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(54) Title: A PROCESS FOR PRODUCING A TEA PRODUCT

(57) Abstract: The present invention relates to a process for preparing a leaf tea product comprising the steps of: a. incubating fresh tea leaf at a temperature in the range 0°C to -200°C for a period of 3 minutes to 8 hours; b. placing the incubated leaf in an environment with temperature in the range 15°C to 45°C for 1 to 8 hours; c. comminuting the incubated leaf to produce dhool; and d. subjecting the comminuted dhool to a step of shear wherein shear is provided at a shear rate in the range of 5000/s to 25000/s.



A PROCESS FOR PRODUCING A TEA PRODUCT

Field of the invention

The present invention relates to a process for producing a tea product. More particularly the present invention relates to a process for producing a leaf tea product with rich red colour and brighter infusion properties.

Background of the invention

Tea is one of the most popular beverages in the world. It is believed that consumption of tea refreshes our mind. Polyphenols that present in the tea also considered to be good for human health. There are several different kinds of tea which are commercially available, e.g. black tea, green tea, oolong tea, white tea, etc. Out of these, black tea is perhaps the most common. Black tea is generally prepared by a process which includes the steps of withering, macerating, fermenting and firing/drying. The characteristic colour, flavour and aroma of black tea are produced during deferent stages of black tea manufacturing. In tea processing, the term 'fermentation' is traditionally used to refer to enzymatic oxidation. After fermentation, the tea is dried at high temperature to arrest enzyme action and to reduce the moisture content to a low level.

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Black tea is predominantly characterized by its rich red and bright coloured infusion. Therefore, there has always been interest in improving the redness and brightness of the liquor produced by a black leaf tea product to enhance the black tea characteristics.

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US 2008/0118602 (Unilever) discloses a process for the manufacture of a tea product which is readily infusible and has improved red colour. The process comprises contacting black tea with ascorbic acid and/or its salts, an oxidizing agent and water for a period of at least 5 minutes followed by drying to prepare a tea product that is infusible in water at 5 to 100°C.

30

WO 2013/075912 (Unilever) discloses a process for producing a black tea product with enhanced sensorials. The process involves a step of anaerobic incubation at specific temperatures and for specific durations and provides tea products having a relatively high amount of polyphenols which have the sensorials of black tea, but without the addition of any exogenous theaflavins and/or catechins.

WO14206883A1 (Unilever) discloses a process of producing a long leaf tea product with black tea characteristics. The process comprises the steps of: (a) incubating fresh tea leaf at a temperature in the range 4 degrees centigrade to 60 degrees centigrade under anaerobic conditions for a period of 4 to 36 hours; and (b) exposing the leaf at a temperature of 15 to 35 degrees centigrade for 70 minutes to 4 hours; wherein there is no step of comminution of the tea leaf before incubation and/or before step (b).

Although the prior art discloses tea products with higher polyphenol content and rich red colour, there is still a need to provide a tea product with rich red colour along with brighter infusion.

It is therefore an object of the present invention to produce a tea product with black tea characteristics.

It is another object of the present invention to produce a tea product that provides an infusion with enhanced red colour and brightness.

The present inventors have surprisingly found that a process which includes a step of incubation of tea leaves at low temperature followed by exposing the tea leaf to an ambient temperature (about 25°C) produces a tea product that provides an infusion with enhanced red colour and brightness value and thereby satisfying one or more of the above-mentioned objects.

Summary of the invention

Accordingly, in a first aspect there is provided a process for preparing a leaf tea product comprising the steps of:

- a. incubating fresh tea leaf at a temperature in the range 0°C to -200°C
5 for a period of 3 minutes to 8 hours;
- b. placing the incubated leaf in an environment with temperature in the range 15°C to 45°C for 1 to 8 hours;
- c. comminuting the incubated leaf to produce dhool; and
- d. subjecting the comminuted dhool to a step of shear wherein shear
10 is provided at a shear rate in the range of 5000/s to 25000/s.

These and other aspects, features and advantages will become apparent to those of ordinary skill in the art from a reading of the following detailed description. For the avoidance of doubt, any feature of one aspect of the present invention may
15 be utilized in any other aspect of the invention. The word “comprising” is intended to mean “including” but not necessarily “consisting of” or “composed of.” In other words, the listed steps or options need not be exhaustive. It is noted that the examples given in the description below are intended to clarify the invention and are not intended to limit the invention to those examples *per se*. Similarly, all
20 percentages are weight/weight percentages unless otherwise indicated. Except in the operating and comparative examples, or where otherwise explicitly indicated, all numbers in this description indicating amounts of material or conditions of reaction, physical properties of materials and/or use are to be understood as modified by the word “about”. Numerical ranges expressed in the
25 format “from x to y” are understood to include x and y. When for a specific feature multiple preferred ranges are described in the format “from x to y”, it is understood that all ranges combining the different endpoints are also contemplated.

