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(54) Title: VACUUM MICROWAVE DRYING WITH HIGHER PRESSURE STEP

(57) Abstract: A method of drying and pasteurizing food and pharmaceutical products in a vacuum microwave chamber (40), in which a relatively lower vacuum pressure step (14) is used for dehydration and a relatively higher vacuum pressure step (18) is used for pasteurization. The higher vacuum pressure is selected to provide a temperature in the vacuum microwave chamber that is effective for pasteurization. One or more pasteurization steps and drying steps can be used in the method. The invention permits both drying and pasteurization to be done in a single vacuum chamber in a continuous throughput process by controlling the vacuum pressure, and therefore product temperature, during each step.

Vacuum Microwave Drying with Higher Pressure Step

Field

The invention pertains to methods of heat-treating and drying of organic materials, such as food and pharmaceutical products.

Background

Dehydration of organic materials is commonly done in the food processing and pharmaceutical industries to preserve the products for storage, to concentrate non-volatile components, or to create products that are used in the dehydrated form, for example dried herbs and various kinds of chips. It is known to dehydrate food and pharmaceutical products by vacuum microwave dehydration. Examples of this in the patent literature include WO 2009/049409, Durance et al.; WO 2009/033285, Durance et al.; WO 2011/085467, Fu et al.; WO 2013/010257, Fu et al.; and WO 2014/085897, Durance et al. Vacuum microwave drying is a rapid method that can yield products with improved quality compared to air-dried and freeze-dried products. Because the drying is done under reduced pressure, the boiling point of water and the oxygen content of the atmosphere are lowered, so food and medicinal components sensitive to oxidation and thermal degradation can be retained to a high degree.

Despite being dehydrated, many organic products have bacterial contamination or contain deleterious enzymes that reduce storage life. In the prior art, separate treatment processes additional to drying are required to address these problems. It is known to process food products by increasing the pressure in a vacuum microwave chamber to atmospheric or greater than atmospheric pressure, thereby elevating the temperature of the product to a sterilization temperature. See Yaghmaee et al., "Efficacy of Vacuum Microwave Drying in Microbial Decontamination of Dried Vegetables," in *Drying Technology*, 25:6, 1099-1104 (2007). However, heat treatment at such elevated temperatures is not suitable for materials that are subject to thermal degradation. There is a need for a cost-effective method of treating food and pharmaceutical products to improve their quality, safety and storage life.

Summary of the Invention

The invention provides a method of pasteurizing and dehydrating an organic material in a vacuum microwave chamber, in which a relatively lower vacuum pressure step is used for dehydration and a relatively higher vacuum pressure step is used for pasteurization. The higher vacuum pressure is selected to provide a heat-treatment temperature in the vacuum microwave chamber that is effective for pasteurization. One or more drying steps and two or more pasteurizing steps can be used in the method, in various orders.

According to one aspect of the invention, there is provided a method of heat-treating and dehydrating an organic material in a vacuum chamber, comprising the steps of: (a) loading the organic material into the vacuum chamber, (b) moving the organic material through the vacuum chamber from an input end to an output end while exposing it to microwave radiation, (c) exposing the organic material to a first pressure below atmospheric one or more times during step (b) to dehydrate the organic material, (d) exposing the organic material to a second pressure below atmospheric and higher than the first pressure during step (b) to pasteurize or blanch the organic material, wherein step (d) is performed at least two times, and (e) unloading the dehydrated organic material from the vacuum chamber.

These and other aspects and features of the invention will be apparent from the following description and drawings of the specific embodiments.

Brief Description of the Drawings

Figure 1 is a flow chart of a method for making a pasteurized and dehydrated product according to one embodiment of the invention.

Figure 2 is a schematic diagram of a vacuum microwave dehydration apparatus for carrying out the process of the invention.

Detailed Description of Preferred Embodiments

In thermal processing of organic materials such as food products, distinctions are made between different levels of heat treatment in terms of the types of

microorganisms that are targeted. A distinction is made between: 1) heat processes that kill all viable organisms, termed "sterilization;" 2) processes that kill all viable organisms of public health concern, termed "commercial sterilization;" and 3) relatively milder heat processes that only kill some of the less heat-resistant pathogenic organisms, termed "pasteurization." Sterilizing with heat requires temperatures well above 100°C, which are achieved at or above atmospheric pressure, not under vacuum pressures. The present disclosure pertains only to processes carried out under vacuum conditions, so the processes pasteurize rather than sterilize.

