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(71) Applicant: ANHEUSER-BUSCH INBEV S.A. [BE/BE];
Grand'Place 1, 1000 Brussels (BE).

(72) Inventors: VANDENBROUCKE, Han; Brouwerijplein 1,
3000 Leuven (BE). DE SCHUTTER, David; Brouwerij-
plein 1, 3000 Leuven (BE).

(74) Agent: BIIP CVBA; Culliganlaan 1B, 1831 Diegem (BE).

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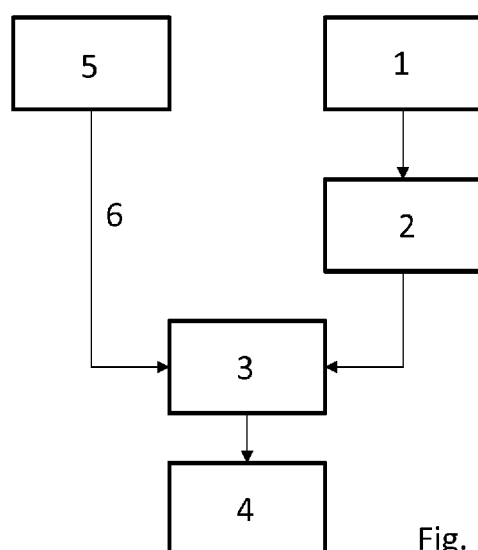


Fig. 1

(57) Abstract: Method of preparing a maltbased beverage, in particular a beer, comprising the steps of: (a) In situ preparing a fermentable sugar solution; (b) Mashing malt obtaining a malt mash; (c) Filtering the malt mash obtaining a wort; (d) Boiling the wort; (e) Adding the fermentable sugar solution to the wort after filtration of the malt mash; (f) Fermenting the wort/fermentable sugar solution mixture obtaining a maltbased beverage.

METHOD OF PREPARING A MALT BASED BEVERAGE USING FERMENTABLE SUGAR SOLUTION OBTAINED FROM A STARCH SOURCE OTHER THAN MALT AND A BREWING SYSTEM FOR PREPARING A MALT BASED BEVERAGE ACCORDING TO THAT METHOD.

Technical field

The present invention concerns a method of preparing a malt based beverage, in particular beer, starting from malt and adjuncts. In particular the method focusses on the preparation of a fermentable wort starting from malt and one or more adjuncts.

Background of the invention

In the traditional brewing process, adjunct is gelatinised and then combined with a malt mash, where malt enzymes will convert the starch from the adjunct and the malt to fermentable sugars. The total mash is then filtered prior to boiling and fermentation. Combining both adjunct and malt in the mash and subsequently filtering the mash has a big impact on the capacity of a brewery as the mash filtering is an important bottleneck in breweries. Additionally, filtering the total mash results in important extract losses in the spent grain.

In order to increase the capacity, some breweries dose an amount of high maltose syrup (HMS) in the wort, either in the wort boiling kettle or in the wort cooler. Although this solution is effective in reducing the amount of mash to be filtered and as such increases the capacity of a brewery, the use of HMS has a big impact on the cost of brewing as the cost of HMS outweighs the extract losses and capacity impact of the filtration of a total mash comprising malt and gelatinised adjunct starch. For this reason, HMS is only considered as a temporarily solution to increase the brewery output in periods of high demand.

From the above it is clear that there remains a need for increasing the capacity of a brewery and for decreasing extract losses in the brewing process, whilst allowing the brewery to use traditional adjunct sources instead of high cost specialty starch carbohydrate sources such as HMS.

Summary of the invention

The present invention addresses the above market need by a method for preparing a malt-based beverage, in particular a beer, the method comprising the steps of:

- (a) *In situ* preparing a fermentable sugar solution;
- (b) Mashing malt obtaining a malt mash;
- (c) Filtering the malt mash obtaining a wort;
- (d) Boiling the wort;
- (e) Adding the fermentable sugar solution to the wort after filtration of the malt mash or even after wort boiling;
- (f) Fermenting the wort/fermentable sugar solution mixture obtaining a malt-based beverage.

The fermentable sugar solution is preferably prepared by a method comprising the steps of:

- (a) Providing a starch source;
- (b) Hydrating the starch to obtain a slurry;
- (c) Treating the starch slurry at a pH between 5 and 6 with an enzyme or enzyme mixture comprising maltogenic amylase activity and α -amylase activity and pullulanase activity and/or α -amylglucosidase activity at a temperature of between 60 and 85°C, thereby obtaining a gelatinized, liquefied and saccharified fermentable sugar solution.

