
<td>38.9 ± 0.1</td>
<td>72.6 ± 0.9</td>
</tr>
<tr>
<td>ligstroside aglycon</td>
<td>2.7 ± 0.04</td>
<td>9.7 ± 0.1</td>
</tr>
<tr>
<td>total phenol</td>
<td>376.4 ± 1.6</td>
<td>606.9 ± 9.7</td>
</tr>
</tbody>
</table>

*Z The data are the mean values of two independent experiments analyzed in duplicate, ± e standard deviation.

Table 2.

<table>
<thead>
<tr>
<th>Volatile Compounds</th>
<th>Control</th>
<th>FTC 15°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(E)-2-pentenal</td>
<td>218 ± 3</td>
<td>217 ± 5</td>
</tr>
<tr>
<td>hexanal</td>
<td>1433 ± 6</td>
<td>1439 ± 81</td>
</tr>
<tr>
<td>(E)-2-hexenal</td>
<td>138950 ± 7990</td>
<td>141265 ± 498</td>
</tr>
<tr>
<td>(E,E)-2,4-hexadienal</td>
<td>2613 ± 188</td>
<td>2575 ± 22</td>
</tr>
<tr>
<td>(E,E)-2,4-hexadienal (i)</td>
<td>1632 ± 170</td>
<td>1765 ± 6</td>
</tr>
<tr>
<td>sum of the aldehydes</td>
<td>144846 ± 7994</td>
<td>147261 ± 505</td>
</tr>
<tr>
<td>1-penten-3-ol</td>
<td>786 ± 4</td>
<td>779 ± 11</td>
</tr>
<tr>
<td>(E)-2-penten-1-ol</td>
<td>766 ± 0</td>
<td>864 ± 26</td>
</tr>
<tr>
<td>1-hexanol</td>
<td>1023 ± 34</td>
<td>1135 ± 8</td>
</tr>
<tr>
<td>(Z)-3-hexen-1-ol</td>
<td>1005 ± 11</td>
<td>1060 ± 18</td>
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<tr>
<td>(E)-2-hexen-1-ol</td>
<td>1678 ± 49</td>
<td>1375 ± 39</td>
</tr>
<tr>
<td>sum of the alcohols</td>
<td>5258 ± 61</td>
<td>5213 ± 52</td>
</tr>
<tr>
<td>hexyl acetate</td>
<td>952 ± 13</td>
<td>2616 ± 131</td>
</tr>
<tr>
<td>(Z)-3-hexenyl acetate</td>
<td>1083 ± 37</td>
<td>1793 ± 106</td>
</tr>
<tr>
<td>sum of the esters</td>
<td>2035 ± 40</td>
<td>4409 ± 168</td>
</tr>
</tbody>
</table>

*Z The data are the mean values of two independent experiments analyzed in duplicate, ± e standard deviation.

[0032] It is thus seen that the plant and the process for producing virgin olive oil according to the present invention achieves the previously outlined objects, in particular obtaining the following advantages:

- increase of the phenolic concentration in the obtained oil;
- increase of volatile compounds responsible for virgin olive oil flavor;
- maintenance of the extractive yields with respect to the systems according to the prior art;
- reduction of the kneading times if the thermal conditioner for heating is also applied.
The plant and the process for producing virgin olive oil of the present invention thus conceived are susceptible in any case of numerous modifications and variants, all falling within the same inventive concept; in addition, all the details can be substituted by technically equivalent elements. In practice, the materials used, as well as the shapes and size, can be of any type according to the technical requirements.

The protective scope of the invention is therefore defined by the enclosed claims.