The processes of the invention are carried out using a vacuum microwave apparatus. A food or pharmaceutical product is fed into and through a vacuum chamber on a continuous throughput basis, moving at a constant speed through the vacuum chamber for a selected residence time, during which microwave generators irradiate the product with microwave radiation, at a constant power output. In one embodiment, the pressure in the vacuum chamber is set at a first pressure less than atmospheric (the "drying pressure"). During the time that the product travels through the vacuum chamber, two or more higher pressure steps ("pasteurization steps") are used to pasteurize the product.

The drying pressure in the vacuum chamber corresponds to a drying temperature that is sufficient to achieve drying of the product within a selected time period. "Drying temperature" means the temperature of the product during the drying step. For example, at 40 Torr (53 mbar), the boiling point of water is 35°C, though the product temperature becomes somewhat higher than this due to presence of solutes in the water which are concentrated as water is evaporated off. The drying pressure may, for example, be in the range of 10 to 60 Torr (13 to 80 mbar), resulting in a drying temperature in the range of 40 to 60°C. The drying step or steps are conducted at this reduced pressure and with microwave radiation heating the product, for a time period sufficient to reduce the water content of the material to a desired level. The term "drying time" as used herein does not include the time period for the pasteurization steps.

After the initial drying step, the pressure in the vacuum chamber is increased to a second vacuum pressure higher than the first pressure and again less than

atmospheric ("the pasteurization pressure"). This higher pressure is selected such that the boiling point of water at that pressure is at a temperature that is sufficient to pasteurize the product, i.e., reduce microorganism numbers to an acceptably low level. For example, the pasteurization pressure may be in the range of 150 to 400 Torr (200 to 533 mbar), resulting in a pasteurization temperature in the range of 60 to 95°C. "Pasteurization temperature" means the temperature of the product during the pasteurization step. The first pasteurization step is conducted for a selected time period, for example, in the range of 3 to 12 minutes, during which microwave radiation continues to be applied to the product.

After the first pasteurizing step, the pressure is reduced to the first pressure, i.e., the drying pressure, for a further time period for drying, followed by a second pasteurizing step. The number of steps at the pasteurization pressure, is selected to be two or more, and the number of steps at the drying pressure, can be selected to be one or more. The order of the steps and the length of the time periods that the product spends at each of the pressures can be selected, depending upon the drying and pasteurization conditions that are suitable for a particular product and moisture content. In embodiments of the process having more than two pasteurization steps, it is important that the pasteurization steps are evenly spaced in time, i.e., occurring at regularly spaced intervals, such as every 15 minutes, or every 20 minutes, etc., during the residence time. In some embodiments, there are many pasteurization steps, for example, five, six, or more, evenly spaced in time, and each one may be done for a relatively short time period, such as one or two minutes. The drying time and the pasteurizing time are the sum of the times of the drying steps and the pasteurizing steps.

It is important to the process that there are at least two separate pasteurization steps during the residence time of the material in the vacuum chamber. Due to the non-homogeneous distribution of moisture contents within the drying chamber, materials are pasteurized at different moisture contents during one single exposure. At least two pasteurization steps are required to ensure that all the material is heated to the pasteurizing temperature during the process.

Following the dehydration and pasteurization steps, the dried product is unloaded from the vacuum chamber. The total residence time in the vacuum chamber may be, for example, in the range of 30 to 60 minutes, alternatively 50 to 60 minutes, and the final moisture level of the dried material may be in the range of 2 to 14 wt.%.

