Title: SOYBEAN PRETREATMENT METHOD

Abstract: The present invention relates to a soybean pretreatment method, which includes the steps of cooking soybeans to inhibit anti-nutrients and/or eliminate anti-nutrients contained therein and drying the cooked soybeans to a water content of less than 8% while keeping the volume expansibility of soybeans at a level of at least 300%. The soybean pretreatment method may provide a fast soy milk making process.
Soybean pretreatment method

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to the field of food processing, and more particularly to a soybean pretreatment method, a soybean pretreatment system, a soy milk making method and a system for making soy milk.

2. Description of the Prior Art

Nowadays, to prevent affluence-related illnesses or to lose weight, an increasing amount of people prefer a healthy and light diet for breakfast or supper, such as soy milk and rice congee. Soy milk is one of the most popular beverages in Asian countries due to its high nutrient content. However, in general it takes a long time (for instance more than 15 minutes) in currently available soy milk makers to inactivate or inhibit anti-nutrients (e.g. trypsin inhibitor) in soybeans by heating. And after heating and grinding steps, a manual filtering step (usually taking more than 10 minutes) has to be carried out, which is also the most troublesome step for consumers, and which is performed because of an aculeate feeling in the throat caused by a high rough fiber content.

It is therefore worthwhile to find a solution to overcome all the problems mentioned above. Processed soybean powders are for sale in the market; however, customers have a much lower degree of acceptance for this as compared to soy milk made from raw soybeans. Therefore, it is necessary to develop a solution which enables all nutrients to be preserved in soybeans while inhibiting and/or eliminating anti-nutrients beforehand so as to reduce the grinding and/or heating time, while also providing nutritious and tasty soy milk for consumers. Pretreatment of soybeans may be an option to preserve all the nutrients and inhibit/eliminate anti-nutrients beforehand so as to reduce the grinding and/or heating time.

Chinese patent application CN102265933A, published on December 7, 2011, entitled "Method for processing raw material of soy milk and soy milk preparing method" discloses a soybean pretreatment method, which includes the following
soybean pretreatment steps: cleaning soybeans; soaking and boiling the soybeans to render the soybeans porous and fluffy; drying the boiled soybeans by means of microwaves; and packaging the dried soybeans for the preparation of soy milk.

The method of CN102265933A uses microwaves to dry the soaked and boiled soybeans, which actually makes it very hard to keep the soaked and boiled soybeans porous and fluffy. From the literature and our research, we have learned that microwave drying may be better than direct heat drying, but the soybeans will shrink during the drying process irrespective of the heating technique used, thus rendering soybeans which are very hard and which cannot be easily ground into powder in a very short time during dry grinding.

Besides, the water content of final dried soybeans according to the method of CN102265933A is between 8% and 25%; if the water content is lower than 8%, the soybeans will be brown and too hard for grinding. More importantly, the microwave-dried soybean is not suitable for dry-grinding; from the description of CN102265933A we know that they can only use the wet grinding method for generating soy milk, and it is additionally proven that the soybeans are still very hard after microwave-drying, so that from the practical application point of view, they can hardly be used for instant soy milk making.

EP 0 712 582 A1 discloses a process for preparing fast rehydrating pulses (legumes), in which the pulses are cooked with steam under pressure, cooled by placing them under vacuum and dried. The starting material is pulses having a water content of 40-80%, which are cooked at a temperature of 105-140°C for 3-40 min. The pulses are cooled to a temperature while placing them under vacuum by drawing off steam and/or condensed vapour to a residual pressure below 300 mbar and maintaining this vacuum for 2-10 min.

US 2,813,796 A discloses a process of treating rice and other starchy vegetables to produce a quick-cooking product which can be quickly re-cooked to correspond in taste and appearance to ordinary cooked vegetables. The process comprises steeping the vegetable under water for a period of several hours until the vegetable is approximately saturated with water, cooking the vegetable under water, abruptly terminating the cooking by separating the vegetable from the cooking water, cooling the vegetable under non-drying conditions, freezing the vegetable by producing a rapid temperature drop to the freezing temperature of about 31°—32° F., maintaining said freezing temperature for a period of at least an hour and thereafter producing a
second rapid temperature drop, thawing the vegetable under non-drying conditions, and
drying the vegetable without changing its appearance or flavour.

