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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

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(54) Title: IMPROVED PROCESSING OF SOYBEANS

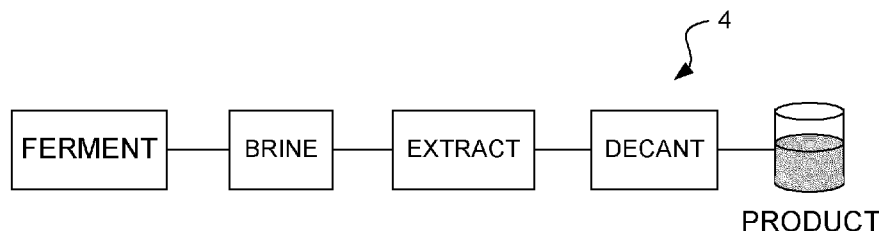


Fig. 4

(57) Abstract: A process for processing soybeans, said process comprising separating the soy sauce from a fermented mixture through decanting and splitting the soybeans into discernible pieces.



IMPROVED PROCESSING OF SOYBEANS

TECHNICAL FIELD

This application relates to a process, a stator, a use and an arrangement for improved processing of fermented products, and in particular to a process, a stator, a use and an arrangement for improved handling of fermented soybeans to extract soysauce and the like.

BACKGROUND

The soybean is a species of legume native to East Asia, widely grown for its edible bean which has numerous uses. The plant is classed as an oilseed rather than a pulse by the Food and Agricultural Organization (FAO). Soybeans produce significantly more protein per acre than most other uses of land. Traditional fermented foods include soy sauce, fermented bean paste, natto, and tempeh, among others.

The traditional process for producing for example soy sauce is performed by sorting, rinsing and then cooking the soybeans to a desired level. After the cooking the soybeans are cooled to an optimum fermentation temperature and thereafter transferred to inoculation vats where the inoculation is done by adding a starter culture, for example a *Bacillus* or *Aspergillus* strain of bacteria. The mixture is then fermented for a time span of a few days to a couple of weeks in these large vats. The resulting culture is traditionally called Koji and is transferred to fermentation tanks where brine, or individual salt and water, is added to form a mixture traditionally called Moroni. The Moroni is fermented for a minimum of three months and sometimes up to a year. After this period the Moroni (which is a mash) is pressed or washed to extract the sauce. The pressing and washing is a batch process where sieving in several stages which are essential for the purity of the resulting soy sauce.

The quality of the resulting soy sauce is determined by the protein content and the purity of the soy sauce. The effectiveness of the soybean protein extraction and the purification of the resulting product is thus of importance.

The batch process, not being continuous is a disadvantage as it prevents the process from being fully automated and increases operation costs in that the batches need to be prepared, delivered and retrieved.

There is thus a need for an improved manner of continuously extracting protein at a high yield. There is also a need for an improved manner of continuously purifying fermented products such as soy sauce.

SUMMARY

According to one aspect, it is an object of the teachings of this application to overcome the problems listed above by providing an arrangement for extraction of soy sauce comprising a decanter for separating the soy sauce from a fermented mixture through decanting.

According to one aspect, it is an object of the teachings of this application to overcome the problems listed above by providing an arrangement for extracting protein from soybeans comprising a means for splitting the soybeans into discernible pieces.

According to one aspect, it is an object of the teachings of this application to overcome the problems listed above by providing an arrangement for processing soybeans comprising a decanter for extraction of soy sauce by separating the soy sauce from a fermented mixture through decanting and a means for splitting the soybeans into discernible pieces.

Such arrangements provide simple solutions allowing continuous operation and that result in end products having high quality.

In one embodiment the means for splitting the soybeans is comprised of a stator arranged to revolve at high speeds having a series of holes.

Arrangements according to the teachings herein are beneficial in that they provide an end product of a high qualitative purity in a continuous manner. This is achieved by an insightful combination of the splitting means (the stator) and the decanter, which combination removes the need for a separate buffering process of removing top flocculation and bottom sediment.

In one embodiment the arrangement further comprises a clarifier which increases the purity of the end product. In fact, after the clarifier the resulting product is ready to be sold.