Figure 1 schematically illustrates an embodiment of the process in which there are two pasteurization steps. The treatment process **10** is done using a continuous throughput vacuum microwave drying apparatus in which the pressure is less than atmospheric and microwave generators are arranged to irradiate the product throughout the process, at a constant energy output, as the product is moved at a constant speed through the vacuum chamber from an input end to an output end, for example on a conveyor belt. Conventional air locks are arranged for loading and unloading the product. The organic product to be treated is loaded **12** into the vacuum chamber. The product is maintained **14** in the vacuum chamber at a first drying pressure less than atmospheric for a specified time period. This is the first drying step. The pressure is then increased **16** to a pasteurizing pressure, higher than the first pressure and still below atmospheric. The product is maintained **18** at this pasteurizing pressure for a specified time period. This is the first pasteurization step. The pressure is then decreased **20** back to the drying pressure. The product is maintained **22** at the drying pressure for a specified time period. This is the second drying step. The pressure is then increased **24** back to the pasteurizing pressure. The product is maintained **26** at the pasteurizing pressure for a specified time period. This is the second pasteurization step. The pressure is then decreased **28** to the drying pressure. The product is maintained **30** at the drying pressure for a specified time period. This is the third drying step. The pasteurized and dehydrated product is then unloaded **32** from the vacuum chamber via an air lock. In this embodiment of the process, there are accordingly two pasteurization steps **18**, **26**, namely those done at the higher vacuum pressure. The balance of the residence time, i.e., in steps **14**, **22** and **30**, is for drying, done at the drying pressure.

In other embodiments of the process, the initial pressure in the vacuum microwave chamber is the relatively higher vacuum pressure for pasteurization

and the pasteurizing step is done first, followed by a drying step at the lower vacuum pressure. These two steps are followed by one or more additional pasteurizing and drying steps.

Where there are two or more pasteurization steps and drying steps, the pasteurizing steps are conducted at the same pasteurizing pressure and the drying steps are conducted at the same drying pressure.

In addition to pasteurization, there is another class of mild heat treatments of food, termed "blanching," which are intended to destroy deleterious enzymes or otherwise improve storage life. The method of the present invention may also be used for blanching. The process for blanching is the same as described above for pasteurizing, using the same pressures, temperatures and processing times.

Figure 2 schematically illustrates an apparatus for carrying out the process of the invention on a continuous throughput basis. The apparatus is a vacuum microwave dehydrator **40**. This comprises a vacuum chamber **42** having an input end **44** for introduction of the material and an output end **46** for removal of the dried product. A first airlock **48** is arranged at the input end and a second airlock **50** at the output end, for loading and unloading the product. A conveyor **52** transports the material at constant speed from the input end to the output end of the vacuum chamber. A microwave source **54** is arranged to irradiate microwave energy into the vacuum chamber. A vacuum source **56** is operatively connected to the vacuum chamber for reducing the pressure inside it to a pressure below atmospheric. Optionally, the conveyor **52** may include means for tumbling the organic material as it travels through the vacuum chamber.

The apparatus **40** includes components that are conventionally required for vacuum microwave dehydrators, including a condenser, a refrigeration unit, a vacuum pump, a water load system, and a programmable logic controller (PLC) for controlling the operation of the system, including controlling the conveyor drive motors, the microwave generator, the vacuum pump, the refrigerant pumps and the airlocks. The higher vacuum pressure steps in the process may be achieved by programming of the PLC.

Examples of materials suitable for pasteurization (or blanching) and dehydration by the invention include fruit, either whole, puree or pieces, either frozen or un-frozen, including banana, mango, papaya, pineapple, melon, watermelon, pomegranate, apples, pears, cherries, berries, peaches, apricots, plums, grapes, oranges, lemons, grapefruit; vegetables, either fresh or frozen, whole, puree or pieces, including peas, beans, corn, carrots, tomatoes, peppers, herbs, potatoes, beets, turnips, squash, onions, garlic; fruit and vegetable juices; pre-cooked grains including rice, oats, wheat, barley, corn, flaxseed; cannabis; hydrocolloid solutions or suspensions, vegetable gums; frozen liquid bacterial cultures, probiotics, food culture, vaccines, enzymes, protein isolates; amino acids; injectable drugs, pharmaceutical drugs, natural medicinal compounds, antibiotics, antibodies; meats, fish and seafoods, either fresh or frozen, either whole, puree or pieces; dairy products such as milk, cheese, whey proteins isolates and yogurt; and moist extracts of fruits, vegetables and meats.