There is a need to improve the drying process of such a soybean
pretreatment method.

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SUMMARY OF THE INVENTION

The invention aims at totally or partly overcoming one or more of the
drawbacks mentioned above.

To this end, a soybean pretreatment method is provided, which includes
the following steps:
- cooking soybeans to achieve a volume expansion of at least 300% and to inhibit
  anti-nutrients and/or eliminate anti-nutrients contained therein; and
- drying the cooked soybeans to a water content of less than 8% while keeping said
  volume expansion of the soybeans at a level of at least 300%.

According to an example of the invention, the step of drying includes
freezing the cooked soybeans and drying the frozen soybeans.

According to an example of the invention, the step of drying can be
performed by means of a convective multi-flash drying process, an osmotic dehydration
process and/or a vacuum drying process.

According to another example of the invention, the step of cooking
soybeans includes the step of boiling, steaming, pressure-boiling and/or
pressure-steaming soybeans.

According to still another example of the invention, the water content of
the dried soybeans is about 4%-8%, preferably about 4.6%-7% or about 5%-6%.

The present invention also provides a method of making soy milk, which
includes:
- providing pretreated soybeans, which are pretreated according to the soybean
  pretreatment method as mentioned above; and
- mixing the pretreated soybeans with water and then grinding the mixed soybeans to
  obtain soy milk, or grinding the pretreated soybeans and then mixing the ground
  soybeans with water to obtain soy milk.

The present invention also provides a soybean pretreatment system, which
includes:
- a cooker for cooking soybeans to achieve a volume expansion of at least 300% and to inhibit anti-nutrients and/or eliminate anti-nutrients contained therein; and
- a drying unit for drying the cooked soybeans to a water content of less than 8% while keeping said volume expansion of soybeans at a level of at least 300%.

According to an example of the invention, the drying unit includes a freezer for freezing the cooked soybeans and a dryer for drying the frozen soybeans.

According to another example of the invention, the dryer may be a convective multi-flash dryer, an osmotic dehydration dryer or a vacuum dryer.

According to still another example of the invention, the cooker is a boiler, a steamer, a pressure-boiler or a pressure-steamer.

The present invention also provides a soy milk making system, which includes:
- a grinding unit for grinding the pretreated soybeans, which are pretreated according to the soybean pretreatment method as mentioned above;
- a generating unit for generating hot water;
- a removable container for containing and mixing the ground pretreated soybeans and the generated hot water therein; and
- a supply unit for supplying the generated hot water into the removable container.

According to an example of the invention, the generating unit can be further configured to generate steam and the supply unit can be further configured to supply the steam into the removable container to heat and/or mix the ground pretreated soybeans and the generated hot water contained therein.

According to another example of the invention, the soy milk making system further includes a reservoir arranged over the grinding unit for holding the pretreated soybeans.

According to still another example of the invention, the soy milk making system further includes a controller unit configured to control the amount of pretreated soybeans supplied from the reservoir into the grinding unit and control the amount of hot water supplied from the supply unit into the removable container according to the amount of ground pretreated soybeans.

One of the main differences of the present invention to the processes proposed in the cited prior art documents is that none of them suggests an expansion of the products to be treated, while cooking, and maintaining said expansion in the subsequent drying process.
Other objects, advantages, and novel features of the present invention will be apparent from the following detailed description of a preferred embodiment thereof with reference to the attached drawings, in which:

5 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic block diagram showing a soybean pretreatment method according to an embodiment of the present invention;

Fig. 2 shows particle size distributions of different examples of soy milk made in three different ways; and

Fig. 3 is a schematic view showing a structure of a soy milk making system according to an embodiment of the present invention;

Fig. 4 schematically shows how a control unit of the soy milk making system controls the amount of pretreated soybeans and the amount of hot water according to an embodiment of the present invention; and

Fig. 5 is a schematic view showing a structure of a soy milk making system according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

With reference to Fig. 1, a soybean pretreatment method according to an embodiment of the present invention may include the following steps:

- washing soybeans with water by means of a washing device to remove dust and pesticides (an optional step, not shown);
- soaking the soybeans by means of a soaking device to reduce oligosaccharide and saponin contained in the soybeans and to soften the rough fiber (an optional step, not shown), so that the texture of the soybeans may be much more fragile after drying. For instance, the soybeans may be soaked in water at a water temperature lower than 95°C and a soybean-water ratio of less than 0.5 to reach at least a 100% expansion rate of the soybeans. The soaking duration depends on the water temperature: at a higher temperature a shorter time is needed to reach a 100% expansion rate;
- cooking soybeans by means of a cooker at a temperature \( T_c \) for a time period \( t_c \) to inhibit anti-nutrients and/or eliminate anti-nutrients contained therein S101, wherein \( T_c \) is about 90-150°C and \( t_c \) is about 2-120 minutes. Trypsin inhibitor is one of the main anti-nutrients, which need to be heated for a long time to achieve an activity reduction by 90%. Experiments show that a 90% activity reduction of trypsin inhibitor may yield...
the highest protein digestibility. Besides, the step of cooking soybeans may include the step of boiling, steaming, pressure-boiling and/or pressure-steaming soybeans. The soybeans may be cooked to at least a rate of expansion of 300% of the soybeans (i.e. the volume of the soybeans increases to at least 300% while cooking);
- drying the cooked soybeans by means of a drying unit to a water content of less than 8% (for instance, the water content of the dried soybeans is about 4%-8%, preferably about 4.6%-7% or about 5%-6%) while keeping the volume expansibility of soybeans at a level of at least 300%> S102. In other words, while drying the soybeans a volume expansion of at least 300% is maintained. The step of drying the cooked soybeans may be performed in the following two ways: (a). one way comprises using a freezer to pre-freeze the cooked soybeans at a temperature $T_f$ for a time period $t_f$, and then using a freeze-dryer to freeze-dry the pre-frozen soybeans at a temperature $T_d$ for a time period $t_d$ to reduce the water content of the soybeans and to keep them fluffy, wherein $T_f$ is lower than $-4^\circ$C, $t_f$ is more than 60 minutes, $T_d$ is about $-40^\circ$C, $t_d$ is about 1080 minutes. Freeze-drying is used to remove water from food material, while leaving the basic structure and composition of the material intact. So the porous and fluffy structure of soybeans may remain intact after freeze-drying, making it much easier to grind the soybeans to powder. The water content may be below 8 %, preventing the soybeans from going bad for a long period of time. And the expansion rate may still be above 300 %, thereby making grinding easy; (b). the other way comprises adopting other drying methods. For example, a convective multi-flash drying process (CMFD), an osmotic dehydration process, a vacuum drying process and/or a microwave drying process. The vacuum drying process may be adopted to keep the soybeans in puffing status and to enable easy grinding. Experimental results show that the structure of whole soybeans after the freeze-drying treatment remains intact;
- storing the dried soybeans in a sealed package for the preparation of soy milk (an optional step, not shown).

Once the soybean pretreatment method is completed, a user can easily prepare soy milk by carrying out the following steps: providing pretreated soybeans, which are pretreated according to the soybean pretreatment method as mentioned above; and mixing the pretreated soybeans with water and then grinding the mixed soybeans for 30-60 seconds to obtain soy milk, or grinding the pretreated soybeans for 30-60 seconds and then mixing the ground soybeans with water to obtain soy milk.
Reference is made to Fig. 2 of the current application, which shows particle size distributions of different kinds of soy milk made in three different ways, in which the horizontal axis indicates particle size within the soy milk, the vertical axis indicates volume percent of the respective particle size, E1 represents the particle size distribution of soy milk made from dry soybeans without the pretreatment method mentioned above and E2, E3 respectively represent the particle size distributions of soy milk made from soybeans pretreated by means of the pretreatment method mentioned above. The difference between E2 and E3 is that the grinding time in E2 is 30 seconds and the grinding time in E3 is 60 seconds.

