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(54) PROCESS FOR THE PRODUCTION OF A BEER OR CIDER CONCENTRATE

(57) 1. A method for preparing beer concentrate, comprising the steps of:
a) Subjecting beer or cider (1) to a first concentration step comprising ultrafiltration (A) to obtain a retentate (2) and a fraction comprising alcohol and volatile flavour components (3), wherein the retentate (2) is characterised by the concentration of unfilterable compounds equal to or higher than 20% (w/w), preferably 30% (w/w), most preferably 40% (w/w), as calculated from density measurement corrected for the alcohol amount;
b) Subjecting the fraction comprising alcohol and volatile flavour components (3) to a next concentration step (B) comprising freeze concentration; nanofiltration, adsorption or reverse osmosis, to obtain a concentrated fraction comprising alcohol and volatile flavour components (4) and a leftover fraction (5).

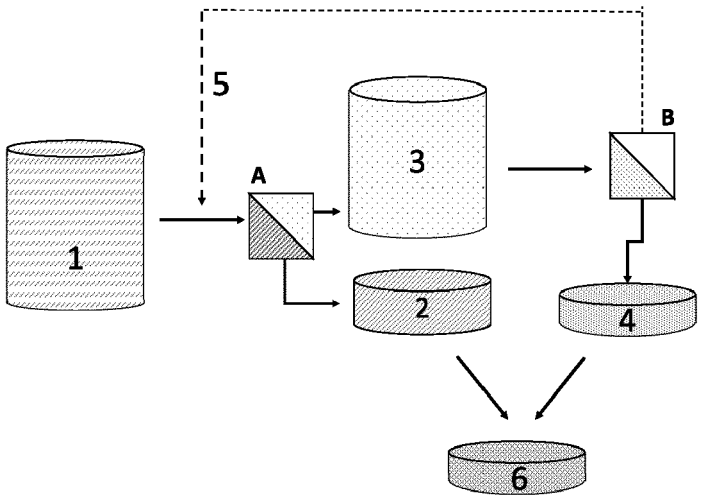

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention concerns a method for preparing beer or cider concentrate comprising alcohol and flavour components, and further beer or cider, respectively prepared therefrom. In particular the invention concerns a two-step concentration method wherein the first step involves a ultrafiltration that results in a concentrated retentate and an aqueous permeate fraction comprising alcohol and volatile flavour components, and wherein the second step involves a subsequent concentration step of the permeate by freeze concentration, adsorption, nanofiltration, reverse osmosis and/or combinations thereof.

BACKGROUND OF THE INVENTION

[0002] The major benefit of producing concentrates is the reduction in weight and volume which allows to save on storage and transportation costs, in addition to also often having favourable effect on improving shelf life of a product. Since beers and many other alcoholic beverages in general contain about 80 to 90% water, it has naturally been recognised that the most economical way to store or distribute them over considerable distances would be in the form of a concentrate.

[0003] In principle, a concentrate can be reconstituted to the initial product at any place at and time by the addition of the solvent, usually water. Nevertheless, it is not straightforward to produce a beer or cider like beverage concentrate, the main difficulty lying in the fact that most concentration procedures lead to reduction in many flavour or aroma components. Beer in particular is a very challenging beverage to produce a concentrate from because, unlike beverages produced from fruit juice fermentation such as wine or perry; the aromas present in beer are subtler and much less concentrated, which means that losing even a small portion of them at the concentration stage will have a profound effect on the organoleptic perception of the final rehydrated product. In addition, because of the great popularity of the drink and existence of a wide public of demanding beer aficionados, the reconstituted drink is expected to meet expectations with regard to its distinctive aroma, taste, mouthfeel, foaming properties, colour, and even haze perception. Reconstituted beer simply cannot taste like a diluted beer missing some characteristics; for gaining consumer acceptance it simply must have all the qualities of the "real" unprocessed beer.

