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(54) Title: A DEVICE FOR EXTRACTING LIQUID FROM SAMPLE AND A METHOD THEREOF

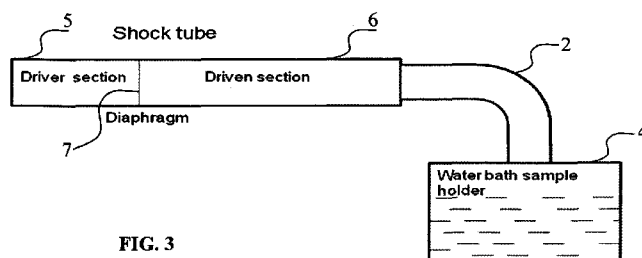


FIG. 3

(57) Abstract: The present disclosure relates to the field of food processing, more particularly relating to a device and method of extracting liquid/juice from sample. A device for extracting liquid from sample comprising a driver section (5), a driven section (6) connected to one end of the driver section (5), a diaphragm (7) placed in between the driver section (5) and the driven section (6), and a water bath (4) comprising the sample connected to the driven section (6), wherein said diaphragm (7) ruptures on applying pressure from driver section (5) to generate steep pressure pulses for extracting liquid of sample inside the water bath (4).

TITLE: A DEVICE FOR EXTRACTING LIQUID FROM SAMPLE AND A METHOD THEREOF

TECHNICAL FIELD

The present disclosure relates to the field of food processing, more particularly relating to a device and method of extracting liquid/juice from comestible sample.

BACKGROUND

Fruit juice industry is one of the thriving businesses in the world where the packed juices are extracted from various fruits and vegetables. The existing technologies used in the industry are based on crushing the fruits or vegetables, separating the juice from the pulp by squeezing, treating the extracted juice with preservatives and packing it in appropriate containers. At consumer level people also extract fresh juice from the fresh vegetables and fruits for immediate consumption by traditional techniques which are unhygienic, laborious and time consuming. The disclosed method can be used both at industrial level as well as at home level.

The main problem faced by existing method was essentially in generating a steep pressure pulse adequate enough to achieve the process and also insulating the fruit from the associated temperature effects. This is achieved by generating a shockwave of appropriate strength and immersing comestible sample such as fruit or vegetable in water bath before exposure to the shockwaves.

Development of economical methods for extraction of juices from fruits and vegetables will have direct impact on the food processing industry. The method disclosed herein is to extract juice from the fruits and vegetables by application of steep pressure pulses using shockwaves. This method is simple to apply and can be built as a home appliance to extract juice from citrus fruits, apples, lemon etc and also to reduce the bitterness of vegetables like bitter gourd. In addition the steep pressure rise inhibits the bacterial multiplication and hence the juices extracted using this technique can be preserved without additional preservatives.

One way for treating food by applying shockwaves is to soften or powder the food sample. For example, US publication No. 20080171115, provides for a method of treating food, wherein the food is softened or powdered within a short period of time without damaging nutritional components. The method involves placing the food in a vacuum chamber and preservative chamber. The publication US20080171115 comprises both the shockwave source and the food in a single chamber.

The published patent application US20080171115 provides for method wherein food is vacuum sealed in a protective chamber, and both food and shock wave generator are immersed in water. Food only gets softened, whereas the disclosure of instant invention provides for a method which does not require the vacuum sealing, and shockwave generator is not immersed in water. Also, the method involves juice is separated in from the pulp.

STATEMENT OF THE DISCLOSURE

The present disclosure is in relation to a device for extracting liquid from sample comprising a driver section (5), a driven section (6) connected to one end of the driver section (5), a diaphragm (7) placed in between the driver section (5) and the driven section (6), and a water bath (4) comprising the sample connected to the driven section (6), wherein said diaphragm (7) ruptures on applying pressure from driver section (5) to generate steep pressure pulses for extracting liquid of sample inside the water bath (4) and also related to a method of extracting liquid from sample, said method comprising acts of placing the sample inside water bath (4); and generating steep pressure pulses by applying pressure from driver section (5) of the extracting device to rupture diaphragm (7) of device for extracting liquid from the sample.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