An example of a vacuum microwave dehydrator that is suitable for use in carrying out the process of the invention is a resonant cavity-type microwave apparatus, as disclosed in WO 2009/049409, commercially available from EnWave Corporation of Delta, BC, Canada, under the trademark nutraREV. Using this type of apparatus, the organic material is placed for treatment in a cylindrical basket that is transparent to microwave radiation and has openings to permit the escape of moisture. The loaded basket is placed in the vacuum chamber with its longitudinal axis oriented horizontally. The pressure in the chamber is reduced. The microwave generator is actuated to radiate microwaves in the vacuum chamber and the basket is rotated within the vacuum chamber, about a horizontal axis, so as to slowly and gently tumble the organic material during treatment as it moves through the vacuum chamber. The rotation of the basket may be effected, for example, by means of rollers on which the basket is supported, or by means of a rotatable cage in which the basket is placed.

Another example of a vacuum microwave dehydrator suitable for carrying out the process of the invention is a travelling wave-type apparatus, as disclosed in WO 2011/085467, commercially available from EnWave Corporation under the trademark quantaREV. The organic material is fed into the vacuum chamber and conveyed across a microwave-transparent window on a conveyor belt while

being subjected to low pressure and microwave radiation. With this type of apparatus, the organic material is processed while resting on a tray or on the conveyor belt, and is not subjected to tumbling.

Example

Red bell pepper slices are pasteurized and dried using an EnWave nutraREV vacuum microwave dehydrator. The material remains in the vacuum chamber for 60 minutes in a continuous throughput process with a constant 100kW microwave output. The initial pressure is 20 Torr (53 mbar). Every 25 minutes, the pressure is raised to 300 Torr (400 mbar) for 5 minutes and then reduced back to 20 Torr. The pressure remains below atmospheric throughout the 60-minute residence time. The boiling point of water within the material is about 20°C at 20 Torr while at 300 Torr it is about 75°C. The product is pasteurized and is dried to a moisture content of about 10 weight %. The pasteurization reduces the total plate count from 50,000 cfu/g to less than 500 cfu/g.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the scope thereof. Accordingly, the scope of the invention is to be construed in accordance with the following claims.

Claims

1. A method of heat-treating and dehydrating an organic material in a vacuum chamber, comprising the steps of:

(a) loading the organic material into the vacuum chamber;

(b) moving the organic material through the vacuum chamber from an input end to an output end while exposing it to microwave radiation;

(c) exposing the organic material to a first pressure below atmospheric one or more times during step (b) to dehydrate the organic material;

(d) exposing the organic material to a second pressure below atmospheric and higher than the first pressure during step (b) to pasteurize or blanch the organic material, wherein step (d) is performed (i) a first time and (ii) a second time; and

(e) unloading the dehydrated organic material from the vacuum chamber.

2. A method according to claim 1, wherein step (c) is done before step (d)(i).

3. A method according to claim 2, wherein step (c) is done a second time after step (d)(i) and before step (d)(ii).

4. A method according to claim 3, wherein step (c) is done a third time after step (d)(ii).

5. A method according to claim 1, wherein step (d)(i) is done before step (c), and step (d)(ii) is done after step (c).

6. A method according to claim 5, wherein step (c) is done a second time after step (d)(ii).

7. A method according to any preceding claim, wherein step (d) is performed at least three times, and time intervals between successive performances of step (d) are equal.

8. A method according to any preceding claim, wherein the first pressure is a drying pressure of about 20 Torr (27 mbar).

9. A method according to any preceding claim, wherein the first pressure is a drying pressure in the range of 10 to 60 Torr (13 to 80 mbar).

10. A method according to any preceding claim, wherein step (c) is done for a drying time of about 20 minutes.

11. A method according to any preceding claim, wherein step (c) is done for a drying time in the range of 10 to 30 minutes, alternatively 10 to 60 minutes.

12. A method according to any preceding claim, wherein a temperature of the organic material during step (c) is in the range of 40 to 60°C.

13. A method according to any preceding claim, wherein the second pressure is a pasteurizing pressure of about 300 Torr (400 mbar).

14. A method according to any preceding claim, wherein the second pressure is a pasteurizing pressure in the range of 150 to 400 Torr (200 to 533 mbar).

15. A method according to any preceding claim, wherein step (d)(i) is done for a pasteurizing time of about 5 minutes.

16. A method according to any preceding claim, wherein step (d)(ii) is done for a pasteurizing time of about 5 minutes.

17. A method according to any preceding claim, wherein step (d)(i) is one for a pasteurizing time in the range of 3 to 12 minutes.