[0004] Methods for producing beer concentrates and then rehydrating them into final beverages are known in the art. Various methods for concentrating alcoholic beverages that are known in the brewing industry include such processes as freeze-drying, reverse osmosis, and filtration. All of these methods start with a substantially finished beer and then remove the water. The resulting concentrated beverages can then be transported more cost-effectively and then reconstituted at a final destination by addition of water, carbon dioxide, and alternatively also alcohol.

[0005] An example of one method for preparation of a reconstitutable beer concentrate can be found in GB2133418. The method is based on subjecting beer to reverse osmosis and results in a low alcohol concentrate which can be rehydrated to a low-alcohol beer.

[0006] Conversely, US4265920 and US4532140 teach two-step methods for obtaining a high-alcohol beer concentrate that can be reconstituted to beers of normal alcohol content. The method of US4265920 comprises a first distillation step to separate ethanol and volatile aroma components from the retentate comprising the rest of the beer components, which is followed by a second step comprising a rather costly freeze-concentration procedure to concentrate the retentate from the first step. Finally, the distilled ethanol from step 1 is combined with the freeze-concentrated retentate from step 2, resulting in the final ethanol-enriched beer concentrate. The method of US4532140, on the other hand, in the first step subjects beer to ultrafiltration to obtain a concentrated retentate and an aqueous permeate that is then, in the second step subjected to reverse osmosis t concentrate ethanol and volatile compounds; lastly, the alcohol fraction from step 2 is pulled with the retentate from step 1 to obtain the final beer concentrate.

[0007] Although at least some of the above described methods provide a general approach for concentrating beer including its alcohol content and, to some extent, volatile components, they achieve their goal at the cost of reaching high concentration factors and only provide final concentrates of a volume half or at most one third of the volume of the starting beer. Therefore, there clearly exists place for improvement and provision of more concentrated beer bases providing further reduction in transport and storage costs.

[0008] The present invention provides a method for producing a naturally alcohol-enriched beer concentrate of high density, said method providing an advantageous concentration factor potential of at least 5, 10, 15, up to 20 or more, while at the same time ensuring high and optionally selective retention of natural beer flavouring compounds, including the volatile ones. These and other advantages of the present invention are presented in continuation.

SUMMARY OF THE INVENTION

[0009] The present invention is defined in the appended independent claims. Preferred embodiments are defined in the dependent claims. In particular, the present invention concerns a method for preparing beer concentrate, comprising the steps of:

a) Subjecting beer or cider (1) to a first concentration step comprising ultrafiltration (A) to obtain a retentate

(2) and a fraction comprising alcohol and volatile flavour components (3), wherein the retentate (2) is characterised by the concentration of unfilterable compounds equal to or higher than 20% (w/w), preferably 30% (w/w), most preferably 40% (w/w), as calculated from density measurement corrected for the alcohol amount;

b) Subjecting the fraction comprising alcohol and volatile flavour components (3) to a next concentration step (B) comprising freeze concentration; nanofiltration, adsorption or reverse osmosis, to obtain a concentrated fraction comprising alcohol and volatile flavour components (4) and a leftover fraction (5).

[0010] In case the next concentration step comprises nanofiltration or reverse osmosis, it is preferred that the permeate of that nanofiltration step or reverse osmosis step is recirculated to the feed of the first concentration step.

[0011] According to a preferred embodiment, the method according to the present invention the permeate of the first concentration step is subjected to a fractionation step, preferably distillation, prior to feeding this permeate to the next concentration step B). In accordance with this preferred embodiment, the distillation allows obtaining a fraction comprising ethanol and volatile flavour components and a leftover fraction comprising water and potentially beer or cider extract. On the one hand, the fraction comprising ethanol and volatile flavour components can in that case be fed to a next concentration step comprising adsorption, wherein the volatilve flavour components are selectively adsorbed on a column and subsequently eluted in a volume of water or ethanol to obtain a concentrated fraction of volatile flavour components. The left-over fraction of the fractionation step on the other hand, can be subjected to a next concentration step comprising freeze concentration to obtain a concentrated extract fraction.

[0012] Both the extract fraction obtained from freeze concentration as the concentrated volatile flavour fractions can, independently of one another, be added to the retentate of the ultrafiltration or can be used as an ingredient for beer or cider, as a component in beer or cider reconstitution or as a flavour component to be added to a beer or cider.