The features described in this disclosure are set forth with particularity in the appended claims. These features and attendant advantages will become apparent from consideration of the following detailed description, taken in conjunction with the accompanying drawings. One or more embodiments are now described, by way of example only, with

reference to the accompanying drawings wherein like reference numerals represent like elements and in which:

FIG. 1 shows schematic diagram of short duration high pressure pulse generator and dry sample holder,

FIG. 2 shows schematic diagram of short duration high pressure pulse generator and sample holder with water bath,

FIG. 3 shows schematic diagram of shock tube for generating short duration high pressure pulse,

FIG. 4 shows pressure cooker/autoclave based short duration high pressure pulse generator,

FIG. 5 shows Apple juice and the pulp after exposure to the pressure pulse,

FIG. 6 shows the bitter juice extracted from the Bitter gourd exposed to the pressure pulse, and

FIG. 7 shows pieces of bitter gourd after removing the juice.

DETAILED DESCRIPTION

In the following detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description, drawings, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented herein. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the figures, can be arranged, substituted, combined, and designed in a wide variety of different configurations, all of which are explicitly contemplated and make part of this disclosure.

This disclosure is drawn, *inter alia*, to a method of liquid extraction and device for liquid extraction.

The present disclosure is in relation to a device for extracting liquid from sample comprising a driver section (5), a driven section (6) connected to one end of the driver section (5), a diaphragm (7) placed in between the driver section (5) and the driven section (6), and a water bath (4) comprising the sample connected to the driven section (6), wherein said diaphragm (7) ruptures on applying pressure from driver section (5) to generate steep pressure pulses for extracting liquid of sample inside the water bath (4).

In still another embodiment of the disclosure the device has diameter of 50 mm and thickness of 10 mm.

In yet another embodiment of the disclosure the device is preferably made of stainless steel and the diaphragm (7) is preferably made of aluminum.

In yet another embodiment of the disclosure the driver section (5) and driven section (6) measure about 1 m and 3 m in length respectively.

In yet another embodiment of the disclosure the water bath (4) comprises a holder (3) for holding the sample.

In yet another embodiment of the disclosure the sample is selected from a group comprising fruits and vegetables, preferably apple and bitter gourd.

The present disclosure is in relation to a method of extracting liquid from sample, said method comprising acts of placing the sample inside water bath (4); and generating steep pressure pulses by applying pressure from driver section (5) of the extracting device to rupture diaphragm (7) of device for extracting liquid from the sample.

In yet another embodiment of the present disclosure the pressure is applied using pressure generating devices selected from a group comprising pressure vessels, pressure pulse generators, pressure cookers and autoclaves.

In yet another embodiment of the present disclosure the pressure generated is ranging from about 20 bars to about 30 bars and is applied for 1 ms on the water bath (4).

FIG. 1 illustrates a schematic diagram of short duration high pressure pulse generator (1) and dry comestible sample holder (3) connected through a tube (2). The pressure pulse generator is directly coupled to the dry sample holder. The high pressure pulse generated by the pressure pulse generator is passed directly onto the sample for a small duration of time of about 1 millisecond. The sample is a comestible substance such as fruits or vegetables held by a holder.

FIG. 2 illustrates schematic diagram of short duration high pressure pulse generator (1) connected through a tube (2) to the sample holder (3) with water bath (4). The comestible sample is placed inside the water bath (4), wherein the pressure of shockwaves are applied onto the water bath (4). The pressure thus transfers from the water bath (4) to the sample for extraction of juice. The sample is firmly held by a sample holder (3).

Here, the effectiveness of the pressure pulses is enhanced by submerging the samples into water bath (4). The water medium ensures application of the pressure uniformly all round the sample and also eliminates any effects of accompanying temperature.

FIG. 3 illustrates schematic diagram of shock tube for generating short duration high pressure pulse. The shocktube is characterized into a driver section (5) and a driven section (6), wherein a metal diaphragm (7) is placed in between the driver section (5) and the driven section (6). A water bath (4) with the sample holder (3) is connected to other end of the driven section (6) through a tube (2). The sample of comestible substance is placed inside the water bath (4) and is held by means of holder (3).

