EUROPEAN PATENT SPECIFICATION

PROCEED DE PRODUCTION DE BOISSON AU MALT FERMENTEE

PROCESS FOR PRODUCING FERMENTED MALT BEVERAGE

VERFAHREN ZUR HERSTELLUNG EINES FERMENTIERTEN GETRAENKS

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Description

TECHNICAL FIELD

[0001] The present invention relates to a method of manufacturing fermented malt beverages such as beers and high adjunct beers. In detail, the present invention relates to a method of manufacturing fermented malt beverages in which filling taste and fullness of mouthfeel of the beverage can be reinforced by addition of α-glucosidase in the process.

BACKGROUND ART

[0002] In a usual process of manufacturing beers, starch derived from ingredients including malt is hydrolyzed by hydrolases (α-amylase, β-amylase) and fermentable sugars such as glucose, maltose, and maltotriose which a brewer's yeast can metabolize, oligosaccharides larger than maltotetrose and dextrin are produced. The fermentable sugars are metabolized by a brewer's yeast and converted to the components of beer such as alcohol. It is said that oligosaccharides larger than maltotetrose and dextrin may remain in the beer without being metabolized and may participate in filling taste and fullness of mouthfeel of the beverages. Besides, isomaltooligosaccharides produced by α-glucosidase from malt may give filling taste and fullness of mouthfeel of the beer, but their concentrations are too low to influence a taste of beer.

[0003] There is a method to increase the concentration of isomaltooligosaccharides by addition of isomaltooligosaccharides syrup in beers and high adjunct beer (Japanese Patent Application Publication No. 7-327659). In these methods, however, kinds and amounts of adjuncts are limited because it is essential to use isomaltooligosaccharides syrup as a adjunct. In addition, adjuncts are used in these methods, which means that these methods cannot be applied to the so-called all malt beers brewing.

[0004] On the other hand, a trial to reinforce filling taste and the like by using α-glucosidase in a method of manufacturing low alcohol beers has been performed. For example, in the method of manufacturing disclosed in Japanese Patent Application Publication No. 5-68529, it is attempted that filling taste and the like may be reinforced by production of isomaltooligosaccharides through addition of α-glucosidase (another name; transglucosidase) to the boiling-treated wort in the wort production process. In detail, after wort boiling in the wort production process a ratio of the fermentable sugars in wort can be reduced by addition of α-glucosidase to wort in which the concentration may be adjusted not more than 10 weight %, so that filling taste of beers similar to that of the usual alcohol concentration beers may be given. In this method in which α-glucosidase is added after the concentration adjustment, however, there is a following problem. That is, α-glucosidase may remain in wort or fermented wort in the fermentation and maturing processes which follow the wort production process, and then, once produced isomaltooligosaccharides may be hydrolyzed by the enzyme to glucose and then the concentration of isomaltooligosaccharides may be decreased.

[0005] Meanwhile, the following arts are known in the high gravity brewing of beers and in the low-calorie beer brewing. The high gravity brewing is a method to ferment the high concentration of original extract in manufacturing beers. Concretely, wort in which the concentration of original extract of wort is usually 13-16 weight % is fermented and matured, and the product is diluted with carbonated water to the designated concentration prior to shipping. The high gravity brewing has an advantage to enhance productive efficiencies of manufacturing equipment such as fermentation and lagering tanks and to curtail energy costs. Therefore, it is widely used in European countries and the United States, whereas the problem that it takes a long time to ferment a great volume of wort extract is indicated. The method to promote the fermentation in the high gravity brewing includes (1) to accelerate the viability and growth of the yeast by supplying a great volume of oxygen, (2) to use fresh yeast, and (3) to supply free-amino nitrogen. Besides, there is a problem that beer flavor manufactured in the high gravity brewing may be different from that of beers in a usual method. Especially, the original extract of wort is high in the high gravity brewing, and since a brewer's yeast is exposed to conditions of high osmotic pressure, expression of acetaldehyde dehydrogenase gene is generally induced. Because acetic acid, an off-flavor of beers, is produced from acetaldehyde, it has been desired to reduce its production.

[0006] Meanwhile, low-calorie beer, also called as diet beer, is a general name of beers with low calories. According to the art of beer brewing, low-calorie beer is defined as that with carbohydrate at 0.75 g/100 g or less and with fermentation degree of 90-92%. On the other hand, light beer is a general name of beers having lighter flavor than that of usual beers. Although it is not standardized on the quality and the method of manufacturing, it has generally lower calories than that of usual beers and is counted as one of low-calorie beers. The method to manufacture low-calorie beers includes (4) to ferment using diluted wort less than 10 weight % of original extract, or to dilute usual beers produced from wort at 12-13 weight % of original extract, (5) to ferment highly using dextrin-hydrolyzing enzymes (glucoamylase, debranching enzyme, α-amylase derived from mold, malt enzyme etc.), (6) to use dextrin-metabolizing yeast including recombinant yeast, (7) to ferment highly by supplying glucose to wort, (8) to dilute beer manufactured through the high gravity brewing, and (9) to ferment separately not less than two kinds of wort with different concentrations of original extract, to mix them to make the concentration the designated one, and to re-ferment and mature and the like.
Enzymes from malt such as \( \alpha \)-amylase are used to saccharify ingredients such as malt in the process of manufacturing beers. Then, because maltose is a major carbon-source in wort, a sake yeast and wine yeast other than a brewer’s yeast, which are less able to metabolize maltose have not been able to be employed in the manufacturing beers.