Detailed description of the invention

30 “Tea” for the purposes of the present invention means material from *Camellia sinensis* var. *sinensis* and/or *Camellia sinensis* var. *assamica*. Especially

preferred is material from var. *assamica* as this has a higher level of tea actives than var. *sinensis*.

5 "Leaf tea" for the purposes of this invention means a tea product that contains tea leaves and/or stem in an uninfused form, and that has been dried to a moisture content of less than 30% by weight, and usually has a water content in the range 1 to 10% by weight (i.e. "made tea").

10 "Fresh tea leaf" refers to tea leaf, buds and/or stem that have never been dried to a water content of less than 30% by weight, and usually have moisture content in the range 60 to 90%.

15 "Fermentation" refers to the oxidative and hydrolytic process that tea undergoes when certain endogenous enzymes and substrates are brought together, e.g. by mechanical disruption of the cells by maceration of the leaves. During this process, colourless catechins in the leaves are converted to a complex mixture of yellow and orange to dark-brown polyphenolic substances.

20 "Black tea" refers to substantially fermented tea. Black tea has different characteristics to green tea. Black tea is more astringent in taste and less bitter than green tea. The redness of black tea liquor is also significantly higher than that of green tea. Black tea also contains higher level of theaflavins.

25 The present invention provides a process for preparing a leaf tea product comprising the steps of:

- a. incubating fresh tea leaf at a temperature in the range 0°C to -200°C for a period of 3 minutes to 8 hours;
- b. placing the incubated leaf in an environment with temperature in the range 15°C to 45°C for 1 to 8 hours;
- 30 c. comminuting the incubated leaf to produce dhool; and

- d. subjecting the comminuted dhool to a step of shear wherein shear is provided at a shear rate in the range of 5000/s to 25000/s.

Step(a):

- 5 Step (a) includes incubating fresh tea leaf at a temperature in the range 0°C to –200°C for a period of 3 minutes to 8 hours. The preferred temperature of the incubation is –2°C to –200°C, more preferably –4°C to –200°C.

The period of incubation is preferably 5 minutes to 8 hours, more preferably 20
10 minutes to 7 hours, furthermore preferably 30 minutes to 6 hours and most preferably 1 to 5 hours.

Any suitable device for low temperature incubation can preferably be used. These kinds of device can maintain the temperature within the above range for
15 the purpose of the incubation. A regular refrigerator can also be preferably used for this purpose.

Alternatively, freezing with liquid nitrogen or other suitable material such as dry ice can also be preferably used. This type of material is known to provide freezing
20 at a very low temperature e.g. –196°C for liquid nitrogen and –78.5°C for dry ice. Dry ice generally more preferable for this purpose as it is simple to handle when compared to liquid nitrogen.

Step(b):

- 25 After the preliminary step of incubation as disclosed above the incubated leaf are subjected to a step of placing the incubated leaf in an environment with temperature in the range 15°C to 45°C for 1 to 8 hours. The preferred temperature for this step is in the range of 20°C to 45°C, more preferably 22°C to 40°C and most preferably in the range of 25°C to 35°C. The time period for
30 this step is preferably 1 to 6 hours, more preferably, 1.5 to 4 hours and most preferably 1.5 to 3 hours.

Step (b) may preferably be carried out by keeping the incubated leaves at an ambient temperature of 25°C to 35°C. The incubated leaves may be just spread on a tray in an open atmosphere as described above.

5

Step (c):

After step (b), the tea leaves are subjected to a step of comminution (size reduction) to produce dhool.

10

This step of size reduction is preferably carried out by crushing, tearing and curling (known in the art of tea processing as CTC). One or more CTC steps may be carried out. In this step the incubated leaf breaks up and releases enzymes that exist in the leaf.

15

Alternatively, after the incubation step, the incubated tea leaf is rolled in an orthodox roller or comminuted in a rotorvane, or a combination thereof. During these steps, precursors present in the tea leaf become amenable to the enzymes.

20 **Step (d):**

After step (c), there is an additional step of subjecting the comminuted dhool to a step of shear. Preferably the dhool is subjected to shear for 30 seconds to 15 minutes by passing the dhool through an instrument with shear rate in the range
25 of 5000/s to 25000/s.

The term 'shear' preferably means the act of producing strain in the structure of a substance/material. Shear as mentioned herein preferably means damaging the comminuted dhool in a controlled way wherein the residence time of the dhool
30 in the shear producing instrument is relatively high compared to maceration in a CTC machine. The direction of application of force and the stress transfer preferably to be perpendicular to each other.

Preferably, the shear is produced by passing the dhool through an instrument. This is preferably done by using a mechanical device. The preferred mechanical devices are screw press, plough shear mixer etc.