The high pressure pulse is generated by the pressure pulse generator (1) connected to the driver section (5). When the driver section (5) is filled with high pressure driver gas such as air or helium, the diaphragm (7) ruptures at an appropriate pressure and generates shockwaves which travels through the driven section (6). As the shockwaves propagates through the driven section (6), it compresses and heats & stores the air between the shockwaves and the following driver gas. This heated and compressed gas which is in the form of a well defined pressure pulses then passes over the sample in the chamber attached to the end of the shock tube. The sudden application of pressure passing through

the sample subjects its cells containing the juices to high pressure. The cells undergo physical squeezing (may even rupture) thus releasing the juices. Since the duration of the pressure pulses/shockwaves is short the effect of temperature is not felt by the sample.

FIG. 4 illustrates pressure cooker/autoclave based short duration high pressure pulse generator (1). The cooker/autoclave can be suitably adapted in the kitchen. The high pressure generated by heating the water in the cooker/autoclave can be used to rupture a diaphragm separating the tube (2) through which the sample holder (3) is attached. The cooker acts as driver section for the shock tube.

Example 1:

FIG. 5 illustrates extraction of juice from a sample of an Apple. The sample of apple is disposed inside the water bath and held by the holder. As the sample is exposed onto the pressure pulses, the pulp is being squeezed by the shockwaves. The cells of the sample after exposure to the pressure pulses undergo physical squeezing thus releasing the juices from the apple. This method could also be much more effective for seasonal fruits like mango.

Example 2:

FIG. 6 and 7 illustrates bitterness removal from the sample. The bitterness is removed by extracting bitter juices from the sample of Bitter gourd. The sample of bitter gourd is placed exposed to the pressure pulses. As the sample is exposed onto the pressure pulses, the pulp of bitter gourd is being squeezed by the shockwaves. The cells of the sample after exposure to the pressure pulses undergo physical squeezing thus releasing the bitter juices from the sample of bitter gourd.

The bitterness of the vegetable inhibits many times its usage as the procedure for removing the bitterness is elaborate. For example typically the pieces of the bitter gourd are marinated overnight after soaking in turmeric and salt. This ensures release of the juice which is bitter and the vegetable is used in cooking after thorough washing to remove the traces of bitterness. After exposing the sample to the pressure pulses inside

the water bath, it is found that all the juice in the vegetable is squeezed out and the bitterness is removed completely. The treated sample does not taste bitter and is ready to eat as raw vegetable. Further, it is well known that the raw bitter gourd juice is a good medicine to control the sugar levels in diabetic patients. Current technology can be utilized to produce raw bitter gourd juice and market it commercially.

Preliminary experiments with apples and bitter gourd are carried out to prove the concept. Apples exposed to the pressure pulse showed no indication of any physical deformation or damage except becoming soft for a touch. When the exposed sample was pressed by hand all the juice came out freely.

Pressure levels of few bars and pulse duration of about few milliseconds are needed to produce the desired results.

With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to inventions containing only one such recitation, even when

the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation *is* explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean *at least* the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means *at least* two recitations, or *two or more* recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

Reference numerals:

- 1: high pressure pulse generator,
- 2: tube,

- 3: sample holder,
- 4: water bath,
- 5: driver section,
- 6: driven section, and
- 7: diaphragm.

Industrial Applicability

The disclosed device and method finds potential application in food processing industry where extraction of juice from fruits or vegetables and sterilization of extracted juice is desirable. The disclosed device and method finds particular applicability in juice extraction. One skilled in the art will recognize, however, that the disclosed device could be utilized in relation to other systems that may or may not be associated with juice extraction devices. For example, the disclosed device and method could be utilized in relation to oil extraction from seeds, or treatment of food items or treatment of seeds.