EP 0 523 333 A1 discloses a method for producing non-alcohol beverage characterized in that \( \alpha \)-glucosidase is added to the beverage at a mashing process of producing beer. US Patent 4,684,525 discloses a method for making a low calorie beer, wherein an amylglucosidase form a Rhizopus culture is added to a wort, and the enzyme is inactivated under pasteurizing conditions.


US Patent 3,379,534 discloses the preparation of a low dextrin beer by using amyloglucosidase.

US Patent Specification 1,174,618 is directed to a process for the production of beer with a predetermined low residual carbohydrate content which comprises addition of a quantity of the enzyme amyloglucosidase to the yeast-fermenting beer wort.

US Patent, 4,355,047 discloses a method of preparing a low calorie beer by introducing a debranching enzyme (pullulanase) obtained from rice into the brewing process.

DISCLOSURE OF THE INVENTION

As described above, there has been no method to reinforce efficiently filling taste and fullness of mouthfeel of the beverages in the process of manufacturing fermented beers.

Thus, the first aspect of the present invention has been performed to provide a method of manufacturing fermented malt beverages in which filling taste and fullness of mouthfeel of the beverages can be reinforced. Especially, it aims to provide a method of manufacturing fermented malt beverages having usual alcohol concentration beers, and that kinds and amounts of adjuncts are limited in the case of using a adjunct such as rice or starch. Also, the above-mentioned method to add \( \alpha \)-glucosidase is for giving filling taste of low alcohol content beers, but cannot be applied to fermented malt beverages with usual alcohol concentration beers.

The present invention has been made based upon such a subject and we have found that new fermented malt beverages with reinforced filling taste and fullness of mouthfeel can be manufactured by addition of \( \alpha \)-glucosidase prior to the heat treatment in the wort production process to produce isomaltotrioligosaccharides. That is, the first aspect of the present invention provides the followings, as presently claimed.

1. A method of manufacturing fermented malt beverages, wherein \( \alpha \)-glucosidase is added prior to heat treatment in the wort production process in the course of manufacturing the fermented malt beverages.
2. The method of manufacturing of [1], wherein heat treatment is boiling treatment.
3. The method of manufacturing of [1] or [2], wherein \( \alpha \)-glucosidase is added simultaneously with ground malt.
4. The method of manufacturing of [1] or [2], wherein \( \alpha \)-glucosidase is added to the mash prior to the heat treatment in the wort production process.
5. The method of manufacturing of [1] or [2], wherein \( \alpha \)-glucosidase is added in the malting process.
6. The method of manufacturing of any one of [1] to [5], wherein only malt is used as an ingredient.
7. The method of manufacturing of any one of [1] to [5], wherein malt and adjuncts are used as sugar ingredients.
8. Fermented malt beverages manufactured by the method of any one of [1] to [7].

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 is a graph showing a result (amount of \( \alpha \)-glucosidase added and sugar composition of wort) to analyze sugar composition before fermentation in Example 1 according to a gel filtration method using HPLC and absorption-distribution method. Fru indicates fructose, and G1; glucose, G2; maltose, i-G2; isomaltose, G3; maltotriose, Pan; panose, i-G3; isomaltotriose, G4; maltotetraose, G5; maltpentaose, G6; maltohexaose, G7; maltotetraose, respectively.

Fig. 2 is a graph showing sugar compositions before and after fermentation in Example 2. Fru indicates fructose, and G1; glucose, G2; maltose, i-G2; isomaltose, G3; maltotriose, Pan; panose, i-G3; isomaltotriose, G4; maltotetraose, G5; maltpentaose, G6; maltohexaose, G7; maltotetraose, respectively.

Fig. 3 is a table showing a result to analyze the components of beer manufactured in Example 2. \( \alpha \)-GLU indicates \( \alpha \)-glucosidase.

Fig. 4 is a table showing a result to evaluate the sensory test for beer in Example 3.

Fig. 5 is a graph showing a result to analyze sugar composition before fermentation in Example 4 according to a gel filtration method using HPLC and absorption-distribution method. G1 indicates glu-
cose, and G2; maltose, i-G2; isomaltose, G3; maltotriose, Pan; panose, i-G3; isomaltotriose, G4; maltotetraose, and G5; maltopentaose, respectively. Also, α-GLU indicates α-glucosidase.