As such a fermentable sugar solution comprising maltose in an amount equal to or larger than 80% maltose/total sugar and/or at least 90% fermentable sugars/total sugar is obtained.

The starch source for the above method according to the invention is preferably selected from: whole corn, corn starch, corn grits, maize grits, rye grits, sorghum grits, unmalted barley grits, rice grits, cassava grits and/or mixtures thereof. The starch preferably comprises less than 0,5w% protein, less than 0,15w% fat and less than 0,15w% ash.

According to a preferred embodiment of the present invention for preparing a beverage, the fermentable sugar solution is not filtered post saccharification and before boiling the wort/fermentable sugar solution mixture.

The present invention also concerns a brewing system comprising a mash tun, a malt mash filter (or lauter tun) unit, a wort processing unit, a fermentation unit and an adjunct mash tun, characterised in that the adjunct mash tun comprises an outlet fluidly coupled to the wort processing unit, by-passing the malt mash filter unit. Additionally, the brewing system may comprise an adjunct mash filter unit separate from the malt mash filter unit, the adjunct mash filter or separation unit having an outlet fluidly coupled to the wort processing unit, by-passing the malt mash filter unit.

Further the present invention also concerns the use of maltogenic amylase for the production of a fermentable sugar solution from a source of starch lacking malt.

Brief description of the figures

Figure 1 schematically illustrates a brewing system according to the present invention;

Figure 2 schematically illustrates an alternative embodiment of a brewing system according to the present invention.

Detailed description of the invention

For the sake of this application, when adjuncts are named in combination with one of the terms starch, grits or flour, this should be understood as an indication of the purity of the concerned starch originating from the concerned adjunct type. In other words, when mentioning an 'adjunct starch' such as corn starch or cassava starch, this indicates that the concerned starch source contains starch in an amount of about 99,5 w% on a dry matter basis; when mentioning 'adjunct flour' such as cassava flour this indicates that the concerned starch source contains between about 99,5w% and about 95w% on a dry matter basis; and when mentioning 'adjunct grits' such as corn grits or sorghum grits this indicates that the starch source contains starch in an amount of between about 85% and 95w%. The impurities in the starch source generally comprise or even consist of parts of the grain other than starch such as lipids, parts of the husk or endosperm or the like.

Figure 1 illustrates a brewing system according to the present invention comprising a mash tun 1, for mashing malt, a malt mash filter unit 2 (or mash lautering unit) for filtering the mashed malt, a wort processing unit 3, in particular a wort boiling kettle for boiling a wort, and a fermentation unit 4 for fermenting the boiled wort. According to the invention, the brewing system also comprises a adjunct mash tun 5 having an output 6 that is fluidly coupled to the wort processing unit 3 and by-passes the malt mash filter unit 2.

This brewing system according to the invention provides the benefit that it allows for higher throughput than traditional brewing systems, wherein malt and adjuncts are both passed through the malt mash filter unit 2 before being collected in the wort boiling kettle.

By keeping the adjunct or at least part of the adjuncts separated from the malt for the mashing operation step obtaining both a malt mash and an adjunct mash and by subsequently by-passing the malt mash filter unit 2 with the adjunct mash, the load of the malt mash filter unit is reduced per volume of beer to be produced and hence can be either downsized or be used for preparing higher volumes of beer per operation time. Furthermore, the present invention allows for reducing extract (fermentable sugar) losses in the malt mash filter unit, thereby further increasing the brewing efficiency.

In order not to jeopardize brewing efficiency and capacity downstream the malt mash filter, the adjunct mash is required to meet strict requirements that in a traditional brewing method are met when the adjunct is mashed and filtered together with the malt.

Therefore, in accordance with the present invention, it is preferred that the adjunct (starch source) lacks malt and is selected from the group of whole corn, corn starch, cassava starch, corn grits, maize grits, rye grits, sorghum grits, unmalted barley grits, rice grits, cassava grits or cassava flour and/or mixtures thereof. In case no adjunct mash filtering is intended, it is further preferred that the starch source comprises or is pre-treated to comprise:

- (a) less than 0,5w% protein;
- (b) less than 0,15w% fat; and
- (c) less than 0,15w% ash.

Such methods for pre-treating adjuncts are known in the art and will not be disclosed in further detail.