The arrangement as disclosed herein is thus highly efficient and cost efficient to operate providing an end result of high quality.

According to one aspect, it t is an object of the teachings of this application to overcome the problems listed above by providing a stator for use as means for splitting soybeans, said stator comprising a circular member arranged with a series of holes.

According to one aspect, it t is an object of the teachings of this application to overcome the problems listed above by providing a use of a stator for splitting soybeans.

According to one aspect, it t is an object of the teachings of this application to overcome the problems listed above by providing a process for extraction of soy sauce, said process comprising separating the soy sauce from a fermented mixture through decanting.

According to one aspect, it t is an object of the teachings of this application to overcome the problems listed above by providing a process for extracting protein from soybeans, said process comprising splitting the soybeans into discernible pieces.

According to one aspect, it t is an object of the teachings of this application to overcome the problems listed above by providing a process for processing soybeans, said process comprising separating the soy sauce from a fermented mixture through decanting and splitting the soybeans into discernible pieces.

It is an object of the teachings of this application to overcome the problems listed above by providing a soysauce produced according to a process according to above.

The inventors of the present invention have realized, after inventive and insightful reasoning that by decanting a fermented solution the solution can effectively be used to separate the desired product from husks or impurities and also other particles in a simple and elegant solution that allows for continuous operation. This has been confirmed by extensive experimentation.

The inventors of the present invention have also realized, after inventive and insightful reasoning, that by splitting the beans an increased surface for protein extraction is achieved without risking that an emulsion is generated thereby providing a simple and elegant solution that allows for continuous operation. The inventors have further realized

that to perform such splitting a stator designed according to herein may beneficially be used to provide a simple and elegant solution that allows for continuous operation.

The teachings herein find use in, but is not limited to, extraction and production of soy sauce, fish sauce and other fermented products. The manner disclosed herein also find use in fermenting wheat products.

An arrangement and a process according to the teachings herein can beneficially be used in and integrated into the production Ketjap Manis and like products, the teachings herein being combined with other processes and arrangements enabling such production.

Other features and advantages of the disclosed embodiments will appear from the following detailed disclosure, from the attached dependent claims as well as from the drawings.

Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc]" are to be interpreted openly as referring to at least one instance of the element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be described in further detail under reference to the accompanying drawings in which:

Figure 1 shows an arrangement for a traditional process for extraction of soy sauce;

Figure 2 shows an improved arrangement for a process according to an embodiment herein for an improved extraction of soy sauce according to one embodiment of the teachings of this application;

Figure 3 shows an improved arrangement for a process according to an embodiment herein for an improved extraction of soy sauce according to the teachings of this application;

Figure 4 shows an improved arrangement for a process according to an embodiment herein for an improved extraction of soy sauce according to the teachings of this application;

Figure 5 illustrates a schematic flowchart for a process for extracting protein from and clarifying a mixture according to an embodiment of the teachings herein;

Figures 6A and 6B each shows an illustration of a stator to be used in an arrangement according to one embodiment of the teachings of this application; and

Figure 7 shows a schematic illustration of an arrangement according to an embodiment of the teachings herein.

DETAILED DESCRIPTION

The disclosed embodiments will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Figure 1 shows an arrangement for a traditional process for extraction of soy sauce. The fermented Moroni (referenced FERMENT in figure 1) is pressed or otherwise treated to extract (referenced EXTRACT in figure 1) the soy sauce which is then sieved (referenced SIEVING in figure 1) repeatedly to produce the finished product, being soy sauce.

Figure 2 shows an improved arrangement 2 for a process according to an embodiment herein for an improved extraction of soy sauce. The arrangement 2 comprises a decanter (referenced DECANT in figure 2) for extracting the soybeans and soybeans particles from the husk and other impurities, thereby efficiently defattening the mixture and increasing the protein yield of the finished product. In one embodiment the decanter is implemented as an Alfa Laval Foodtec® 500 or 510 decanter. These decanters have enough capacity to efficiently separate the husks and other particles and impurities from the beans or bean fragments.