Fig. 6 is a graph showing a result to analyze sugar composition before fermentation in Example 5 according to gel filtration method using HPLC and absorption-distribution method. G1 indicates glucose, and G2; maltose, i-G2; isomaltose, G3; maltotriose, Pan; panose, i-G3; isomaltotriose, G4; maltotetraose, and G5; maltopentaose, respectively. Also, α-GLU indicates α-glucosidase.

Fig. 7 is a graph showing a temperature pattern of mashing process in the high gravity brewing.

Fig. 8 is a graph showing a time-course change of branched oligosaccharides by addition of α-glucosidase during fermentation.

Fig. 9 is a graph showing a relationship between amount of acetic acid produced and amount of oligosaccharides in the wort production process. The beverages can be made in the same process as that for previous fermented malt beverages.

Fig. 10 is a table showing a result to analyze the components of beer manufactured using a sake yeast.

Fig. 11 is a graph showing a relationship between the amount of acetic acid produced and the amount of α-glucosidase added in a brewing using a sake yeast.

Fig. 12 is a graph showing a relationship between real degree of fermentation and the amount of α-glucosidase added in a brewing using a brewer’s yeast.

Fig. 13 is graphs showing (a) a time-course change of oligosaccharides by no addition of α-glucosidase and (b) a time-course change of oligosaccharides by addition of α-glucosidase.

Fig. 14 is a graph showing a relationship between real degree of fermentation and the amount of α-glucosidase added in a brewing using a brewer’s yeast.

Fig. 15 is a graph showing a relationship between real degree of fermentation and the amount of α-glucosidase added in a brewing using a sake yeast.

BEST MODE FOR CARRYING OUT THE INVENTION

[0017] The present invention is a method of manufacturing fermented malt beverages characterized by addition of α-glucosidase prior to heat-treatment in the wort production process in the manufacturing fermented malt beverages.

[0018] Fermented malt beverage is a concept of beverages including so-called 100 % malt beers (pure malt beers), the sugar ingredient of which is only malt, beers which are made from the adjunct such as rice and refined starch by the designated amounts in addition to malt, and so-called high adjunct beer which is made from ingredients containing malt whose amount is less than the constant one. Fermented malt beverages in the present invention include those with alcohol of about 4.1 to about 15.0 weight %. Preferably, they include those with alcohol of about 4.1 to about 8.0 weight %. Adjusting the extract concentration in the wort production process can make final products with the desired concentration of alcohol.

[0019] In the method of manufacturing in the present invention, α-glucosidase is added prior to heat-treatment in the wort production process. Except for addition of α-glucosidase prior to heat treatment in the wort production process, the beverages can be made in the same process as that for previous fermented malt beverages.

[0020] A part of sugar ingredient is converted to iso-maltooligosaccharides such as isomaltose and panose as a result of the addition of α-glucosidase.

[0021] Now, a method of manufacturing fermented malt beverages is generally composed of a series of the processes including a malting process, a wort production process, a fermentation process, and a lagering process. Malting process is a process in which barley is germinated to produce malt and the green malt is kilned and its root is removed and stocked. In a wort production process, brewing water is added to ground malt and starch is converted to sugars by enzymes included in malt to make mash. In the process of manufacturing beers with adjuncts, the adjuncts such as rice and starch are also added with brewing water and thereby sugars derived from them are also produced. Mash is lauterated and then boiled after hops are added. Such boiling-treatment is performed in order to inactivate enzymes in wort, to make wort clear by precipitating proteins, to extract and isomerize hop components, and to sterilize. Subsequently, the extract of the wort is adjusted to the designated one by the addition of water to the wort after boiling. After cooling of the wort obtained in the wort production process, it is submitted to the fermentation process. In a fermentation process, a yeast is added and sugars in the wort are converted to alcohol. Thus obtained beer is called as young beer. In a maturation process, young beer is placed calmly for the designated period, and lagered to mature.

[0022] In the method of manufacturing in the present invention, α-glucosidase is added prior to heat-treatment (wot boiling) in the wort production process. Therefore, α-glucosidase is added in the malting process or before wort boiling in the wort production process. By addition of α-glucosidase, isomaltoligosaccharides such as isomaltose and panose are produced by the action of α-glucosidase in mash or wort on malt-dextrin and oligosaccharides in the wort production process.

[0023] In the present invention, "heat-treatment in the wort production process" indicates for example boiling-treatment in general process of manufacturing described above. That is, in this case α-glucosidase is added prior to boiling-treatment (aims of which are to inactivate enzymes in wort and to precipitate proteins) in the wort production process. Thus, if a part of the process of the previous manufacturing is adopted as "heat-treatment in the wort production process" in the present invention, no ad-
ditional process is necessary and a new type of the beverages with new filling taste can be made in the process as similar to that for previous beverages except for addition of α-glucosidase.