We claim:

1. A device for extracting liquid from sample comprising:
 - a. a driver section (5),
 - b. a driven section (6) connected to one end of the driver section (5),
 - c. a diaphragm (7) placed in between the driver section (5) and the driven section (6), and
 - d. a water bath (4) comprising the sample connected to the driven section (6),
wherein said diaphragm (7) ruptures on applying pressure from driver section (5) to generate steep pressure pulses for extracting liquid of sample inside the water bath (4).
2. The device as claimed in claim 1, wherein the device has diameter of 50 mm and thickness of 10 mm.
3. The device as claimed in claims 1, wherein the device is preferably made of stainless steel and the diaphragm (7) is preferably made of aluminum.
4. The device as claimed in claim 1, wherein the driver section (5) and driven section (6) measure about 1 m and 3 m in length respectively.
5. The device as claimed in claim 1, wherein the water bath (4) comprises a holder (3) for holding the sample.
6. The device as claimed in claim 1, wherein the sample is selected from a group comprising fruits and vegetables, preferably apple and bitter gourd.
7. A method of extracting liquid from sample, said method comprising acts of:
 - a) placing the sample inside water bath (4); and
 - b) generating steep pressure pulses by applying pressure from driver section (5) of the extracting device to rupture diaphragm (7) of device for extracting liquid from the sample.

8. The method as claimed in claim 7, wherein the pressure is applied using pressure generating devices selected from a group comprising pressure vessels, pressure pulse generators, pressure cookers and autoclaves.
9. The method as claimed in claim 7, wherein the pressure generated is ranging from about 20 bars to about 30 bars and is applied for 1 ms on the water bath (4).