Decanters are known in other fields, but have not been used for the purpose of extracting soy sauce from the Moron mixtures. By realizing, after insightful reasoning, that decanters may also be used for separating the husks and impurities from the mixture, a simple and elegant, yet effective solution is provided to enable an efficient continuous process.

The use of decanters can also be used for separating soymilk from husks and impurities.

A problem that arises when pressing the Moroni mixture is that the resulting mash is prone to generate an emulsion of the fats and the proteins. It is nearly impossible to mechanically separate the fats from the proteins in such an emulsion.

Figure 3 shows an improved arrangement 3 for a process according to an embodiment herein for an improved extraction of soy sauce. The arrangement 3 is arranged to split, chop or slice the soybeans in the mixture through the use of splitting means instead of pressing them. In one embodiment this slicing is achieved by the use of a revolving stator (referenced STATOR in figure 3). The stator is arranged to revolve at high speed, for example 2500 RPM. In one embodiment the revolving speed is in the range of 1000 to 4000 RPM and in one embodiment the revolving speed is 2000 to 3000 RPM.

The stator is further arranged to have large holes. The holes should be large enough to at least partially receive a bean to be processed. The edges of the holes will interact with the soybeans by splitting them into smaller pieces. The resulting increased surface of the soybeans enables a higher yield of soy protein. The desired size of the resulting pieces depends on the finished product. The smaller the pieces, the higher the protein yield, but if the pieces are too small, the risk for generating an emulsion increases. The pieces should therefore be of a size where the pieces are still individually discernible and does not form a powder. By having rectangular cross sections of the stator holes a cleaner cut of the soybeans is achieved resulting in a cleaner product and less risk of an emulsion. It also provides a higher protein yield. In one embodiment the stator is arranged to split the soybeans into quarter-sized pieces. As will be described later on, the holes may also have other cross sections such as circular.

The size of the holes and the revolving speed of the stator interact in such a way that the higher the speed and the smaller the holes, the higher the risk of creating an emulsion. Smaller holes allows for less adjustment of the revolving speed. The holes should be at least the

same substantial size as the particle to be split, in the case of the soysauce, the same size of the soybean.

In one embodiment the stator is implemented as a Tetra Almix in-line® mixer with a specially adapted stator. More details of the stator will be given with reference to figure 6.

The use of stators is known in other fields, but stators have not been used for the purpose of extracting soy sauce from Moroni mixtures and like mixes. By realizing, after insightful reasoning and careful and extensive experimentation, that stators may also be used for slicing or chopping the soybeans to provide a resulting increased surface for extracting the protein, a simple and elegant, yet effective solution is provided to enable an efficient continuous process which provides a high protein yield. For example, a prior art system produces soysauce having a protein yield of 2.1 % per each produced litre. A system according to the teachings herein will produce a soysauce having a protein yield of more than 2.5 % per each produced litre, thus providing an increase by over 20% for the protein yield.

To facilitate the handling of the Moroni mixture, the process and arrangement includes a station or step where brine (or individual salt and water) is added to the mixture. The brine affects the qualities of the resulting product, and also facilitates the run of the resulting mixture through the revolving stator and the subsequent decanter as the mixture is more fluid than the Moroni mixture on its own. The brine further affects the resulting yield of protein and the more brine that is added, the larger the total amount of extracted protein.

Figure 4 shows an improved arrangement 4 for a process according to an embodiment herein for an improved extraction of soy sauce. The arrangement 4 is arranged to add brine (referenced BRINE in figure 4) to the fermented mixture before or during the extraction.

In one embodiment the process is arranged to keep the mixture at a temperature at a stable or low temperature, for example below 45 degrees Celsius. Increasing the temperature will affect the quality and cleanliness of the resulting product and it is therefore beneficial to maintain a low temperature all through the process.

Figure 5 illustrates a schematic flowchart for a process for extracting protein from and clarifying a mixture according to an embodiment of the teachings herein. In a first step 510 brine (or water and/or salt) is added to the mixture. In a succeeding or simultaneous step 520 the

beans in the mixture are split, for example using a stator. The mixture is then run through a decanter in step 530.