[0024] However, "heat-treatment in the wort production process" in the present invention is not limited to a boiling treatment as described above but may be a process in which α-glucosidase added can be inactivated at least. Therefore, another process can be provided separately to achieve the above aims and it can be made "heat-treatment in the wort production process" in the present invention. Also in this case, the heat-treatment can be boiling-treatment.

[0025] Preferably, α-glucosidase is added in the end of a malting process or in the early stage of a wort production process. By this treatment, α-glucosidase can act fully by the addition of α-glucosidase at the early stage in the course of manufacturing, and it is possible that larger amounts of isomaltooligosaccharides may be produced. For example, α-glucosidase can be added simultaneously with addition of ground malt into warm water, or α-glucosidase may be added to ground malt and then the mixture may be added to warm water. Besides, after ground malt is added in warm water, α-glucosidase may be added to the mixture. On the other hand, α-glucosidase may be added after mash is prepared by adding ground malt to warm water.

[0026] Also, α-glucosidase can be added in a malting process.

[0027] In the case of using adjuncts, α-glucosidase can be added in wort production process simultaneously with the adjuncts.

[0028] Amounts of isomaltooligosaccharides produced can be adjusted by adjusting the schedule of addition of α-glucosidase. [0024]

[0029] Origin of α-glucosidase in the present invention is not limited but generally one on the market can be used, for example, α-glucosidase "Amano" (Amano Enzyme Inc.) or Transglucosidase L "Amano" (Amano Enzyme Inc.).

[0030] Produced isomaltooligosaccharides may affect filling taste and fullness of mouthfeel of the fermented malt beverages. Amount of isomaltooligosaccharides produced are adjusted by amount of α-glucosidase added, and consequently filling taste and fullness of mouthfeel of the beverages can be adjusted. Although amount of α-glucosidase added is not limited especially, but preferably α-glucosidase may be added from 1/10,000 to 1/500 of weight of ingredients. More preferably α-glucosidase may be added in the range of 1/5,000 to 1/1,000 of weight of ingredients. Concentration of alcohol in the finished beer is adjusted by adjusting original extract of wort prior to a fermentation process as in the previous method of manufacturing.

[0031] It is also possible that various saccharide hydrolysases such as α-amylase, β-amylase, and debranching enzymes can be used concomitantly with α-glucosidase.

[0032] Hereinafter, the present invention is explained in detail using Examples. Examples described hereinafter are used to explain the effects of the present invention but the present invention is not limited as the above explanations and Examples. Various variations are also included in the present invention as long as they are included in the scope of claim and they are conceived easily by those skilled in the art.

[Example 1] Amount of α-glucosidase added and sugar composition of wort

[0033] Saccharification of mash was performed as follows. Ground malt and α-glucosidase "Amano" are added in the water for preparation pre-warmed at 46 °C. Amount of α-glucosidase "Amano" added was 1/10,000 - 1/500 of that of ground malt. The mash mixture is heated with a rest at 46 °C for 30 min with stirring and then heated to 65 °C with 1 °C increase per min. It was further warmed at 65 °C for 80 min and then heated to 76 °C with 1 °C increase per min. It was warmed at 76 °C for 10 min so that saccharification was terminated. The saccharified mash was filtered through a filtration paper (No.2), and the filtrate was boiled. The resulted precipitation in the filtrate was removed by filtration through the filtration paper and the filtrate was diluted to prepare the concentration of original extract as 12 weight % of wort.

[0034] Sugar composition of the wort before fermentation was analyzed according to a gel filtration method using HPLC and absorption-distribution method.

[0035] As shown in Fig. 1, as amount of α-glucosidase "Amano" added was increased, production of maltose was decreased and isomaltose and panose, which are non-fermentable sugars, were increased. It is supposed that α-glucosidase "Amano" may act the produced maltose and generate the transglucosilation reaction. Production of glucose was also increased concomitantly and it is likely that this phenomenon may be caused by the transglucosilation reaction of α-glucosidase as the vice-reaction.

[Example 2] Manufacturing 100% malt beer by addition of α-glucosidase [0035]

[0036] Manufacturing 100% malt beer without any adjuncts was tried. Saccharification was performed using α-glucosidase "Amano" added at 1/1,000 of malt amount. Then, a brewer's yeast was added to wort whose extract was prepared to be about 13 weight %, and they were fermented for about 2 weeks to brew. Sugar compositions before and after fermentation are shown in Fig. 2.

[0037] Isomaltooligosaccharides such as isomaltose and panose produced by addition of α-glucosidase remained in the finished beers. Also, isomaltooligosaccharides larger than G4 were increased compared with the control group.

[0038] Analyzed values of composition of the manufactured beer are shown in the table in Fig. 3.
example 3] The sensory evaluation

A sensory evaluation was performed by 11 assessors who were experts in brewing. In the group of α-glucosidase addition compared with the group without any enzyme preparation, senses of mild and fullness of mouthfeel were observed. Their comments showed characteristics such as mild, fullness of mouthfeel, and smooth. On the other hand, in the group of no addition, negative evaluations such as dull and unfine taste were given although senses such as flavor purity and liveliness were also observed.