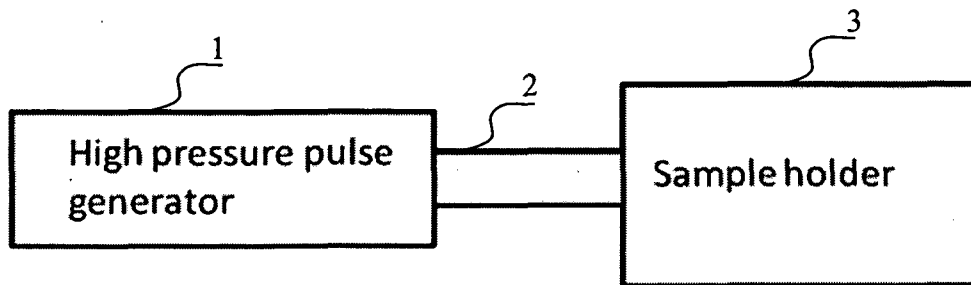


FIG. 1

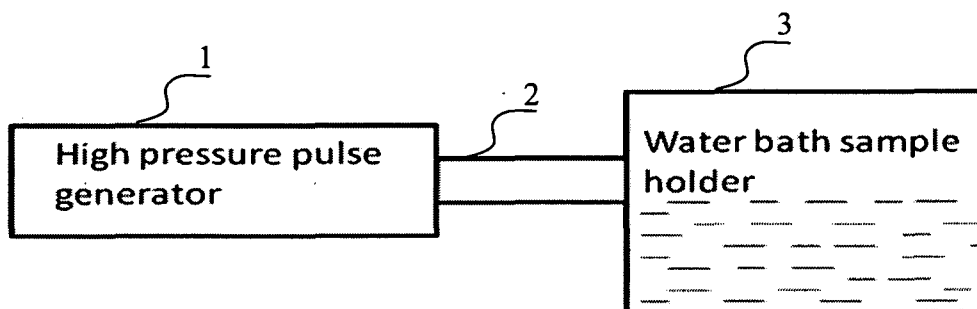


FIG. 2

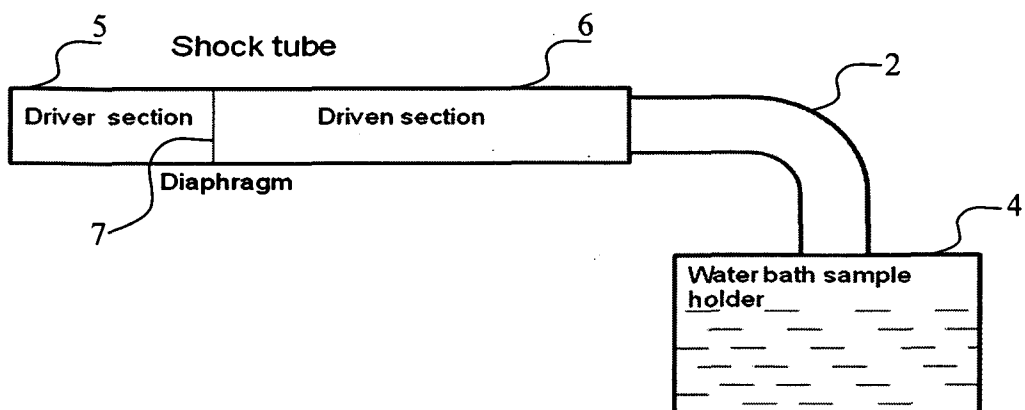


FIG. 3

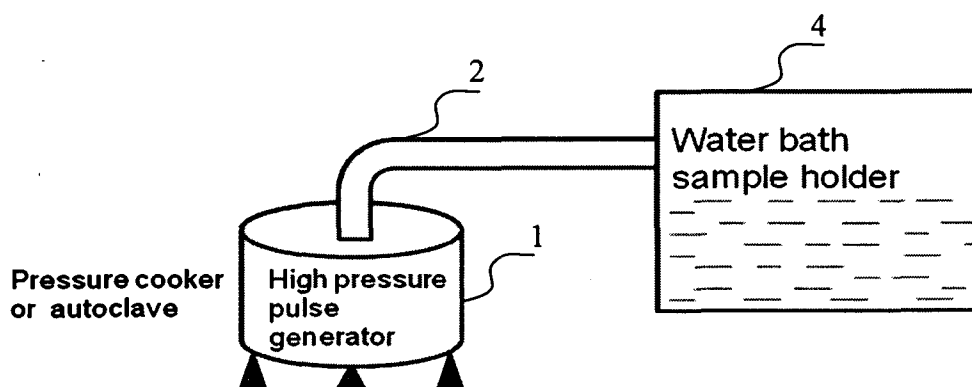


FIG. 4

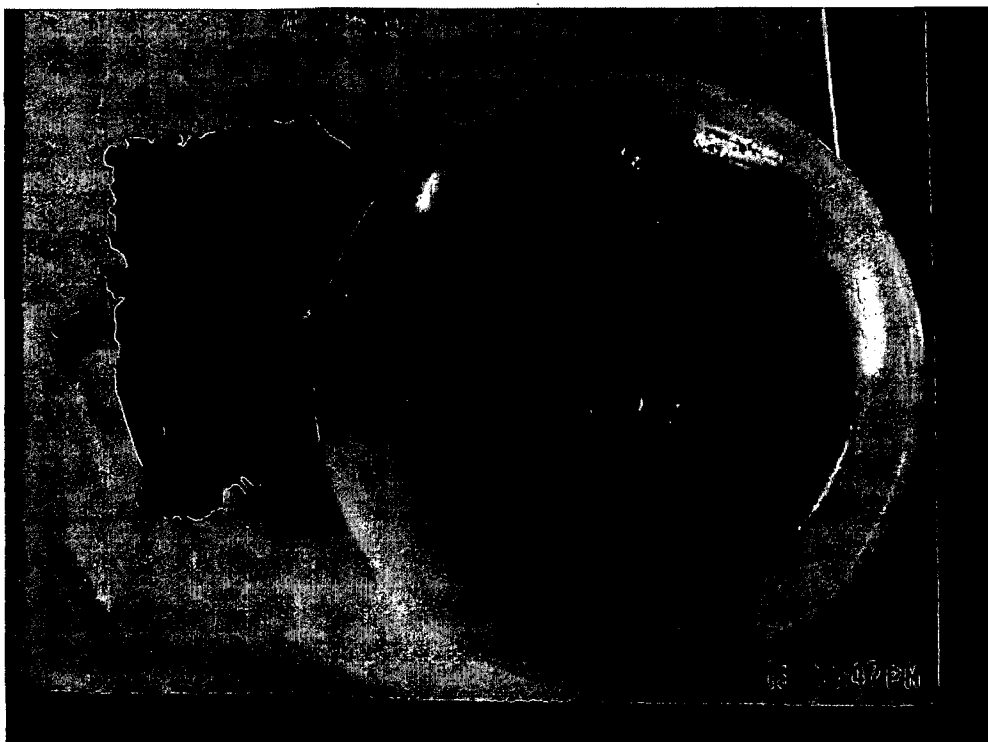


FIG. 5



FIG. 6

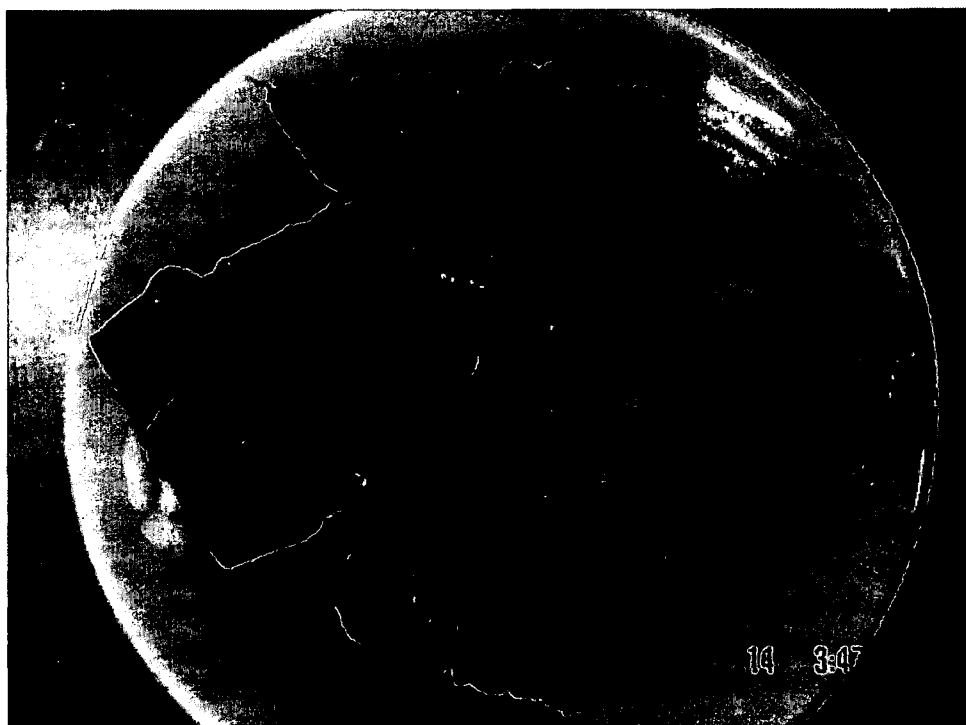


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN 2010/000254

A. CLASSIFICATION OF SUBJECT MATTER

IPC⁸: **A23N 1/00** (2006.01); **A23L 1/025** (2006.01); **B02C 19/00** (2006.01)

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)

IPC⁸: A23N1/00; B02C19/00

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)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2009247941 A (J MAC SYSTEM KK) 29 October 2009 (29.10.2009) <i>abstract, figures, paragraphs [0019],[0031] and [0033] of the online translation of the JPO</i>	1-6
	--	
A	US 2008/171115 A1 (ITOH) 17 July 2008 (17.07.2008) <i>whole document</i>	1-6

☐ 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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
13 January 2010 (13.01.2010)Date of mailing of the international search report
26 January 2011 (26.01.2011)Name and mailing address of the ISA/ AT
Austrian Patent Office
Dresdner Straße 87, A-1200 ViennaAuthorized officer
KRENN M.

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Telephone No. +43 / 1 / 534 24 / 435

Continuation of first sheet**Continuation No. II:****Observations where certain claims were found unsearchable****(Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

Claims Nos.: 7-9 because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claim 7 is incomplete, because it does not disclose how the liquid is exactly extracted from the fruits, etc.. The formulation "...generating stepp pressure pulses.." describes the method in a too general way.

It further remains unclear how a stepp pressure pulse can be obtained by using a "pressure vessel", a "pressure cooker" or an "autoclave" (claim 8).

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/IN 2010/000254

Patent document cited in search report			Publication date	Patent family member(s)			Publication date
JP	A	2009247941		JP	A	2009247941	2009-10-29
US	A	2008171115		US	A1	2008171115	2008-07-17
				WO	A1	2006098453	2006-09-21