To further clarify and clean the resulting product a further step of running the mixture through a clarifier is performed in step 550. Depending on the desired finished product and the quality of the product the resulting mixture may also be run through a sieve in step 540. These steps are optional and indicated as such in figure 5 by the dashed lines.

Figure 6A shows an illustration of a stator 10 to be used in an arrangement according to above. The stator 10 is comprised of a circular member 11 having an inner diameter of 200 mm and a thickness of material of 4 mm. The stator 10 is arranged with a plurality of relatively large holes 12. In the example embodiment of figure 6 the stator 10 is arranged with fourteen holes 12 each having a diameter of 30 mm. In this embodiment the stator is a TetraPak stator having a product number CP3097735. In an alternative embodiment, see figure 6B which shows an illustration of a cross section of a stator 10 to be used in an arrangement according to above, the stator 10 is a TetraPak stator having a product number CA3026040 having an inner diameter of 200 mm, a thickness of material of 5.5 mm (in one embodiment 4 mm), and twenty holes 12 having a rectangular cross section measuring 30 mm (width) by 50 mm (height). In an embodiment the thickness of material is 4 to 6 mm. Experiments have shown that such a stator is more beneficial in that it provides cleaner cuts. In one embodiment the holes 12 have different sizes. The size of the hole depends on design parameters for the stator 10 such as the thickness, the revolving speed, the material, the number of the holes and the thickness of the material to name a few.

Figure 7 shows a schematic illustration of an arrangement 7 according to an embodiment of the teachings herein. A fermenting station 71 is arranged to ferment a mixture. Brine (or water and/or salt) is effectively added to the mixture by means for adding brine in a brine station 72. The brine is either added as a solution or by adding salts and water individually. The diluted solution is then run through a high speed revolving stator 73 and thereafter decanted in a decanter 74. To further improve the quality of the product the solution may be sieved in a sieve 75 and also or alternatively clarified in a clarifier 76. To regulate the temperature during the process temperature regulating means 77 are part of the arrangement. The temperature

regulating means 77 may be implemented through a cooling system or other known manner of cooling a production line.

Experiments have shown that using a process as described above, soy sauce with a fat content of less than 0.5 % can be achieved.

The addition of the brine which allows for the beans to be split with a stator also makes the solution suitable for decanting with a decanter.

The use of a decanter and a stator is thus technically linked to provide an improved process and arrangement for such a process for processing soybeans.

One benefit of the teachings herein is that the process and arrangement provides an end product of high quality.

Another benefit of the teachings herein is that the process and arrangement provides a high yield of protein. The process and arrangement provides a lowered fat content.

One more benefit of the teachings herein is that the process and arrangement enables continuous operation and is cheaper to operate. The process and arrangement also prevents an emulsion from being generated.

The teachings herein relating to the use of the decanter and/or the stator find use in manufacturing and producing soy sauce, but also find use in producing other fermented products such as fish sauce, wheat-based products and other grain-based products.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

CLAIMS

1. An arrangement (2, 3, 4, 7) for extraction of soy sauce comprising a decanter (74) for separating the soy sauce from a fermented mixture through decanting.
- 5 2. An arrangement (3, 4, 7) for extracting protein from soybeans comprising a means (73) for splitting the soybeans into discernible pieces.
3. An arrangement (3, 4, 7) for processing soybeans comprising a decanter (74) for extraction of soy sauce by separating the soy sauce from a fermented mixture
10 through decanting and a means (73) for splitting the soybeans into discernible pieces.
4. The arrangement (3, 4, 7) of claims 2 or 3, wherein the means for splitting the soybeans is comprised of a stator (73, 10) arranged to revolve at high speeds having a series of holes.
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5. The arrangement (3, 4, 7) of claim 1, wherein the holes have a rectangular cross section.
6. The arrangement (2, 3, 4, 7) according to any preceding claim further
20 comprising means (72) for adding brine to the fermented mixture.
7. The arrangement (2, 3, 4, 7) according to any preceding claim further comprising a clarifier (76).
- 25 8. The arrangement (2, 3, 4, 7) according to any preceding claim further comprising means (77) for regulating the temperature of the arrangement (2, 3, 4, 7) to be maintained below 45 degrees Celsius.
9. The arrangement (2, 3, 4, 7) according to any preceding claim further
30 comprising a sieve (75).