18. A method according to any preceding claim, wherein step (d)(ii) is one for a pasteurizing time in the range of 3 to 12 minutes.

19. A method according to any preceding claim, wherein a temperature of the organic material during step (d) is in the range of 60 to 95°C.

20. A method according to any preceding claim, wherein step (b) is done at a constant speed.

21. A method according to any preceding claim, wherein the microwave radiation has a constant energy level during steps (c) and (d).

22. A method according to any preceding claim, wherein the organic material is dehydrated to a moisture content in the range of 2 to 14 wt.%.

23. A method according to any preceding claim, wherein the heat-treating comprises pasteurizing.

24. A method according to any preceding claim, wherein the heat-treating comprises blanching.

25. A method according to any preceding claim, wherein the organic material comprises one of fruit, either whole, puree or pieces, either frozen or un-frozen, including banana, mango, papaya, pineapple, melon, watermelon, pomegranate, apples, pears, cherries, berries, peaches, apricots, plums, grapes, oranges, lemons, grapefruit; vegetables, either fresh or frozen, whole, puree or pieces, including peas, beans, corn, carrots, tomatoes, peppers, herbs, potatoes, beets, turnips, squash, onions, garlic; fruit and vegetable juices; pre-cooked grains including rice, oats, wheat, barley, corn, flaxseed; cannabis; hydrocolloid solutions or suspensions, vegetable gums; frozen liquid bacterial cultures, probiotics, food culture, vaccines, enzymes, protein isolates; amino acids; injectable drugs, pharmaceutical drugs, natural medicinal compounds, antibiotics, antibodies; meats, fish and seafoods, either fresh or frozen, either whole, puree or pieces; dairy products such as milk, cheese, whey proteins isolates and yogurt; and moist extracts of fruits, vegetables and meats.

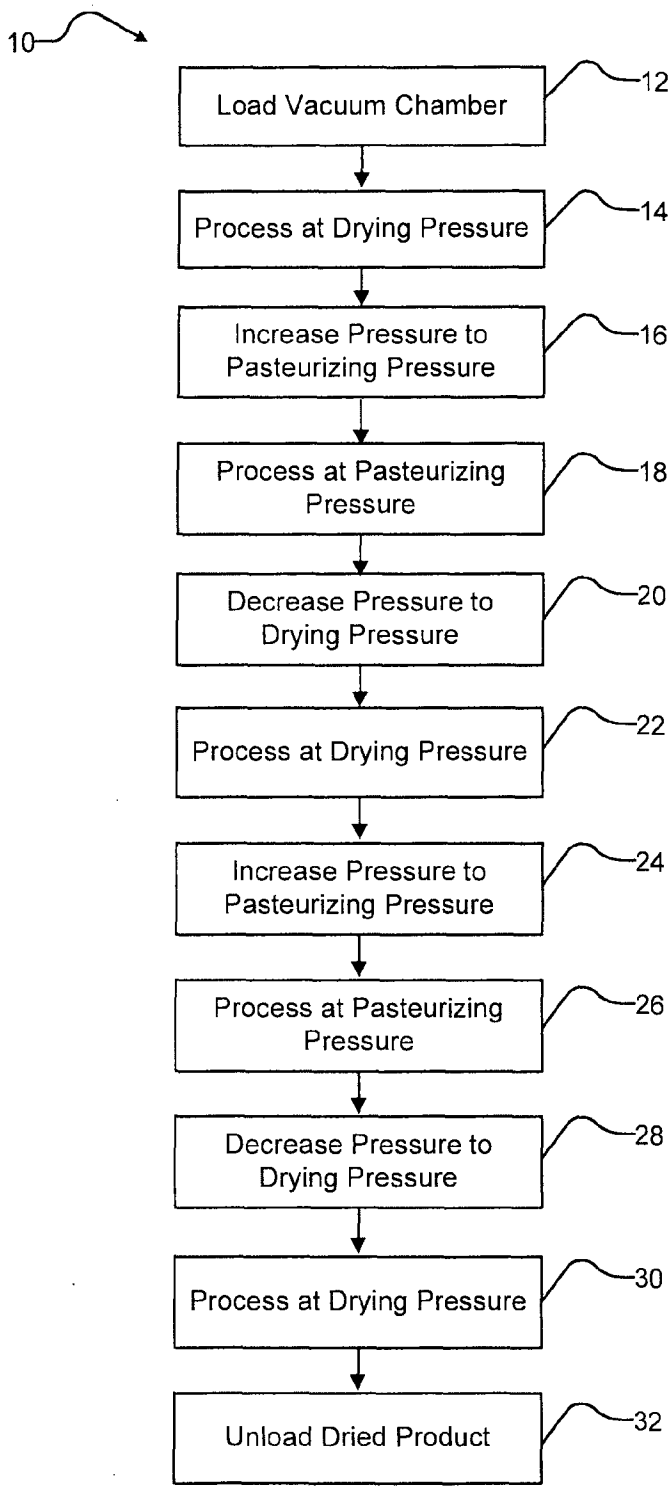
10
Load Vacuum Chamber
12
Process at Drying Pressure
14
Increase Pressure to Pasteurizing Pressure
16
Process at Pasteurizing Pressure
18
Decrease Pressure to Drying Pressure
20
Process at Drying Pressure
22
Increase Pressure to Pasteurizing Pressure
24
Process at Pasteurizing Pressure
26
Decrease Pressure to Drying Pressure
28
Process at Drying Pressure
30
Unload Dried Product
32