5

The dhool is exposed to shear preferably for 30 seconds to 5 minutes and most preferably 30 seconds to 3 minutes.

The shear rate for the above step is preferably in the range of 10000 /s to 15000 /s.

10

The shear is the rate at which a material deforms at a given speed in a channel having a defined depth and diameter. In case of the present disclosure, if the comminuted dhool (either at the pre-fermentation or post fermentation stage) is subjected to shear in a device with a shaft diameter D cm and with a channel depth of H cm of at N rpm, then the shear rate is:

15

$$\text{Shear Rate} = \frac{\pi * D * N}{H}$$

For the equipment's for which the above equation is applicable, there is a rotating shaft inside a channel through which the material is to be passed. The rotation of this shaft conveys the material from one end (inlet) of the instrument to the other end (outlet). During this conveyance the material experiences shear as against the wall of the channel and the shaft. When the shaft is preferably having screw like extensions, it is known as screw press. Channel depth means the longitudinal distance from the shaft to the wall of the channel.

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25

E.g. for a screw press wherein the diameter is 12.7 cm with a channel depth of 0.1 cm and at 25 rpm, the shear rate as calculated using the above equation is approximately 10000 / s.

30

Preferably, pressure applied for the process is in the range of 10^4 to 10^6 Pa, more preferably 10^4 to 5×10^5 Pa, furthermore preferably 10^4 to 2×10^5 Pa and most preferably 10^4 to 5×10^4 Pa.

- 5 Preferably, the filling percentage of the dhool in said instrument is also considered as a controlling parameter. The words “filling percentage” preferably means the percentage of the instrument’s available volume (i.e. capacity) that is filled by the dhool. Preferably the filling percentage of the dhool in said instrument is in the range of 35% to 80%, more preferably 40% to 80%, furthermore preferably 50%
10 to 80% and most preferably from 60% to 80%.

- After the shear step the dhool preferably undergoes fermentation. This step may be carried out by keeping the comminuted leaf at a temperature of 10°C to 60°C for 15 minutes to 5 hours. The preferred temperature of fermentation is in the
15 range of 20°C to 50°C and more preferably 25°C to 45°C . The preferred period of fermentation is in the range of 30 minutes to 4 hours and more preferably 1 hours to 3 hours.

- After fermentation the fermented dhool may preferably be dried. During drying
20 step, the dhool is dried to a moisture content preferably less than 10% by weight of the tea leaf, more preferably less than 5% by weight of the tea leaf, to obtain the black leaf tea product.

- The drying step is preferably carried out by thermal drying, freeze drying or
25 vacuum drying.

- Thermal drying is preferably carried out by contacting the leaf with air; with the temperature of air being preferably 80 to 160°C , more preferably 90 to 150°C , most preferably 100 to 130°C . Thermal drying may be carried out in any
30 conventional dryer. However, a fluidized bed dryer or a tray dryer is particularly preferred for thermal drying. The leaf can also be dried by vacuum drying. During

vacuum drying the tea leaf is subjected to an absolute pressure of preferably from 66.7 to 6.67×10^4 Pa, more preferably from 6.67×10^3 to 3.9×10^4 Pa and most preferably from 1.3×10^4 to 2.67×10^4 Pa. Vacuum drying is carried out at a temperature in the range of preferably 20 to 70°C, more preferably 25 to 60°C and most preferably 30 to 55°C. Vacuum drying may be carried out in any suitable vacuum drier, preferably in a rotary vacuum drier.

Now the invention will be demonstrated in terms of examples. The following examples are just for illustration and in no way limit the scope of the present invention.

Examples

Preparation of different tea products:

All the experiments were carried out in Kenya using tea leaf obtained from a Kenyan tea garden.

Example A:

Fresh tea leaves were harvested from a Kenyan tea garden, and withered for 18 hours at about 25°C. The withered leaves were subjected to CTC (cut tear curl) for 4 times to obtain macerated dhool. The macerated dhool was fermented (exposed to air at 25°C) for 90 minutes, and then dried to a moisture content of less than 5% by weight (at 140°C in a fluidized bed dryer) to obtain a black leaf tea product.

25

Example 1:

Fresh tea leaves were harvested from a Kenyan tea garden, and withered for 18 hours at about 25°C. The withered leaves were incubated at a low temperature by placing them into a freezer for 4 hours. The temperature of the freezer was – 20°C. Next, the frozen leaves were taken out from the freezer and kept at a temperature of 25°C for 1 hour. After that the tea leaves were subjected to CTC (cut tear curl) for 4 times to obtain macerated dhool. The macerated dhool was

30

then fermented (exposed to air at 25°C) for 90 minutes, and then dried to a moisture content of less than 5% by weight (at 140°C in a fluidized bed dryer) to obtain a black leaf tea product.