10. A stator (73, 10) for use as means for splitting soybeans, said stator (10) comprising a circular member (11) arranged with a series of holes (12).

11. Use of a stator (73, 10) for splitting soybeans.

5

12. A process for extraction of soy sauce, said process comprising separating the soy sauce from a fermented mixture through decanting.

13. A process for extracting protein from soybeans, said process
10 comprising splitting the soybeans into discernible pieces.

14. A process for processing soybeans, said process comprising separating the soy sauce from a fermented mixture through decanting and splitting the soybeans into discernible pieces.

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15. A soysauce produced according to a process according to claim 12, 13 or 14.

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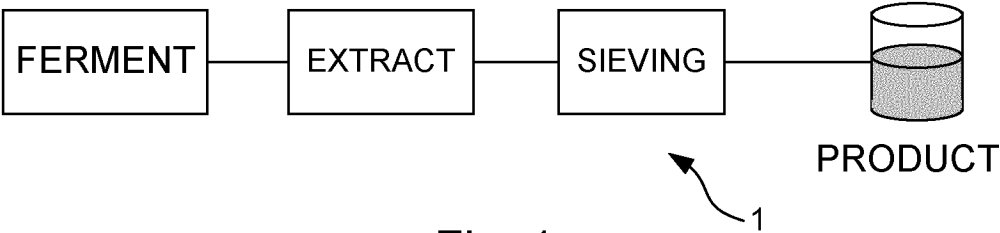