BRIEF DESCRIPTION OF THE FIGURES

[0013] For a fuller understanding of the nature of the present invention, reference is made to the following detailed description taken in conjunction with the accompanying drawings in which:

Figure 1: shows a block diagram schematically illustrating key steps of the method according to the present invention. A - first concentration step comprising ultrafiltration; B - second concentration step comprising freeze concentration, nanofiltration, reverse osmosis or adsorption;
1 - beer subjected to ultrafiltration; 2 - retentate; 3 - permeate comprising ethanol and volatile aroma components; 4 - retentate of the nanofiltration or reverse osmosis; 5 - permeate of the nanofiltration or reverse osmosis; 6 - concentrated beer or cider

Figure 2: shows a block diagram schematically illustrating key steps of an alternative method according to the present invention. A - first concentration step comprising ultrafiltration; B - second concentration step comprising freeze concentration (B"), or adsorption (B'); C - fractionation step, preferably distillation
1 - beer subjected to ultrafiltration; 2 - retentate; 3 - permeate comprising ethanol and volatile aroma components; 6 - concentrated beer or cider; 7 - fraction of the distillation comprising alcohol and volatile flavour components; 8 - fraction of the distillation comprising water and extract; 9-concentrated fraction of volatile flavour components; 10- concentrated fraction of extract.

Figure 3: shows a graph illustrating the relationship between the concentration factors of different retentates (4) obtained from different beers (beer 1-4), and the amount of unfilterable compounds ("% solids") achieved is said retentates following the first concentration step and retentate concentration step (RC) according to the method of the invention.

DEFINITIONS

[0014] As used herein, the term ***"concentrate"*** is given the definition of Oxford dictionary: "A *substance made by removing or reducing the diluting agent; a concentrated form of something"* (cf. http://www.oxforddictionaries.com/definition/english/concentrate). In line with this, the term *"beer* or cider *concentrate"* or, alternatively *"(concentrated) beer or cider base"* or *"beer or cider syrup",* is meant to relate to beer or cider, respectively which had the majority of its solvent component - i.e. water - removed, while retaining most of the dissolved components conferring such features as taste, smell, colour, mouthfeel etc.

[0015] As used herein, the term "***beer***" is to be construed according to a rather broad definition:

"the drink obtained by fermenting from a wort, prepared with starchy or sugary raw materials, including hop powder or hop extracts and drinkable water. Aside from barley malt and wheat malt, only the following may be considered for brewing, mixed with e.g. wheat malt, starchy or sugary raw materials in which the total quantity may not exceed 80%, preferably 40% of the total weight of the starchy or sugary raw materials:

(a) maize, rice, sugar, wheat, barley and the various forms of them.
(b) saccharose, converted sugar, dextrose and glucose syrup.

Although according to certain national legislations, not all fermented malt-based beverages can be called beer, in the context of the present invention, the term *"beer"* and *"fermented malt based beverage"* are used herein as synonyms and can be interchanged. It follows, that as used herein the terms *"reconstituted beer"* and *"reconstituted fermented malt based beverage"* are to be understood as beverages composition-wise substantially identical to beer but obtained by addition of the solvent, i.e. water or carbonated water, to a previously prepared beer concentrate.

[0016] Next, as used herein, the term ***"cider"*** is to be understood as every alcoholic beverage resulting from the fermentation of apple juice or apple juice mixed with up to 10% pear juice. This term also encompasses the any product of this fermented apple juice further modified by adding such standard cider manufacturing additives as acids (citric or tartaric) and/or sugar, filtering, cooling, saturating with carbon dioxide, pasteurizing, etc., which is commercialized under the term cider.