FIG. 1

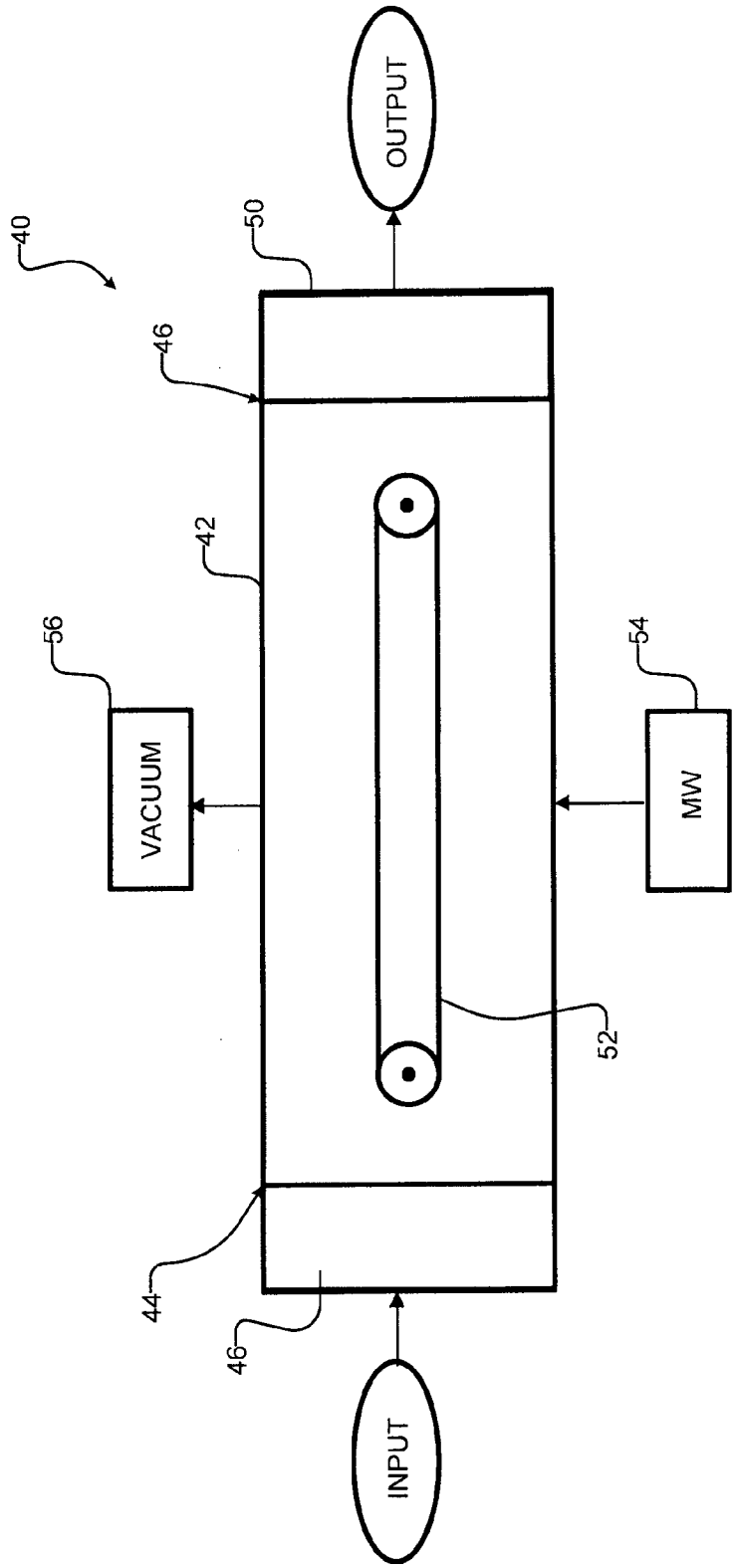

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***A23L 3/54*** (2006.01) , ***A23B 7/015*** (2006.01) , ***A23B 7/02*** (2006.01) , ***A23B 7/024*** (2006.01) , ***A23L 3/40*** (2006.01) , ***A23L 3/44*** (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)
A23L 3/54, A23B 7/015, A23B 7/02, A23B 7/024, A23L 3/40, A23L 3/44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Intellect (Canadian Patent Database) and Questel Orbit
Search terms: vacuum, microwave, first pressure, second pressure, pressure, dehydrate, fruit, vegetable, pasteuri#+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	WO 2019/041017 A1 (DURANCE et al.) 07 March 2019 (07-03-2019) Whole document	1-25
A	US 5972397 A (DURANCE et al.) 26 October 1999 (26-10-1999) Whole document	1-25
A	CA 2781644 C (FU et al.) 29 Septembre 2015 (29-09-2015) Whole document	1-25
A	CA 2818377 C (DURANCE et al.) 20 January 2015 (01-20-2015) Whole document	1-25
A	CA 2678089 C (DURANCE et al.) 04 October 2011 (04-10-2011) Whole document	1-25

☐ 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
"D"	document cited by the applicant in the international application
"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 25 October 2019 (25-10-2019)	Date of mailing of the international search report 25 October 2019 (25-10-2019)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Emman Ben Jamil (819) 639-8427

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2019/050261

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
WO2019041019A1	07 March 2019 (07-03-2019)	WO2019041019A1	07 March 2019 (07-03-2019)
		US10051414B1	14 August 2018 (14-08-2018)
US5972397A	26 October 1999 (26-10-1999)	US5972397A	26 October 1999 (26-10-1999)
		AU7902498A	04 January 1999 (04-01-1999)