[Example 4] Manufacturing beer with adjuncts by addition of α-glucosidase

Beer, which is manufactured using adjuncts, was manufactured using the ingredient composed of 70 weight % malt and 30 weight % barley. Saccharification was performed using α-glucosidase “Amano” added at 1/1,000 of ingredient weights. Then, a brewer’s yeast was added to the wort whose extract was prepared to be about 13 weight %, and they were fermented for about 2 weeks to brew. Sugar composition before fermentation is shown in Fig. 5.

[Example 5] Manufacturing high adjunct beer by addition of α-glucosidase

example 5, isomaltooligosaccharides such as isomaltose and panose remained in finished beer, and beer with good flavor could be manufactured.

[Example 6] Manufacturing high adjunct beer by addition of α-glucosidase

Beer, which is manufactured using adjuncts, was manufactured using the ingredient composed of 25 weight % malt and 75 weight % barley. Saccharification was performed using α-glucosidase added at 1/1,000 of the ingredients’ weights. Then, a brewer’s yeast was added to the wort whose extract was prepared to be about 13 weight %, and they were fermented for about 2 weeks to brew. Sugar composition before fermentation is shown in Fig. 6.

[Example 7] Manufacturing high adjunct beer by addition of α-glucosidase

example 2, isomaltooligosaccharides such as isomaltose and panose remained in the products, and high adjunct beer with good flavor could be manufactured.

[Example 8] Manufacturing high adjunct beer by addition of α-glucosidase

Similarly to the case of 100 % malt beer in Example 2, isomaltooligosaccharides such as isomaltose and panose remained in the products, and high adjunct beer with good flavor could be manufactured.

[Example 9] Manufacturing high adjunct beer by addition of α-glucosidase

Similarly to the case of 100 % malt beer in Example 2, isomaltooligosaccharides such as isomaltose and panose remained in the products, and high adjunct beer with good flavor could be manufactured.

[Example 10] Manufacturing high adjunct beer by addition of α-glucosidase

Similarly to the case of 100 % malt beer in Example 2, isomaltooligosaccharides such as isomaltose and panose remained in the products, and high adjunct beer with good flavor could be manufactured.
Results of componental analysis of beer manufactured are shown in a table in Fig. 10. In the case of α-glucosidase addition, the amount of acetic acid produced was suppressed more than the case of glucoamylase addition. It is supposed that an increase in the amount of acetic acid produced by addition of glucoamylase may be due to increase in osmotic pressure by a rapid increase in glucose production. As shown in the table in Fig. 10, it is suggested that employment of a sake yeast in beer brewing may increase components giving good flavor such as malic acid, succinic acid, and ethyl caproate so that beer with new qualities different from those of beers brewed using a brewer’s yeast can be manufactured. Fig. 11 shows a relationship between amount of acetic acid produced in beer using a sake yeast and amount of α-glucosidase added. Addition of α-glucosidase remarkably decreased the amount of acetic acid produced even using a sake yeast as in the case of a brewer’s yeast.

**Example 8**

28 Kg of Ground malt was added in 84 L of warm water so that wort whose original weight % was prepared according to the infusion method. Time-course of temperature in the infusion method is according to Fig. 7.

A brewer’s yeast was added at 2.5 g per 1 L to the obtained wort. Then, α-glucosidase was added at 50, 100, 200 and 400 ppm of wort and fermentation was performed at 15 °C for 21 days. In control group, fermentation was performed in the same manner as in the above without addition of α-glucosidase.

Relationship between real degree of fermentation and amount of α-glucosidase added after fermentation is shown in Fig. 12. Addition of α-glucosidase remarkably increased real degree of fermentation so that low-calorie beer with less remaining sugars can be manufactured using a brewer’s yeast.

A graph summarizing increase and decrease of sugars in fermentation individually by polymerization is shown in Fig. 13. In no addition group, maltotetraose (G4 in the graph), maltpentaose (G5 in the graph), maltohexaose (G6 in the graph), and larger sugars than maltoheptaose (G7 ≤5 in the graph) remained, whereas these oligosaccharides decreased as the progress of fermentation by addition of α-glucosidase (400 ppm).

**Example 9**

Sake yeast was added at 2.5 g per 1 L to the wort prepared according to Example 8. Then, α-glucosidase was added at 50, 100, 200 and 400 ppm of wort and fermentation was performed at 15 °C for 21 days. In control group, fermentation was performed in the same manner as in the above without addition of α-glucosidase.

Relationship between real degree of fermentation and amount of α-glucosidase added is shown in Fig. 14. Addition of α-glucosidase remarkably increased real degree of fermentation so that low-calorie beer with less remaining sugars can be manufactured using a sake yeast.