[0017] As used herein, the term ***"unfilterable compounds"*** is to be understood as referring to all the diverse compounds comprised in any type of beer or cider, which cannot pass through a **nanofiltration** membrane, i.e. beer compounds having the mean size greater than 150 Da, 180 Da, or 200 Da, which is the molecular weight retention size cut-off depending on a given nanofiltration membrane. As opposed to the *"filterable compounds"* comprising water, monovalent and some bivalent ions, low molecular alcohols such as ethanol, low molecular esters and a number of volatile flavour components, the unfilterable compounds mainly include sugars, mostly polysaccharides; sugar alcohols, polyphenols, pentosans, peptides and proteins, high molecular weight alcohols, high molecular weight esters, partially multivalent ions, and many other mainly organic and highly divergent compounds that vary depending on the beer or cider type. Due the complexity and discrepancies between different beer or cider compositions, the collective concentration of the unfilterable compounds is often referred to (in great simplification and without being exact) as "concentration of sugars" or "concentration of solids" and can be easily calculated from mass balance considerations taking into account of parameters such as density, viscosity, beer rheology, original gravity or extract, real gravity or extract, degree of fermentation (RDF) and/or alcohol content. In brewing practice, the concentration of unfilterable compounds is routinely estimated from density (real extract) measurement corrected for the density of the measured ethanol amount, ethanol being the most prevalent compound of density < 1 g/cm^3 and therefore affecting the density measurement most substantially. Such measurements are well known in the art, are routinely performed using standard beer analysing systems like Anton Paar Alcolyzer device, and thus are readily and easily performable by any person skilled in beer brewing.

[0018] The amount of components dissolved in beer can also be expressed as so called specific gravity (relative density) or apparent specific gravity. The first one is measured as density (weight per unit volume) of beer divided by the density of water used as a reference substance, whereas the second one as the weight of a volume of beer to the weight of an equal volume of water. For example, a specific gravity of 1.050 ("50 points") indicates that the substance is 5% heavier than an equal volume of water. The densities of water, and consequently also beer, vary with temperature; therefore for both specific gravity and apparent specific gravity the measurement of the sample and the reference value is done under the same specified temperature and pressure conditions. Pressure is nearly always 1 atm equal to 101.325 kPa, while temperatures may differ depending on the choice of further systems for approximating beer density. Examples of such systems are two empirical scales, Plato and the Brix scale, that are commonly used in brewing and wine industries, respectively. Both scales represent the strength of the solution as percentage of sugar by mass; one degree Plato (abbreviated °P) or one degree Brix (symbol °Bx) is 1 gram of sucrose in 100 grams of water. There is a difference between these units mainly due to both scales being developed for solutions of sucrose at different temperatures, but it is so insignificant that they may be used virtually interchangeably. For example, beer measured at 12° Plato at 15.5°C has the same density as a water-sucrose solution containing 12% sucrose by mass at 15.5°C, which is approximately equal to 12° Brix, being the same density as a water-sucrose solution containing 12% sucrose by mass at 20°C. The Plato and Brix scales have an advantage over specific gravity in that they expresses the density measurement in terms of the amount of fermentable materials, which is particularly useful at early stages of brewing. As, of course, both beer and wort are composed of more solids than just sucrose, it is not exact. The relationship between degrees Plato and specific gravity is not linear, but a good approximation is that 1°P equals 4 "brewer's points" (4 x 0.001); thus 12° Plato corresponds to specific gravity of 1.048 [1+(12 x 4 x .001)].

[0019] The term *"original gravity"* or *"original extract"* refers to specific gravity as measured before fermentation, whereas the term *"final gravity"* or *"final extract"* relates to specific gravity measured at the completion of fermentation. In general, gravity refers to the specific gravity of the beer at various stages in its fermentation. Initially, before alcohol production by the yeast, the specific gravity of wort (i.e. the ground malt before beer fermentation) is mostly dependent on the amount of sucrose. Therefore, the original gravity reading at the beginning of the fermentation can be used to determine sugar content in Plato or Brix scales. As fermentation progresses, the yeast convert sugars to carbon dioxide,

ethanol, yeast biomass, and flavour components. The lowering of the sugar amount and the increasing presence of ethanol, which has appreciably lesser density than water, both contribute to lowering of the specific gravity of the fermenting beer. Original gravity reading compared to final gravity reading can be used to estimate the amount of sugar consumed and thus the amount of ethanol produced. For example, for a regular beer, original gravity could be 1.050 and final gravity could be 1.010. Similarly, knowing original gravity of a beverage and its alcohol amount can be used to estimate the amount of sugars consumed during the fermentation. The degree to which sugar has been fermented into alcohol is expressed with the term *"real degree of fermentation"* or "RDF", and is often given as a fraction of original gravity transformed into ethanol and CO_2. The RDF of beer is in theory indicative of its sweetness as beers usually have more residual sugar and thus lower RDF.