		CA2290811A1	23 December 1998 (23-12-1998)
		JP2002505581A	19 February 2002 (19-02-2002)
		WO9857554A1	23 December 1998 (23-12-1998)
CA2781644C	29 September 2015 (29-09-2015)	CA2781644A1	21 July 2011 (21-07-2011)
		CA2781644C	29 September 2015 (29-09-2015)
		AU2010342753A1	12 July 2012 (12-07-2012)
		AU2010342753B2	09 July 2015 (09-07-2015)
		BR112012016310A2	01 September 2015 (01-09-2015)
		BR112012016310B1	30 October 2018 (30-10-2018)
		CL2012001969A1	11 January 2013 (11-01-2013)
		CL2015002280A1	05 February 2016 (05-02-2016)
		CN102711529A	03 October 2012 (03-10-2012)
		CN102711529B	23 July 2014 (23-07-2014)
		DK2525675T3	13 July 2015 (13-07-2015)
		DK2526776T3	07 December 2015 (07-12-2015)
		EP2525675A1	28 November 2012 (28-11-2012)
		EP2525675A4	31 July 2013 (31-07-2013)
		EP2525675B1	15 April 2015 (15-04-2015)
		EP2526776A2	28 November 2012 (28-11-2012)
		EP2526776A3	31 July 2013 (31-07-2013)
		EP2526776B1	23 September 2015 (23-09-2015)
		ES2540989T3	15 July 2015 (15-07-2015)
		ES2555412T3	30 December 2015 (30-12-2015)
		HK1172214A1	28 November 2014 (28-11-2014)
		HUE025591T2	30 May 2016 (30-05-2016)
		JP2013517442A	16 May 2013 (16-05-2013)
		JP5778175B2	16 September 2015 (16-09-2015)
		MX341850B	05 September 2016 (05-09-2016)
		MX2012007766A	01 August 2012 (01-08-2012)
		NZ600723A	25 July 2014 (25-07-2014)
		PT2525675E	21 August 2015 (21-08-2015)
		PT2526776E	30 December 2015 (30-12-2015)
		US2012291305A1	22 November 2012 (22-11-2012)
		US9316437B2	19 April 2016 (19-04-2016)
		US2016209114A1	21 July 2016 (21-07-2016)
		US9958203B2	01 May 2018 (01-05-2018)
		US2018224206A1	09 August 2018 (09-08-2018)
		US10139160B2	27 November 2018 (27-11-2018)
		US2018224207A1	09 August 2018 (09-08-2018)
		US10139161B2	27 November 2018 (27-11-2018)
		WO2011085467A1	21 July 2011 (21-07-2011)