Claims

1. Plant (10) for producing virgin olive oil, the plant (10) comprising:

- at least one crushing device (14), configured for producing an oily paste by means of crushing of olives;
- at least one kneading tank (18), placed downstream of the at least one crushing device (14) and configured for carrying out a gradual heating to a final kneading temperature and a continuous mixing of the oily paste;
- at least one decanter (20), placed downstream of the at least one kneading tank (18) and configured for carrying out separation of the oily paste into an oily phase and into a solid and aqueous phase; and
- at least one separator (22), placed downstream of said at least one decanter (20) and configured for carrying out a final removal of the water and solid residues from the oily phase, said at least one separator (22) providing the virgin olive oil,

the plant (10) being characterized in that it comprises, downstream of said at least one crushing device (14) and upstream of said at least one kneading tank (18), at least one first thermal conditioner (16) configured to instantly cool said oily paste provided by said at least one crushing device (14) to a first temperature value in order to reduce degradation of phenolic compounds and/or to increase the formation of volatile compounds influencing the aroma of the virgin olive oil.

2. Plant (10) according to claim 1, characterized in that said first temperature value is a temperature value within the range of 15°C-20°C.

3. Plant (10) according to claim 1 or 2, characterized in that said final kneading temperature is a temperature within the range of 25°C-30°C.

4. Plant (10) according to any one of claim 1 to 3, characterized in that downstream of said at least one first thermal conditioner (16) and upstream of said at least one kneading tank (18), at least one second thermal conditioner is provided that is configured for heating the oily paste to a second temperature value, wherein said second temperature value is greater than said first temperature value and wherein said second temperature value is lower than or equal to said final kneading temperature.

5. Plant (10) according to any one of claims 1 to 4, characterized in that said at least one first thermal conditioner (16) is of tubular type and comprise one or more coil ducts through which the heat exchange occurs in counter-current between the oily paste and a specific heat exchange fluid.

6. Plant (10) according to claim 4, characterized in that said at least one second thermal conditioner is of tubular type and comprise one or more coil ducts through which the heat exchange occurs in counter-current between the oily paste and a specific heat exchange fluid.

7. Plant (10) according to any one of claims 1 to 6, characterized in that the crushing device (14) is selected from the group of:

- a mill device equipped with rotating hammers or knives, which are arranged to operate against a perforated grating, so as to crush the whole olives;
- a mill device equipped with two counter-rotating tooted discs, which are arranged to crush the whole olives; and
- a pitter device equipped with rotating blades which are arranged to operate against a perforated basket, so as to crush only the pulp and the skin of the olives, simultaneously separating the pit.

8. Plant (10) according to any one of claims 1 to 7, characterized in that the kneading tank (18) is at least partially surrounded by a chamber filled with hot water, which is configured for carrying out the gradual heating of the oily paste, and the kneading tank (18) is internally provided with a rotating reel with horizontal axis, provided with shaped
blades configured for carrying out the continuous mixing of the oily paste.

9. Plant (10) according to any one of claims 1 to 8, characterized in that it comprises at least one washing tank (12) for the whole olives, placed upstream of the at least one crushing device (14).

10. Plant (10) according to any one of claims 1 to 9, characterized in that it comprises a filtering device (24), placed downstream of the at least one separator (22) and configured for carrying out a step of filtering the virgin olive oil obtained from said at least one separator (22).

11. Plant (10) according to any one of claims 1 to 10, characterized in that the decanter (20) is constituted by a horizontal centrifuge.

12. Plant (10) according to any one of claims 1 to 11, characterized in that the separator (22) is constituted by a vertical centrifuge.

13. Process for producing virgin olive oil, the process comprising the steps of:

   - production of an oily paste by means of crushing of olives;
   - instantaneous cooling of the oily paste to a first temperature value, so as to reduce degradation of phenolic compounds and/or to increase the formation of volatile compounds influencing the aroma of the virgin olive oil;
   - gradual heating to a final kneading temperature and continuous mixing of the oily paste for a predefined time period, so as to obtain depolymerizing liberation of oil drops by means of enzymatic activity and coalescence of oil drops, which allows the subsequent extraction thereof;
   - separation of the oily paste into an oily phase and into a solid and aqueous phase; and
   - final removal of the water and solid residues from the oily phase in order to obtain the virgin olive oil.

14. Process according to claim 13, characterized in that said first temperature value is a temperature value within the range of 15°C-20°C.

15. Process according to claim 13 or 14, characterized in that said final kneading temperature is a temperature within the range of 25°C-30°C.