[0020] Concentration steps may involve any of the variety of techniques recognised in the art, which allow partial or substantial separation of water from the beer and thus retention of most of the dissolved therein components in a lower than initial volume. Many of the techniques currently used within the beverage industry rely on the so called membrane technologies, which provide a cheaper alternative to conventional heat-treatment processes and involve separation of substances into two fractions with the help of a semipermeable membrane. The faction comprising particles smaller than the membrane pore size passes through the membrane and, as used herein is referred to as *"permeate"* or *"filtrate"*. Everything else retained on the feed side of the membrane as used herein is referred to as *"retentate"*.

[0021] Typical membrane filtration systems include for example pressure-driven techniques microfiltration, ultrafiltration, nanofiltration and reverse osmosis. As used herein, the term *"microfiltration"* refers to a membrane filtration technique for the retention of particles having size of 0.1 to 10 μm and larger. Usually, microfiltration is a low-pressure process, typically operating at pressures ranging from 0.34 - 3 bar[1]. Microfiltration allows separation of particles such as yeast, protozoa, large bacteria, organic and inorganic sediments etc. Then, as used herein, the term *"ultrafiltration"* designates a membrane filtration technique for the retention of particles having size of about 0.01 μm and larger. Ultrafiltration usually retains particles having molecular weight greater than 1000 Dalton, such as most viruses, proteins of certain sizes, nucleic acids, dextrins, pentosan chains ect. Typical operating pressures for ultrafiltration range from 0.48 - 10 bar. Further, as used herein the term *"nanofiltration"* shall be understood as a membrane filtration technique for the retention of particles having size of 0.001 μm to 0.01 μm and larger. Nanofiltration is capable of retaining divalent or multivalent ions, such as divalent salts, and most organic compounds larger than appox. 180 Dalton, which include oligosaccharides and many flavour compounds; while allowing water, ethanol, monovalent ions, and some organic molecules such as many aromatic esters pass through. Operating pressures of 8 - 41 bar are typical for nanofiltration. Where nanofiltration is operated under inlet pressure within the upper end of this range, from 18 bar above, as used herein, it shall be termed *"high pressure nanofiltration"*. Lastly, as used herein the term *"reverse osmosis"* shall be understood as referring to a high-pressure membrane process where the applied pressure is used to overcome osmotic pressure. Reverse osmosis usually allows to retain particles having size of 0.00005 μm to 0.0001 μm and larger, i.e. almost all particles and ionic species. Substances with molecular weight above 50 Dalton are retained almost without exception. Operating pressures are typically between 21 and 76 bar, but may reach up to 150 bar in specific applications.

[1] Wherein the unit bar equals 100,000 Pa, in accordance with the definition of IUPAC, [1 Pa = 1 N/m^2 = 1 kg/m*s^2 in SI units.]

[0022] Further, as used herein the term *"volatile flavour components"* shall be understood as any of the substances comprised in beer that contribute to its complex olfactory profile, said substances by their chemical nature having a boiling point lower than that of water. Examples of volatile beer flavour components include but are not limited to acetaldehyde, N-propanol, ethyl acetate, isobutyl alcohol, isoamyl alcohol, isoamyl acetate, ethyl hexanoate, ethyl octanoate, phenylethyl alcohol, 2-methyl-1-butanol and many more.