The adjunct is preferably gelatinized, liquefied and saccharified prior to feeding the adjunct mash to the wort kettle 3, or -in case the amount of solids and lipids in the saccharified adjunct are sufficiently low- directly to a wort cooler. According to the present invention, this mashing is performed in situ in a brewing house to ensure full freshness and quality of the mashed adjuncts. According to a preferred method of the present invention, the adjuncts are converted into a fermentable sugar solution by the steps of:

- (a) Providing a starch source;
- (b) Steeping the starch in water (preferably at about 60°C) to obtain a slurry;
- (c) Treating the starch slurry at a pH between 5 and 6, preferably in the presence of an earth alkali ion (eg. CaCl_2), with an enzyme or enzyme mixture comprising maltogenic amylase (also referred to as maltogenic α -amylase) activity and pullulanase activity and/or α -amylglucosidase activity at a temperature of between 60°C and 70°C and subsequently with an enzyme or enzyme mixture comprising (heat stable) α -amylase activity at a temperature of between 75 and 85°C, thereby obtaining a gelatinized, liquefied and saccharified fermentable sugar solution.

The enzymes mentioned above can all be added at the same time as an enzyme cocktail, in which case the α -amylase and pullulanase and/or α -amylglucosidase will be active during the treatment at 60°C to 70°C, potentially allowing limiting the time at which the slurry is to be kept at a higher temperature of 75-85°C.

The method for converting the adjuncts into a fermentable sugar solution preferably does not comprising a process step wherein the starch is heated to a temperature of 100°C or higher.

This method of preparing the fermentable sugar solution allows for a gelatinization, liquefaction and saccharification of the adjunct in a process without boiling of the adjunct mash, which on the one hand is energy efficient and, on the other hand reduces the risk of creating off-flavours due to Maillard or other high temperature related reactions.

The fermentable sugar solution preferably comprising maltose in an amount of at least 50% maltose/total sugar, more preferably in an amount equal to or larger than 80% maltose/total sugar, and most preferably comprises at least 90% fermentable sugars based on the total amount of sugars therein. Fermentable sugars are hereby defined as sugars fermentable by brewer's yeast and consist of glucose, maltose and maltotriose.

Figure 2 illustrates an alternative embodiment of a brewing system according to the present invention, wherein an adjunct mash filter unit 7 (or adjunct mash lautering unit) is provided between the adjunct mash tun 5 and the wort processing unit 6, which adjunct mash filter unit 7 (or malt mash lautering unit) is a unit separate from the malt mash filter unit 4 and wherein the mash tun output 6 is fluidly coupled to the adjunct mash filter unit 7 and by-passes the malt mash filter unit 2.

By providing a separate adjunct mash filter unit 7, starch sources having higher protein, fat, ash and/or fibre contents can be processed without affecting downstream brewing efficiency and quality.

In summary, the method according to the present invention for preparing a malt-based beverage, in particular beer, comprises the steps of:

- (a) *In situ* preparing a fermentable sugar solution;
- (d) Mashing malt obtaining a malt mash;
- (e) Filtering the malt mash obtaining a wort;
- (f) Boiling the wort;
- (g) Adding the fermentable sugar solution to the wort after filtration of the malt mash;
- (h) Fermenting the wort/fermentable sugar solution mixture obtaining a malt-based beverage.

Example 1

As a first example of a method according to the present invention for preparing a fermentable sugar solution, starch (corn starch) granules are hydrated in water at approximately 60°C to obtain a starch slurry. This mixture is subsequently treated for 50 to 60 minutes at 60-70, preferably 65°C with an enzyme mixture (Ceremix Flex) comprising β -amylase activity (preferably maltogenic

amylase), heat stable α -amylase activity, pullulanase activity and, optionally, α -amyloglucosidase activity after which the temperature is increased to 75-85°C, preferably 80°C for an approximately 40 min treatment resulting in a saccharified starch solution that can be applied as fermentable sugar solution in a method according to the present invention for preparing a malt-based beverage, in particular beer.

Example 2

As a second example, rice grits were used as a starch source. The grits were hydrated in water at approximately 60°C to obtain a starch slurry. This mixture is subsequently treated for 20 minutes at 60-70, preferably 65°C with an enzyme mixture (eg. Ceremix Flex) comprising β -amylase activity (preferably maltogenic amylase), α -amylase activity, pullulanase activity and, optionally, α -amyloglucosidase activity after which the temperature is increased to 72°C over a period of 20 minutes to allow gradual gelatinization of the starch. Subsequently the temperature of the slurry is increased to 80°C and maintained at that temperature of about 15 minutes. The resulting saccharified starch solution that can be applied as fermentable sugar solution in a method according to the present invention for preparing a malt-based beverage, in particular beer, by addition to the wort kettle (wort boiling step. In this example both the Ceremix Flex and Thermamyl SCDS were dosed at 3000ppm and 300 ppm respectively.