Fig. 1

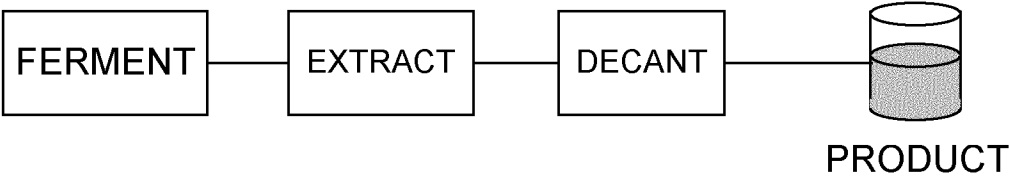


Fig. 2

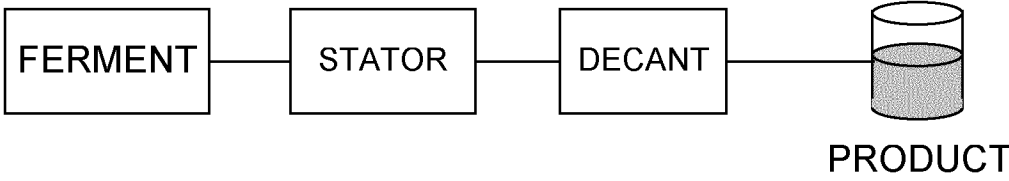


Fig. 3

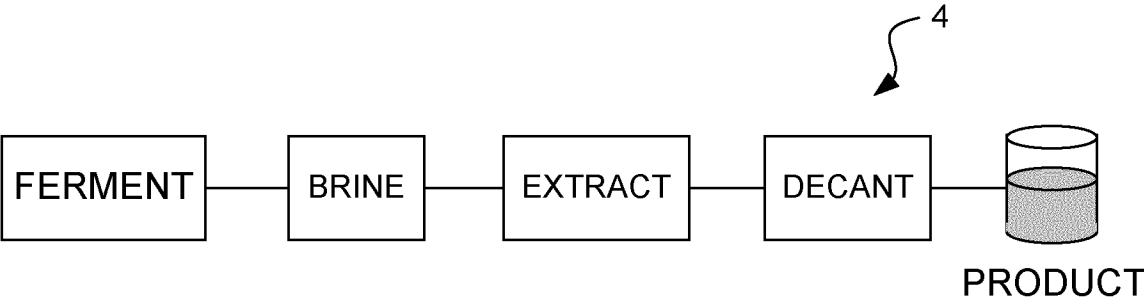


Fig. 4

2/3

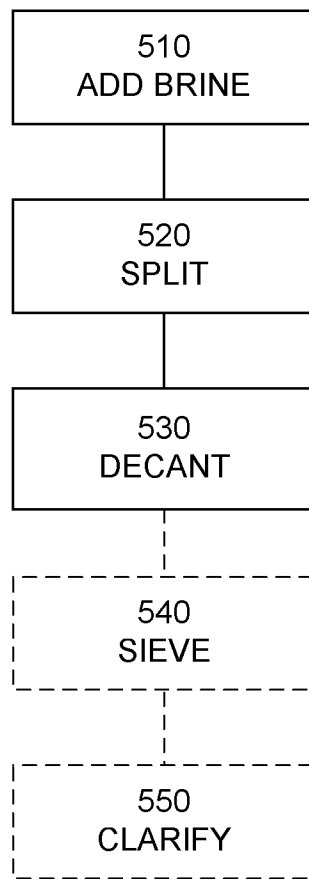


Fig. 5

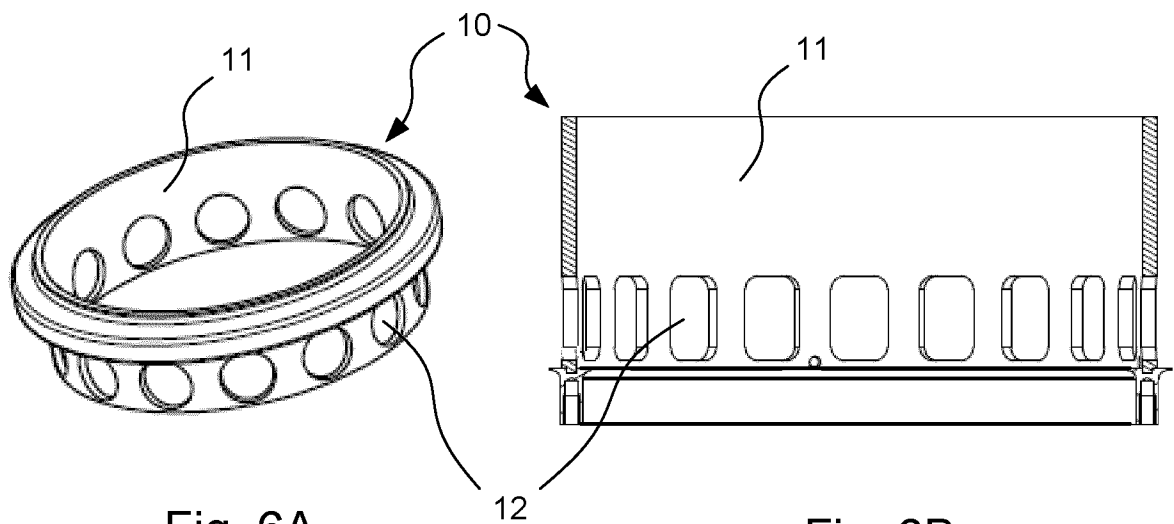


Fig. 6A

Fig. 6B

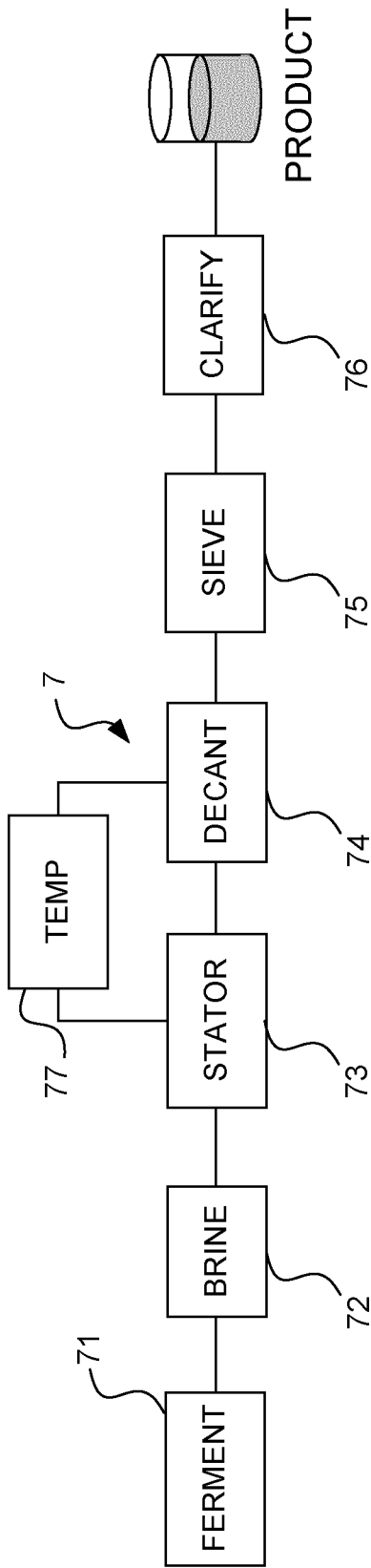


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/065909

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23L1/238 A23L1/23 A23L1/20 A23J1/00
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A23L A23J

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

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

EPO-Internal, WPI Data, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Week 198347 Thomson Scientific, London, GB; AN 1983-823694 XP002715593, & JP S58 175473 A (NISSAN CHEM IND LTD) 14 October 1983 (1983-10-14)	1,6-9, 12,15
A	abstract	3
X	DATABASE WPI Week 197801 Thomson Scientific, London, GB; AN 1978-00926A XP002715594, & JP S52 136997 A (DAISEL LTD) 16 November 1977 (1977-11-16)	1,6-9,15
A	abstract	3,12
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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) 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

10 January 2014

Date of mailing of the international search report

20/01/2014

Name and mailing address of the ISA/

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Saunders, Thomas

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2013/065909

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2009 016489 A1 (KRONES AG [DE]) 14 October 2010 (2010-10-14)	1,6-9, 12,15
A	paragraph [0002] - paragraph [0003] -----	3