According to our experiments, soybeans which have been pretreated can be simply ground fine within 30 seconds, even without heating. A very fast soy milk making process may thus be provided. According to the results of particle size distribution shown in Fig. 2, the particle sizes of soy milk that was ground for 30 seconds and the particle sizes of soy milk made in 24 minutes by means of a traditional soy milk maker were similar. And it is obvious that the particle size will be smaller if the grinding time is longer. Meanwhile the hardness of soybeans which have been pretreated is almost half that of dry soybeans, so even though the particle size distribution is similar, the rough feeling of the throat will be substantially reduced with softer soybean particles (see Table 1 shown below). Moreover, according to our experiments, the trypsin inhibitor activity of pretreated soybeans is 4.5% (that is, more than 95% of the trypsin inhibitor activity of soybeans is inhibited), which is much lower than 9.0% in the soy milk made by a traditional soy milk maker, which means the soybeans do not have to be cooked anymore.

<table>
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<tr>
<th>Hardness (Kg)</th>
<th>Dry soybeans</th>
<th>Soybeans with pretreatment</th>
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<td>2.1592</td>
<td>1.1046</td>
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Table 1

This invention incorporates a method of pretreating soybeans. In this pretreatment, soybeans are caused to expand to stretch and soften the rough fiber, thus making them much easier to grind and enabling soy milk to be made without any filtering. Inhibiting/eliminating anti-nutrients will be also incorporated in the process, and then soybeans thus pretreated can skip the long heating process for consumers, enabling them to make soy milk in less than 1 minute. Thus, consumers can quickly
make soy milk without a long duration of the soy milk making process and without going through the trouble of filtering.

Now, with reference to Figs. 3-5, a description is given of a soy milk making system and method.

The soy milk making system 300 according to Fig. 3 includes: a grinding unit 301 for grinding the pretreated soybeans, which are pretreated according to the soybean pretreatment method mentioned above; a generating unit 302 for generating hot water; a removable container 303 for containing and mixing the ground pretreated soybeans and the generated hot water therein; a supply unit 304 for supplying the generated hot water into the removable container; a reservoir (not provided with a reference numeral) arranged above the grinding unit 301 for retaining the pretreated soybeans; and a controller unit (see Fig. 2, which will be explained afterwards) configured to control the amount of pretreated soybeans delivered from the reservoir into the grinding unit 301 and to control the amount of hot water supplied from the supply unit 304 into the removable container 303 according to the amount of ground pretreated soybeans.

The structure of the grinding unit 301 is generally similar to that of a coffee bean grinding unit commonly used in a coffee maker.

The generating unit 302 can be further configured to generate steam for heating and mixing the soy milk. There will be also a water tank 3021, which is accommodated in the generating unit 302, with a pressure heater 3022 to heat the water.

The supply unit 304 can be further configured to supply the steam into the removable container 303 to heat and/or mix the ground pretreated soybeans and the generated hot water contained therein.

In operation, the pretreated soybeans are first ground to powder by the grinding unit 301, and then the soybean powder directly drops into the removable container 303, such as a cup; next, the hot water and/or steam generated by the generating unit 302 are directly supplied into the removable container 303 via the supply unit 304, such as a pumping system. The generating unit 302 is used mainly for mixing hot water with soybean powder as well as short time heating (e.g. 1 minute). Water temperature and steam heating time can be controlled based on the user's choice.

Now, with reference to Figs. 3 and 4, a brief description is given of how the controlling unit of the soy milk making system 300 controls the amount of pretreated
soybeans and the amount of hot water. The relationship between the reference numbers of Fig. 4 and the respective actions performed is shown in table 2.

<table>
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<tr>
<th>S401</th>
<th>Choosing the volume and the temperature of the soy milk by a user</th>
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<tbody>
<tr>
<td>S402</td>
<td>Starting the preparation of soy milk</td>
</tr>
<tr>
<td>S403</td>
<td>Calculating the volume of beans, water temperature and steam heating period</td>
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<tr>
<td>S404</td>
<td>Grinding the pretreated soybeans</td>
</tr>
<tr>
<td>S405</td>
<td>Supplying hot water</td>
</tr>
<tr>
<td>S406</td>
<td>Supplying steam to mix and heat soy milk</td>
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</tbody>
</table>

Table 2

Specifically, the main control process and strategy of the controlling unit will be briefly explained hereinbelow:

- soybeans are automatically introduced into the grinding unit 301 in order to be ground. Volume control is necessary for regulating the volume of soybeans to be ground;
- pressure heater 3022 is used for heating the water from water tank 3021. Volume control is also necessary for regulating the water volume to be heated for each operation;
- pressure heater 3022 is also used for generating the steam to heat and mix soy milk. The function of switching between generating steam and generating hot water is carried out by the volume control; steam is generated by feeding less water into the pressure heater 3022;
- a water pipe is used to inject hot water into the removable container 303. This pipe is also designed to supply steam generated by the pressure heater 3022 for heating. The water pipe is designed to be easy to mount and demount, so that the water pipe can be cleaned separately; and
- the soybean powder can also be soluble in water of a comparatively low temperature (e.g., 30–40°C), the water temperature and steam heating time may be controllable so as to obtain soy milk of different temperatures.

Fig. 5 is a schematic view showing a structure of a soy milk making system 500 according to another embodiment of the present invention. The system architecture (especially the generating unit 502, the supply unit 504 and the removable container 503) shown in Fig. 5 is similar to that of Fig. 3, but with some modifications to meet special business requirements. The system architecture shown in Fig. 5 can serve many different tastes of soy milk at the same time due to the specially designed reservoir 505 and the grinding unit 501. The reservoir 505 is divided into multiple...
chambers to contain different beans and other materials. Besides, the reservoir 505 has a rotator 506 arranged under the multiple chambers and above the grinding unit 501 for switching conveniently between the multiple chambers to serve different tastes of soy milk.

The advantage of this soy milk making system 300, 500 is that: dry grinding technology (grinding without water) is used, soybean powder is mixed with water in the cup of a user, so that it is easy to clean the internal parts of the soy milk making system 300, 500 and a bad smell in the soy milk making system 300, 500 is prevented.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, number, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

It should be noted that the abovementioned embodiments illustrate rather than limit the invention and that those skilled in the art would be able to design alternative embodiments without departing from the scope of the appended claims.

In the claims, the word "comprising" does not exclude the presence of elements or steps not listed in a claim or in the description. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. In the apparatus claims enumerating several units, several of these units can be embodied by one and the same item of hardware or software. The usage of the words first, second and third, et cetera, does not indicate any ordering. These words are to be interpreted as names.
CLAIMS:

1. A soybean pretreatment method, comprising:
   cooking soybeans to achieve a volume expansion of at least 300% and to inhibit
   anti-nutrients and/or eliminate anti-nutrients contained therein; and
   drying the cooked soybeans to a water content of less than 8% while keeping said
   volume expansionof the soybeans at a level of at least 300%.

2. The soybean pretreatment method as claimed in claim 1, wherein the step
   of drying can be performed by means of a convective multi-flash drying process, an
   osmotic dehydration process and/or a vacuum drying process.

3. The soybean pretreatment method as claimed in claim 1, wherein the step
   of drying comprises the following steps:
   freezing the cooked soybeans; and
   drying the frozen soybeans.

4. The soybean pretreatment method as claimed in claim 1, wherein the step
   of cooking soybeans comprises the step of boiling, steaming, pressure-boiling and/or
   pressure-steaming soybeans.

5. The soybean pretreatment method as claimed in claim 1, wherein the
   water content of the dried soybeans is about 4%-8%, preferably about 4.6%-7% or about
   5%-6%.

6. A soybean pretreatment system, comprising:
   a cooker for cooking soybeans to achieve a volume expansion of at least 300% and to
   inhibit anti-nutrients and/or eliminate anti-nutrients contained therein; and
   a drying unit for drying the cooked soybeans to a water content of less than 8% while
   keeping said volume expansion of the soybeans at a level of at least 300%.
7. The soybean pretreatment system as claimed in claim 6, wherein the
drying is a convective multi-flash dryer, an osmotic dehydration dryer or a vacuum
dryer.

8. The soybean pretreatment system as claimed in claim 6, wherein the
drying unit comprises:
- a freezer for freezing the cooked soybeans; and
a dryer for drying the frozen soybeans.

9. The soybean pretreatment system as claimed in claim 6, wherein the
cooker is a boiler, a steamer, a pressure-boiler or a pressure-steamer.

10. The soybean pretreatment system as claimed in claim 6, wherein the
system further comprises a controller unit, which controller unit is configured to control
the drying process such that the water content of the dried soybeans is about 4%-8%,
preferably about 4.6%-7% or about 5%-6%.