DETAILED DESCRIPTION OF THE INVENTION

[0023] The present invention concerns a method for the production of a beer or cider concentrate, said method comprising the steps of:

a) Subjecting beer or cider (1) to a first concentration step comprising ultrafiltration (A) to obtain a retentate (2) and a fraction comprising alcohol and volatile flavour components (3), wherein the retentate (2) is characterised by the concentration of unfilterable compounds equal to or higher than 20% (w/w), preferably 30% (w/w), most preferably 40% (w/w), as calculated from density measurement corrected for the alcohol amount;

b) Subjecting the fraction comprising alcohol and volatile flavour components (3) to a next concentration step (B) comprising freeze concentration; nanofiltration, adsorption or reverse osmosis, to obtain a concentrated fraction comprising alcohol and volatile flavour components (4) and a leftover fraction (5).

[0024] In general, beer (1) subjected to ultrafiltration (A) according to the invention is preferably clear beer that was treated using any regular beer clarification technique to remove yeast and most of the other particles above 0.2 μm in diameter. Such techniques are standard and well known in the art of beer preparation. For example,

they include centrifugation, filtration through e.g. kieselguhr (diatomaceous earth) optionally preceded by centrifugation, or other types of standard microfiltration techniques.

[0025] As can be appreciated from the present disclosure, the method of the invention is particularly advantageous for obtaining low-volume high-density beer or cider concentrates with limited or ideally no loss of volatile flavour components. The degree of concentration of the final product largely depends on the degree of concentration of the retentate obtained via nanofiltration in step B). Therefore, the present invention provides a method wherein the retentate not only comprises majority of beer (or cider) flavour components but also can potentially be characterised by a high concentration factor of 5, 10, 15, or even 20 or higher.

[0026] A used herein the term *"concentration factor"* shall be understood as the ratio of the beer or cider volume subjected to ultrafiltration in step A) to the volume of the obtained retentate at the end of the ultrafiltration in step a), i.e. the ration of the feed volume to the volume of the retentate obtained in the step a) of the method of the present invention. In an particularly preferred embodiment, a method in accordance with the previous embodiments is provided, wherein the retentate obtained in step a) is characterised by concentration factor of 5 or higher, preferably 10 or higher, more preferably 15 or higher, most preferably 20 or higher. A relationship between the concentration factor within the above-defined meaning, and the concentration of unfilterable compounds possible to be obtained in the retentate from step a) naturally depends on the type of beer or cider initially subjected to ultrafiltration, which is shown and can be appreciated from in the graph presented in Figure 3, wherein each line represents a different beverage (lines 1-4 were obtained for different beers, line 5 obtained for cider)

[0027] In case of cross-flow filtration we can always achieve the concentration one pass. But to make the operation more economical multi stages operation is done.

[0028] In line with the above, the present invention is based on the finding that by concentrating the beer in a first concentration step comprising ultrafiltration, allows for a high concentration factor, yet at the cost of loss of some extract and volatile flavour components.

[0029] After the ultrafiltraton step, the highly concentrated retentate (2) is collected while the aqueous permeate (3) is processed by either nanofiltration, reverse osmosis, freeze concentration or adsorption in order to selectively retrieve volatile flavour components and optionally ethanol.

[0030] The permeate of the first concentration step by ultrafiltration may be subjected to a fractionation, preferably distillation prior to feeding it to the next concentration step, thereby allowing using specific concentration processes for the extract recovery and the volatile flavour recovery.

[0031] Figure 1 schematically illustrates a scheme of the method according to the present invention wherein a beer (1) is subjected to a first concentration step comprising ultrafiltration (semi-permeable membrane acting as physical barrier to passage of most beer components of mean molecular weight (MW) > 1000 Da) to obtain a retentate (2) comprising concentrated extract of the beer and a permeate (3) mainly comprising water and ethanol, yet also comprising a an amount of volatile flavour components and some extract. The permeate is subsequently processed by nanofiltration or reverse osmosis to recover extract and volatile flavour components that can be added to the retentate (2) of the ultrafiltration or can be used as an ingredient for beer or cider, as a component in beer or cider reconstitution or as a flavour component to be added to a beer or cider. The permeate (5) of the nanofiltration or reverse osmosis step (B) is preferably recirculated to the feed of the ultrafiltration step (A) as such recirculating alcohol and volatile flavour components.