5 Example 2:

Fresh tea leaves were harvested from a Kenyan tea garden, and withered for 18 hours at about 25°C. The withered leaves were incubated at a low temperature by placing them into a freezer for 4 hours. The temperature of the freezer was—20°C. The frozen leaves were taken out from the freezer and kept in at a
10 temperature of 25°C for 1 hour. After that the tea leaves were subjected to CTC (cut tear curl) for 4 times to obtain macerated dhool. The macerated dhool was subjected to shear by passing the dhool through a screw press (Model No: Vincent ® CP4) at a pressure of 2 bar. The diameter of the screw press used was 12.7 cm, the channel depth of 0.1 cm and it was operating at 25 rpm
15 (rotational speed). The shear was calculated to be 9969.5 /s. The residence time for the shear step was 2 minutes. The filling percentage for this experiment was 75% of the instrument's capacity. The macerated dhool was then fermented (exposed to air at 25°C) for 90 minutes, and then dried to a moisture content of less than 5% by weight (at 140°C in a fluidized bed dryer) to obtain a black leaf
20 tea product.

Tea infusions were prepared for all the above tea products by infusing 2 g of leaf tea in 200 mL of freshly boiled deionized water for 2 minutes without stirring. Infusions colour measurements were done using the following procedure:

25

Colour measurement:

Colour (CIE L*a*b* values) was measured using a Hunter lab Ultrascan XE (Model-USXE/UNI version 3.4, Hunterlab Associates Laboratories Inc. Virginia). A halogen cycle lamp was used as the light source. The illuminant used was D65
30 and the measurements were made at 10°- Observer angle. Measurements were made using a quartz cuvette of 10 mm path length. Tea infusions as prepared

above was filled up to the brim in the cuvette and placed in the instrument for colour measurement. The instrument was calibrated using a standard white tile (Hunterlab Duffuse/8°, mode-RSEX, Port-1" and area- large) in accordance with the instructions provided in the instructions manual. The L*a*b* values were
 5 measured at room temperature (25°C).

The maximum value for L* is 100, which represents a perfect reflecting diffuser. The minimum is L*=0, which represents black. The a* and b* axes have no specific numerical limits. Positive a* is red and negative a* is green. Similarly,
 10 positive b* is yellow and negative b* is blue.

The higher the a* value the redder is the infusion. In the same way the higher the b* value the brighter is the infusion.

15 The results of these experiments are summarized below in Table 1

Table 1:

Example No.	a* value	b* value
A	8.49	74.03
<u>1</u>	<u>9.50</u>	<u>75.70</u>
<u>2</u>	<u>15.70</u>	<u>84.33</u>

It is evident that the examples that are within the scope of the present invention (Example 1 and 2) provides much redder and brighter infusions when compared
 20 with the control example (Example A). It is also clear that an additional step of shear produces tea product that provides an infusion with much higher a* and b* value (Example 2).

Claims

- 1 A process for preparing a leaf tea product comprising the steps of:
 - a. incubating fresh tea leaf at a temperature in the range 0°C to -200°C for a period of 3 minutes to 8 hours;
 - b. placing the incubated leaf in an environment with temperature in the range 15°C to 45°C for 1 to 8 hours;
 - c. comminuting the incubated leaf to produce dhool; and
 - d. subjecting the comminuted dhool to a step of shear wherein shear is provided at a shear rate in the range of 5000/s to 25000/s.
- 2 A process as claimed in claim 1 wherein the dhool is exposed to shear for about 30 seconds to 15 minutes.
- 3 A process as claimed in in any one of claims 1 or 2 wherein the pressure applied to produce shear is in the range of 10^4 to 10^6 Pa.
- 4 A process as claimed in any one of the preceding claims wherein shear is generated using a mechanical device.
- 5 A process as claimed in any one of the preceding claims wherein the temperature in step (a) is in the range of -2°C to -200°C.
- 6 A process as claimed in any one of the preceding claims wherein the temperature in step (b) is in the range of 20°C to 45°C.
- 7 A process as claimed in claim 1 wherein the comminuted dhool undergoes fermentation.

- 13 -

- 8 A process as claimed in claim 7 wherein fermentation is performed by keeping the comminuted dhool at a temperature of 10°C to 60°C for 15 minutes to 5 hours.
- 9 A process as claimed in claim 7 that further comprises a step of drying the fermented dhool.
- 10 A process as claimed in claim 9 wherein the drying is performed at a temperature in the range of 80°C to 160°C.
- 11 A process as claimed in claim 1 wherein the moisture content of the fresh tea leaf is in the range of 60 to 90% by weight.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A23F A23L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data, FSTA, BIOSIS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	----- CN 103 431 088 A (ZHENJIANG AGRICULTURAL SCIENCE INST JIANGSU HILLY AREAS) 11 December 2013 (2013-12-11) claim 1	1-11
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/076016

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2019/076016

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