**Example 10**

A wine yeast (W-1) were added at 2.5 g per 1 L to the wort prepared according to Example 8. Then, α-glucosidase was added at 50, 100, 200 and 400 ppm of wort and fermentation was performed at 15 °C for 21 days. In control group, fermentation was performed in the same manner as in the above without addition of α-glucosidase.

Relationship between real degree of fermentation and amount of α-glucosidase added is shown in Fig. 15. Addition of α-glucosidase remarkably increased real fermentation degree so that low-calorie beer with less remaining sugars can be manufactured using a wine yeast.

**INDUSTRIAL APPLICABILITY**

According to the method of manufacturing disclosed in the aspect the present invention, isomaltooligosaccharides are produced by addition of α-glucosidase and the resulted isomaltooligosaccharides remain in the final products without being metabolized by yeasts in a fermentation process which follows a wort production process. Because α-glucosidase is added prior to heat-treatment in a wort production process and is entirely inactivated through heat-treatment, the once produced isomaltooligosaccharides are not hydrolyzed to glucose.
by the enzyme in the following processes (fermentation and maturation). Thus, isomaltooligosaccharides produced by addition of $\alpha$-glucosidase can be remained efficiently in the final products. As described above, fermented malt beverage with abundant isomaltooligosaccharides can be manufactured according to the method of manufacturing in the present invention.

[0061] Filling taste is also given to so-called 100 % malt beer which is brewed using only malt as an ingredient. Also, in brewing of usual beer, it is unnecessary to use isomaltooligosaccharides syrup, and it is possible to select adjuncts according to the purpose.

[0062] Furthermore, because the beverages are manufactured in the same manner as in the previous method of manufacturing except for the addition of $\alpha$-glucosidase prior to heat treatment in the wort production process, it is unnecessary to establish more facilities nor to alter the process and beers with filling taste and plentiful fullness of mouthfeel compared with conventional fermented malt beverages can be manufactured. Also, because isomaltooligosaccharides are produced by addition of $\alpha$-glucosidase prior to heat treatment in the wort production process, more energetically efficient process of manufacturing can be performed in comparison to the process in which isomaltooligosaccharides syrup is prepared separately and added to the fermentation.

Claims

1. A method of manufacturing fermented malt beverages having usual alcohol concentrations comprising the steps of:
   a) conducting a malting process,
   b) conducting a wort production process,
   c) adjusting the concentration of original extract of wort to 12 to 13 %,
   d) conducting a fermentation process, and
   e) conducting a lagering process,
   wherein said step b) comprises the substeps of
   i) adding ground malt and $\alpha$-glucosidase to brewing water to make a mash, and
   ii) conducting a heat treatment on the mash to deactivate the $\alpha$-glucosidase.

2. The method of manufacturing of claim 1, wherein said heat treatment is boiling treatment.

3. The method of manufacturing of either of claims 1 or 2, wherein said $\alpha$-glucosidase is added simultaneously with said ground malt.

4. The method of manufacturing of any one of claims 1 to 3, wherein only malt is used as a sugar ingredient.

5. The method of manufacturing of any one of claims 1 to 3, wherein malt and adjuncts are used as sugar ingredients.

6. Fermented malt beverages having usual alcohol concentrations obtainable by the method of manufacturing of any one of claims 1 to 5.

Patentansprüche

1. Verfahren zum Herstellen fermentierter Malzgetränke mit üblichen Alkoholkonzentrationen, umfassend die Schritte:
   a) Ausführen eines Mälzvorgangs,
   b) Ausführen eines Vorgangs zur Herstellung von Stammwürze,
   c) Einstellen der Konzentration des ursprünglichen Extraks auf 12 bis 13 % Stammwürze,
   d) Ausführen eines Fermentierungsvorgangs und
   e) Ausführen eines Lagerungsvorgangs, wobei Schritt b) die Unterschritte umfasst
   i. Hinzufügen von gemahlenem Malz und $\alpha$-Glucosidase zum Brauwasser, um eine Maische herzustellen, und
   ii. Ausführen einer Hitzebehandlung der Maische, um die $\alpha$-Glucosidase zu deaktivieren.

2. Verfahren zum Herstellen nach Anspruch 1, wobei die Hitzebehandlung Kochbehandlung ist.

3. Verfahren zum Herstellen gemäß Anspruch 1 oder 2, wobei die $\alpha$-Glucosidase gleichzeitig mit dem gemahlenen Malz hinzugefügt wird.

4. Verfahren zum Herstellen nach einem beliebigen der Ansprüche 1 bis 3, wobei nur Malz als ein Zuckerbestandteil verwendet wird.

5. Verfahren zum Herstellen gemäß einem beliebigen der Ansprüche 1 bis 3, wobei Malz und Beigaben als Zuckerbestandteile verwendet werden.

6. Fermentierte Malzgetränke mit üblichen Alkoholkonzentrationen, erhältlich durch das Verfahren zum Herstellen nach einem beliebigen der Ansprüche 1 bis 5.