Analysis of the resulting saccharified starch showed that over 90% of sugars contained therein were fermentable sugars and that the ash levels were below 0,15w%. The content of solids and fat were higher than preferred requirements. Yet during boiling of the wort comprising both the adjunct mash and malt mash, it was observed that the solids and fat levels decreased to an acceptable level during coagulation of the proteins in the wort boiling vessel.

Example 3

As a third example, corn grits were used as a starch source. The grits were hydrated in water at approximately 60°C to obtain a starch slurry. This mixture is subsequently treated for 60 minutes at 60-70, preferably 65°C with an enzyme mixture (eg. Ceremix Flex and optionally Thermamyl SCDS) comprising β -amylase activity (preferably maltogenic amylase), α -amylase activity, pullulanase activity and, optionally, α -amyloglucosidase activity. The temperature of the slurry is subsequently increased to 80°C and maintained at that temperature of about 40 minutes. The resulting saccharified starch solution that can be applied as fermentable sugar solution in a

method according to the present invention for preparing a malt-based beverage, in particular beer, by addition to the wort kettle (wort boiling step. In this example both the Ceremix Flex and Thermamyl SCDS were both dosed at 3000ppm and 300 ppm respectively.

Analysis of the resulting saccharified starch showed that over 90% of sugars contained therein were fermentable sugars and that the ash levels were below 0,15w%. The content of solids and fat were higher than preferred requirements. Yet during boiling of the wort comprising both the adjunct mash and malt mash, it was observed that the solids and fat levels decreased to an acceptable level during coagulation of the proteins in the wort boiling vessel.

When starting from a corn starch or cassava starch having less than 0,5w% protein; less than 0,15w% fat; and less than 0,15w% ash, there was no need for filtering the adjunct mash prior to addition to the wort kettle.

CLAIMS

1. Method of preparing a malt-based beverage, in particular a beer, comprising the steps of:
 - (a) *In situ* preparing a fermentable sugar solution;
 - (b) Mashing malt obtaining a malt mash;
 - (c) Filtering the malt mash obtaining a wort;
 - (d) Boiling the wort;
 - (e) Adding the fermentable sugar solution to the wort after filtration of the malt mash;
 - (f) Fermenting the wort/fermentable sugar solution mixture obtaining a malt-based beverage.
2. Method according to claim 1, the fermentable sugar solution obtained by treating a starch source comprising corn starch, cassava starch, corn grits, maize grits, rye grits, sorghum grits, unmalted barley grits, rice grits, cassava grits, cassava flour and/or mixtures thereof with an enzyme mixture comprising at least following enzymatic activities:
 - (a) maltogenic amylase activity;
 - (b) α -amylase activity, preferably thermostable α -amylase activity;
 - (c) pullulanase activity.
3. Method according to claim 2, the enzyme mixture comprising α -amylglucosidase activity.
4. Method according to any of claims 1 to 3, the fermentable sugar solution obtained from a starch source lacking malt.
5. Method according to claim 2, the corn starch comprising:
 - (a) less than 0,5w% protein;
 - (b) less than 0,15w% fat; and
 - (c) less than 0,15w% ash.
6. Method according to any of the preceding claims, the method not having a step of filtering the fermentable sugar solution prior to boiling the wort/fermentable sugar solution mixture.

7. Method according to any of the preceding claims, the fermentable sugar solution comprising maltose in an amount equal to or larger than 50% maltose/total sugar, preferably equal to or larger than 80% maltose/total sugar.
8. Method according to any of the preceding claims, the fermentable sugar solution comprising at least 90% fermentable sugars/total sugar.
9. Use of maltogenic amylase for the production of a fermentable sugar solution from a source of starch lacking malt.
10. Use according to claim 9, wherein the fermentable sugar solution is prepared from corn starch.
11. Use according to claim 9 or 10, the starch source comprising:
 - (a) less than 0,5w% protein;
 - (b) less than 0,15w% fat; and
 - (c) less than 0,15w% ash.
12. Brewing system comprising a mash tun, a malt mash filter (or mash lautering) unit, a wort processing unit, a fermentation unit and an adjunct mash tun, characterised in that the adjunct mash tun comprises an outlet fluidly coupled to the wort processing unit, by-passing the malt mash filter unit.
13. Brewing system according to claim 12, comprising an adjunct mash filter unit separate from the malt mash filter unit, the adjunct mash filter unit having an outlet fluidly coupled to the wort processing unit, by-passing the malt mash filter unit.
14. Method of preparing a fermentable sugar solution comprising:
 - (a) Providing a starch source;
 - (b) Hydrating the starch in water to obtain a slurry;
 - (c) Treating the starch slurry at a pH between 5 and 6, with an enzyme or enzyme mixture comprising maltogenic amylase activity at a temperature of between 60°C and 70°C