CA2818377C	20 January 2015 (20-01-2015)	CA2818377A1	07 June 2014 (07-06-2014)
		CA2818377C	20 January 2015 (20-01-2015)
		AU2012396134A1	28 May 2015 (28-05-2015)
		AU2012396134A2	28 May 2015 (28-05-2015)
		AU2012396134B2	04 May 2017 (04-05-2017)
		BR112015013184A2	11 July 2017 (11-07-2017)
		CN104769377A	08 July 2015 (08-07-2015)
		CN104769377B	08 March 2017 (08-03-2017)
		EP2753888A1	16 July 2014 (16-07-2014)
		EP2753888A4	15 June 2016 (15-06-2016)
		HK1208524A1	04 March 2016 (04-03-2016)
		JP2015536440A	21 December 2015 (21-12-2015)
		JP6042996B2	14 December 2016 (14-12-2016)
		KR20150092155A	12 August 2015 (12-08-2015)
		KR101966209B1	13 August 2019 (13-08-2019)
		MX2015005161A	17 July 2015 (17-07-2015)
		MX365683B	11 June 2019 (11-06-2019)
		NZ706088A	28 April 2017 (28-04-2017)
		US2015128442A1	14 May 2015 (14-05-2015)
		US9267734B2	23 February 2016 (23-02-2016)
		WO2014085897A1	12 June 2014 (12-06-2014)
CA2678089C	04 October 2011 (04-10-2011)	CA2678089A1	23 April 2009 (23-04-2009)
		CA2678089C	04 October 2011 (04-10-2011)
		AU2008314458A1	23 April 2009 (23-04-2009)
		AU2008314458A2	10 June 2010 (10-06-2010)
		AU2008314458B2	19 December 2013 (19-12-2013)
		BRPI0818421A2	07 October 2014 (07-10-2014)
		BRPI0818421B1	12 June 2018 (12-06-2018)
		CL2010000398A1	07 January 2011 (07-01-2011)
		CN101820780A	01 September 2010 (01-09-2010)
		CN101820780B	10 July 2013 (10-07-2013)
		EP2200458A1	30 June 2010 (30-06-2010)
		EP2200458A4	01 December 2010 (01-12-2010)
		EP2200458B1	14 August 2019 (14-08-2019)
		EP2377411A1	19 October 2011 (19-10-2011)
		EP2377411B1	29 March 2017 (29-03-2017)
		HK1143718A1	06 December 2013 (06-12-2013)
		JP2011501086A	06 January 2011 (06-01-2011)
		JP6110052B2	05 April 2017 (05-04-2017)
		JP2015061998A	02 April 2015 (02-04-2015)
		JP6177814B2	09 August 2017 (09-08-2017)
		LT2200458T	10 September 2019 (10-09-2019)
		MX355861B	03 May 2018 (03-05-2018)
		MX2010004095A	25 June 2010 (25-06-2010)
		NZ584266A	12 January 2012 (12-01-2012)
		US2010218395A1	02 September 2010 (02-09-2010)
		US10178873B2	15 January 2019 (15-01-2019)
		WO2009049409A1	23 April 2009 (23-04-2009)