X	"Tetra Alwin Soy - Soya base extraction unit", 1 January 2009 (2009-01-01), XP055085736, Retrieved from the Internet: URL:http://www.tetrapak.com/fr/SiteCollect ionDocuments/Processing/PDF_Equipements/Tetra Alwin_Soy.pdf [retrieved on 2013-10-29]	1-11,13
A	the whole document -----	12,14
X	EP 2 241 194 A1 (KIKKOMAN CORP [JP]) 20 October 2010 (2010-10-20)	15
A	paragraph [0002] -----	1,6-9,12
X	KR 2008 0097962 A (MOON KYUNG HWA [KR]) 6 November 2008 (2008-11-06)	2,4,5,7, 8,10,11, 13
A	abstract -----	1,3,14
X	DATABASE WPI Week 200923 Thomson Scientific, London, GB; AN 2009-F05594 XP002718536, & KR 2008 0097531 A (MOON K H) 6 November 2008 (2008-11-06)	2,4,10, 11,13
A	abstract -----	1,3,14
X	"Tetra Almix - Turbo Mixer/Dynamic Stator suitable for Tetra Almix Batch Mixers", 1 January 2011 (2011-01-01), XP055085739, Retrieved from the Internet: URL:http://www.tetrapak.com/usprocessing/P roduct documentation/Mixer/Tetra Almix_Dynamic Stator - Brochure.pdf [retrieved on 2013-10-29] the whole document -----	2,4,5, 10,11,13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2013/065909

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.:

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 12(completely); 6-9, 15(partially)

Arrangement and process for extracting soy sauce, comprising separating the soy sauce from the fermented mixture through decanting.

2. claims: 2, 10, 11, 13(completely); 4-9, 15(partially)

Arrangement and process for splitting soybeans into discernible pieces.

3. claims: 3, 14(completely); 4-9, 15(partially)

Arrangement and process for extracting soy sauce, comprising a means or step for splitting soybeans into discernible pieces and a decanter for separating the soy sauce from the fermented mixture.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/065909

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