and subsequently with an enzyme or enzyme mixture comprising α -amylase activity and pullulanase activity at a temperature of between 75 and 85°C, thereby obtaining a gelatinized, liquefied and saccharified fermentable sugar solution.

15. The method according to claim 14, the fermentable sugar solution comprising maltose in an amount equal to or larger than 80% maltose/total sugar.

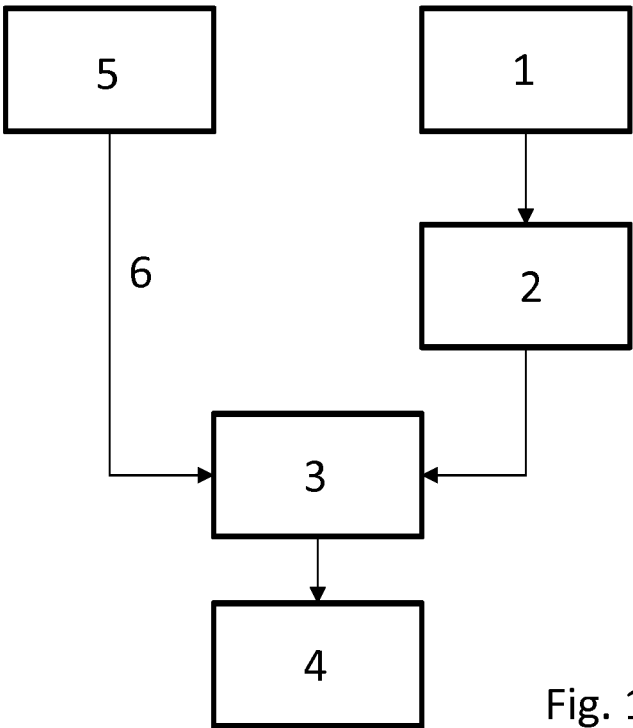


Fig. 1

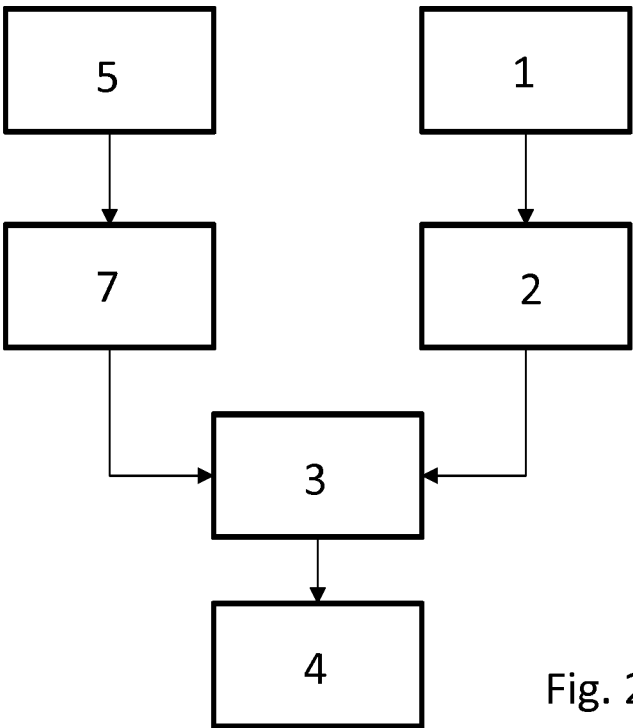


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/058335

A. CLASSIFICATION OF SUBJECT MATTER				
INV.	C12C1/00	C12C5/00	C12C7/00	C12C7/04
	C12C7/053	C12C7/14	C12C7/165	C12C7/20
	C12C13/00			C12C3/00
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) C12C				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data, FSTA, BIOSIS				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages			Relevant to claim No.
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Y	paragraph [0024] - paragraph [0088] -----			2,3,7,8
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	claims 1, 13, 20 -----			
	-/--			
☒ 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			Date of mailing of the international search report	
29 May 2018			07/06/2018	
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 Meryl-Rausch, Eva	

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/058335

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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