Revendications

1. Méthode pour fabriquer les boissons au malt fermentées ayant des concentrations d’alcool habituelles, comprenant les étapes de:
a) effectuer un processus de maltage,
b) effectuer un processus de fabrication de moût,
c) ajuster la concentration de l’extrait de moût d’origine à 12% à 13%,
d) effectuer un processus de fermentation, et
e) effectuer un processus de garde basse,
dans laquelle l’étape b) comprend les sous-étapes suivantes :

i) ajouter le malt concassé et l’α-glucosidase à l’eau de brassage pour former un empâtage, et
ii) soumettre l’empâtage à un traitement thermique pour désactiver l’α-glucosidase.

2. Méthode de fabrication de la revendication 1, dans laquelle le traitement thermique est un traitement à ébullition.

3. Méthode de fabrication selon l’une des revendications 1 ou 2 dans laquelle ladite α-glucosidase et ledit malt concassé sont ajoutés simultanément.

4. Méthode de fabrication selon l’une quelconque des revendications 1 à 3, dans laquelle seul le malt est utilisé comme ingrédient sucrant.

5. Méthode de fabrication selon l’une quelconque des revendications 1 à 3 dans laquelle le malt et des succédanés sont utilisés comme ingrédients sucrants.

FIG. 1

Effect of α-Glucosidase dosage on sugar composition of wort
FIG 2

No addition

α-Glucosidase addition

□: Before fermentation  ■: After fermentation

Sugar compositions before and after fermentation
### FIG. 3

#### Analysis of beer components (1)

<table>
<thead>
<tr>
<th>Component</th>
<th>α-GLU addition</th>
<th>No addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol (%)</td>
<td>4.41</td>
<td>5.95</td>
</tr>
<tr>
<td>Apparent extract (%)</td>
<td>4.84</td>
<td>1.76</td>
</tr>
<tr>
<td>Real extract (%)</td>
<td>6.42</td>
<td>3.89</td>
</tr>
<tr>
<td>Original extract of wort (%)</td>
<td>13.0</td>
<td>12.9</td>
</tr>
<tr>
<td>Apparent degree of fermentation (%)</td>
<td>62.8</td>
<td>86.4</td>
</tr>
<tr>
<td>Real degree of fermentation (%)</td>
<td>58.7</td>
<td>76.0</td>
</tr>
</tbody>
</table>

#### Analysis of beer components (2)

<table>
<thead>
<tr>
<th>Component</th>
<th>α-GLU addition</th>
<th>No addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color (EBC)</td>
<td>11.9</td>
<td>10.8</td>
</tr>
<tr>
<td>pH</td>
<td>4.78</td>
<td>4.63</td>
</tr>
<tr>
<td>Acidity (mL)</td>
<td>2.29</td>
<td>2.29</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>0.82</td>
<td>0.74</td>
</tr>
<tr>
<td>Amino acid (%)</td>
<td>0.30</td>
<td>0.26</td>
</tr>
<tr>
<td>Carbon dioxide (g/L)</td>
<td>4.68</td>
<td>4.65</td>
</tr>
<tr>
<td>Enzymes unit (IU/L)</td>
<td>24.0</td>
<td>25.4</td>
</tr>
</tbody>
</table>

#### Analysis of beer components (3)

<table>
<thead>
<tr>
<th>Component</th>
<th>α-GLU addition</th>
<th>No addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphoric acid</td>
<td>976</td>
<td>850</td>
</tr>
<tr>
<td>Citric acid</td>
<td>288</td>
<td>295</td>
</tr>
<tr>
<td>Fumaric acid</td>
<td>trace</td>
<td>46.7</td>
</tr>
<tr>
<td>Malic acid</td>
<td>153</td>
<td>146</td>
</tr>
<tr>
<td>Succinic acid</td>
<td>87.3</td>
<td>86.1</td>
</tr>
<tr>
<td>Lactic acid</td>
<td>79.2</td>
<td>89.8</td>
</tr>
<tr>
<td>Acetic acid</td>
<td>86.3</td>
<td>105</td>
</tr>
</tbody>
</table>
| Pyrogallic acid                                | 273            | 244         | (Unit ppm)

#### Analysis of beer components (4)

<table>
<thead>
<tr>
<th>Component</th>
<th>α-GLU addition</th>
<th>No addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl acetate</td>
<td>28.7</td>
<td>35.2</td>
</tr>
<tr>
<td>n-Propyl alcohol</td>
<td>6.72</td>
<td>11.5</td>
</tr>
<tr>
<td>1-Butanol</td>
<td>14.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Isobutyl acetate</td>
<td>1.19</td>
<td>1.32</td>
</tr>
<tr>
<td>1-Amyl alcohol</td>
<td>41.1</td>
<td>56.9</td>
</tr>
</tbody>
</table>
| Ethyl caproate                                 | 0.18           | 0.31        | (Unit ppm)
FIG. 4