16. Process according to any one of claims 13 to 15, characterized in that it comprises, downstream of the step of instantaneous cooling and upstream of the step of gradual heating and continuous mixing of the oily paste, a step of heating the oily paste to a second temperature value, wherein said second temperature value is greater than said first temperature value and wherein said second temperature value is lower than or equal to said final kneading temperature.

17. Process according to any one of claims 13 to 16, characterized in that it comprises, upstream of the step of producing an oily paste by means of crushing of the olives, a step of washing the olives.

18. Process according to any one of claims 13 to 17, characterized in that it comprises, downstream of the final removal of the water and solid residues from the oily phase, a step of filtering the virgin oil.
# EUROPEAN SEARCH REPORT

**EP 3 059 298 A1**

**Application Number**
EP 15 18 3569

## DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
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<td>X</td>
<td>EP 2 248 880 A1 (PIERALISI MAIP SOCIETTA PER AZI [IT]) 10 November 2010 (2010-11-10) paragraphs [0005], [0007], [0008], [0018], [0019], [0021], [0027], [0031] - [0036], [0049], [0055]; claims 1,2,4*</td>
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<td>INV. C11B1/04 C11B1/06 C11B1/10 A23N1/02</td>
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<td>EP 2 535 399 A1 (PIERALISI MAIP SOCIETTA PER AZIONI [IT]) 19 December 2012 (2012-12-19) * paragraphs [0023], [0025], [0029], [0033], [0043]; claims 1,4,5*</td>
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<tr>
<td>A</td>
<td>US 4 522 119 A (FINCH HARVEY E [US] ET AL) 11 June 1985 (1985-06-11) * column 2, line 66 - column 3, line 2; claims 1,9,12; figure 1* * column 4, line 30 - line 45* * column 6, line 7 - line 13*</td>
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<td>A</td>
<td>LUZ-STELLA ARTAJO ET AL: &quot;Partition of phenolic compounds during the virgin olive oil industrial extraction process&quot;, EUROPEAN FOOD RESEARCH AND TECHNOLOGY; ZEITSCHRIFT FÜR LEBENSMITTELUNTERSUCHUNG UND -FORSCHUNG A, SPRINGER, BERLIN, DE, vol. 225, no. 5-6, 15 September 2006 (2006-09-15), pages 617-625, XP019537686, ISSN: 1438-2385 * &quot;Results and Discussion&quot;; page 620*</td>
<td>1-18</td>
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The present search report has been drawn up for all claims

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**Place of search**
The Hague

**Date of completion of the search**
7 March 2016

**Examiner**
Villányi Kelemen, K

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**CATEGORY OF CITED DOCUMENTS**

- **X**: particularly relevant if taken alone
- **Y**: particularly relevant if combined with another document of the same category
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- **O**: non-written disclosure
- **P**: intermediate document

- **T**: theory or principle underlying the invention
- **E**: earlier patent document, but published on, or after the filing date
- **D**: document cited in the application
- **L**: document cited for other reasons

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**EP Form 102 & 102b (EP95)**

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9
## Documents Considered to Be Relevant

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<td>13 November 2014 (2014-11-13)</td>
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<td>EP 2 596 707 A1 (UNIV BARI [IT])</td>
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<td>* paragraphs [0008], [0009], [0011], [0022]; claims 1,2; figure 1</td>
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**Examiner:** Villányi Kelemen, K

**Place of search:** The Hague

**Date of completion of the search:** 7 March 2016

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ON EUROPEAN PATENT APPLICATION NO.

EP 3 059 298 A1

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<td></td>
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<td>IT 1394287 B1</td>
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<td>ES 2525105 T3</td>
<td>17-12-2014</td>
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<td>MA 35265 B1</td>
<td>03-07-2014</td>
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<td>PT 2721130 E</td>
<td>12-12-2014</td>
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<td>TN 2013000496 A1</td>
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<td>WO 2012171843 A1</td>
<td>20-12-2012</td>
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<td>11-06-1985</td>
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<td>WO 2014181284 A1</td>
<td>13-11-2014</td>
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<td>04-09-2014</td>
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<td>WO 2013076592 A1</td>
<td>30-05-2013</td>
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