11. A method for making soymilk, comprising:
providing pretreated soybeans which are pretreated according to the soybean
pretreatment method as claimed in any one of claims 1-5; and
mixing the pretreated soybeans with water and then grinding the mixed soybeans to
obtain soymilk, or grinding the pretreated soybeans and then mixing the ground
soybeans with water to obtain soymilk.

12. A soy milk making system, comprising:
- a grinding unit for grinding the pretreated soybeans, which are pretreated according to
  the soybean pretreatment method as claimed in any one of claims 1 to 5;
a generating unit for generating hot water;
a removable container for containing and mixing the ground pretreated soybeans and the
generated hot water therein; and
a supply unit for supplying the generated hot water into the removable container.

13. The soy milk making system as claimed in claim 12, wherein the
generating unit can be further configured to generate steam and the supply unit can be
further configured to supply the steam into the removable container to heat and/or mix the ground pretreated soybeans and the generated hot water contained therein.

14. The soy milk making system as claimed in claim 12, further comprising a reservoir arranged over the grinding unit for holding the pretreated soybeans.

15. The soy milk making system as claimed in claim 14, further comprising a controller unit configured to
- control the amount of pretreated soybeans delivered from the reservoir into the grinding unit; and
- control the amount of hot water supplied from the supply unit into the removable container according to the amount of ground pretreated soybeans.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23L1/201 A23L1/211 A23B9/02 A23B9/10

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

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
A23L A23B

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 database and, where practicable, search terms used)
EPO-Internal, WPI Data, BIOSIS, EMBASE, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>EP 0 712 582 Al (NESTLE SA [CH]) 22 May 1996 (1996-05-22)</td>
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<td>Y</td>
<td>abstract page 2 examples 1-4 claims 1,3</td>
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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) on 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
"I" 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
"A" document member of the same patent family

Date of the actual completion of the international search: 12 March 2015
Date of mailing of the international search report: 25/06/2015

Name and mailing address of the ISA:
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016

Authorized officer:
de La Tour, Camille

Form PCT/ISA/210 (second sheet) (April 2005)
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<td>US 2 813 796 A (KENEASTER KENNETH K ET AL) 19 November 1957 (1957-11-19) col umns 1,2 col umn 5, line 58 - col umn 6, line 11</td>
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<td>US 4 273 796 A (MAXCY THOMAS A ET AL) 16 June 1981 (1981-06-16) abstract col umns 3-5; claim 1</td>
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<td>A</td>
<td>US 3 352 687 A (ROCKLAND LOUIS B ET AL) 14 November 1967 (1967-11-14) the whole document</td>
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INTERNATIONAL SEARCH REPORT

Box 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:

1. ☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
   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:

3. ☐ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

   see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

   1, 2, 4, 5 (all partly)

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.
This International Search Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 2, 4, 5 (all partially)

   A soybean pretreatment method comprising cooking soybeans and drying soybeans to the water content of less than 8%, where the step of drying can be performed with the aid of a convective multi-flash drying process.

2. claims: 1, 2, 4, 5 (all partially)

   A soybean pretreatment method comprising cooking soybeans and drying soybeans to the water content of less than 8%, where the step of drying can be performed with the aid of an osmotic dehydration process.

3. claims: 1, 2, 4, 5 (all partially)

   A soybean pretreatment method comprising cooking soybeans and drying soybeans to the water content of less than 8%, where the step of drying can be performed with the aid of a vacuum drying process.

4. claims: 1, 2, 4, 5 (all partially)

   A soybean pretreatment method comprising cooking soybeans and drying soybeans to the water content of less than 8%, where the step of drying can be performed with the aid of a combination of any of a convective multi-flash drying process, an osmotic dehydration process and a vacuum drying process.

5. claims: 3 (completely) ; 1, 4, 5 (partially)

   A soybean pretreatment method comprising cooking soybeans and drying soybeans to the water content of less than 8%, where the step of drying comprises freezing and drying the frozen soybeans.

6. claims: 6-10

   A soybean pretreatment system.

7. claim: 11

   A method for making soymilk.
8. claims: 12-15

A soy milk making system

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