### α - Glucosidase addition

- **excellent**
- **thick, fullness of mouthfeel**
- **mild, smooth**
- **flavor purity**
- **fresh, liveliness**

<table>
<thead>
<tr>
<th>Number of people</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10 11</td>
</tr>
</tbody>
</table>

- faults
- thin, watery
- harsh
- unfine taste, bad taste
- dull

- Feel strongly
- Feel
- Not feel
- Feel
- Feel strongly

---

### No addition

- **excellent**
- **thick, fullness of mouthfeel**
- **mild, smooth**
- **flavor purity**
- **fresh, liveliness**

<table>
<thead>
<tr>
<th>Number of people</th>
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</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10 11</td>
</tr>
</tbody>
</table>

- faults
- thin, watery
- harsh
- unfine taste, bad taste
- dull

- Feel strongly
- Feel
- Not feel
- Feel
- Feel strongly
FIG. 5

Malt : Barley = 70 : 30

- No addition
- α-GLU addition (1/1,000)

Effect of α-GLU addition on sugar composition of wort
FIG. 6

Malt : Barley = 25 : 75

Effect of α-GLU addition on sugar composition of wort
FIG. 7

Temperature diagram during mashing
FIG. 8

Sugar concentration (%)

Fermentation days (day)

α-Glucosidase dosages
- 0 ppm
- 50 ppm
- 100 ppm
- 200 ppm
- 400 ppm

Brewer's yeast
FIG. 10

<table>
<thead>
<tr>
<th></th>
<th>Brewer's yeast No addition</th>
<th>Sake yeast α-GLU addition</th>
<th>Sake yeast GA addition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol (v/v)</td>
<td>8.84</td>
<td>11.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Real extract (w/w%)</td>
<td>7.02</td>
<td>4.09</td>
<td>3.90</td>
</tr>
<tr>
<td>Original extract (w/w%)</td>
<td>19.8</td>
<td>20.1</td>
<td>20.2</td>
</tr>
<tr>
<td>Glucose (%)</td>
<td>0.02</td>
<td>0.17</td>
<td>0.08</td>
</tr>
<tr>
<td>Maltose (%)</td>
<td>0.07</td>
<td>0.03</td>
<td>0.11</td>
</tr>
<tr>
<td>Maltotriose (%)</td>
<td>0.97</td>
<td>0.33</td>
<td>0.24</td>
</tr>
<tr>
<td>Maltotetraose (%)</td>
<td>0.17</td>
<td>—</td>
<td>0.02</td>
</tr>
<tr>
<td>Citric acid (ppm)</td>
<td>4.49</td>
<td>4.56</td>
<td>4.46</td>
</tr>
<tr>
<td>Malic acid (ppm)</td>
<td>2.14</td>
<td>2.59</td>
<td>2.65</td>
</tr>
<tr>
<td>Succinic acid (ppm)</td>
<td>1.34</td>
<td>2.85</td>
<td>2.55</td>
</tr>
<tr>
<td>Lactic acid (ppm)</td>
<td>1.35</td>
<td>1.87</td>
<td>1.68</td>
</tr>
<tr>
<td>Acetic acid (ppm)</td>
<td>1.40</td>
<td>1.39</td>
<td>2.88</td>
</tr>
<tr>
<td>Ethyl acetate (ppm)</td>
<td>8.48</td>
<td>9.35</td>
<td>1.12</td>
</tr>
<tr>
<td>1-Propanol (ppm)</td>
<td>22.2</td>
<td>23.8</td>
<td>24.6</td>
</tr>
<tr>
<td>Isoamyl acetate (ppm)</td>
<td>4.37</td>
<td>7.84</td>
<td>7.35</td>
</tr>
<tr>
<td>Isoamyl alcohol (ppm)</td>
<td>7.65</td>
<td>58.0</td>
<td>61.0</td>
</tr>
<tr>
<td>Ethyl caproate (ppm)</td>
<td>0.34</td>
<td>1.85</td>
<td>1.62</td>
</tr>
<tr>
<td>Amino acid (ppm)</td>
<td>3.480</td>
<td>3.250</td>
<td>3.410</td>
</tr>
</tbody>
</table>

α-GLU : α-Glucosidase  GA : Glucoamylase
FIG. 11

Acetic acid ppm

0 50 100 200 400

α-Glucosidase dosage (ppm)

Sake yeast
FIG. 12

Bar chart showing the real degree of fermentation in Brewer's yeast with different $\alpha$-glucosidase dosages (ppm).
FIG. 13

(a) No addition

(b) 400 ppm of α-Glucosidase addition

Fermentation days (day)

Sugar composition %

- G3
- G2
- G1
- G7
- G6
- G5
- G4
FIG. 14

![Graph showing the relationship between α-Glucosidase dosage (ppm) and the real degree of fermentation for sake yeast.](image-url)
REFERENCES CITED IN THE DESCRIPTION

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