[0032] Figure 2 schematically illustrates a scheme of an alternative method according to the present invention wherein a beer (1) is subjected to a first concentration step comprising ultrafiltration (semi-permeable membrane acting as physical barrier to passage of most beer components of mean molecular weight (MW) > 1000 Da) to obtain a retentate (2) comprising concentrated extract of the beer and a permeate (3) mainly comprising water and ethanol, yet also comprising a an amount of volatile flavour components and some extract. The permeate is subsequently processed by fractionation step (C), preferably distillation. The fractionation allows obtaining a fraction (7) comprising ethanol and volatile flavour components and a leftover fraction (8) comprising water and potentially beer or cider extract. On the one hand, the fraction (7) comprising ethanol and volatile flavour components can in that case be fed to a next concentration (B') step comprising adsorption, wherein the volatile flavour components are selectively adsorbed on a column and subsequently eluted in a volume of water or ethanol to obtain a concentrated fraction of volatile flavour components (9). The left-over fraction (8) of the fractionation step on the other hand, can be subjected to a next concentration step (B") comprising freeze concentration to obtain a concentrated extract fraction (10).

[0033] Both the extract fraction (10) obtained from freeze concentration as the concentrated volatile flavour fraction (9) can, independently of one another, be added to the retentate of the ultrafiltration or can be used as an ingredient for beer or cider, as a component in beer or cider reconstitution or as a flavour component to be added to a beer or cider.

[0034] The distillation mentioned above is a classic example of a fractionation technique known to be particularly suited for separating alcohol and volatile component from water. The term *"distillation"* as used herein refers to the separation of the liquid mixture into the components thereof by utilising the difference in relative volatility and/or boiling point among the components by inducing their successive evaporation and condensation in the

process of heating and cooling. Examples of the distillation may include simple distillation, fractional distillation, multistage distillation, azeotropic distillation, and steam distillation. In a preferred embodiment, a method of the invention is provided wherein the concentration in step b) comprises aromatic distillation, said distillation defined as distillation configured to ensure high retrieval of aroma-producing compounds. Figure 2 shows a specific embodiment of the general method according to the invention, wherein the second concentration (B) is performed by fractional distillation, as schematically illustrated by the presence of fractionating column.

[0035] Distillation forms part of a larger group of separation processes based on phase transition, collectively termed as *"fractionation"*. Other examples of fractionation comprise column chromatography that is based on difference in affinity between stationary phase and the mobile phase, and fractional crystallization and fractional freezing both utilising the difference in crystallisation or melting points of different components of a mixture at a given temperature. In an advantageous arrangement of the present invention, method b) may comprise such fractionation, preferably distillation, arrangement, wherein different fractions are analysed for the presence of different components such as different volatile flavour component species and then selectively directed for pooling with the retentate from step a) or discarded, which would provide greater control over aroma profile of the final beer concentrate of the invention.

Claims

1. A method for preparing beer concentrate, comprising the steps of:

   a) Subjecting beer or cider (1) to a first concentration step comprising ultrafiltration (A) to obtain a retentate (2) and a fraction comprising alcohol and volatile flavour components (3), wherein the retentate (2) is **characterised by** the concentration of unfilterable compounds equal to or higher than 20% (w/w), preferably 30% (w/w), most preferably 40% (w/w), as calculated from density measurement corrected for the alcohol amount;
   b) Subjecting the fraction comprising alcohol and volatile flavour components (3) to a next concentration step (B) comprising freeze concentration; nanofiltration, adsorption or reverse osmosis, to obtain a concentrated fraction comprising alcohol and volatile flavour components (4) and a leftover fraction (5).

2. The method according to claim 1, comprising recirculating at least part the permeate of the nanofiltration or the reverse osmosis to the feed of the first concentration step.

3. The method according to claim 1 or 2, wherein the permeate of the first concentration step is subjected to a fractionation prior to the next concentration step (B), said fractionation providing a left-over fraction (5) mainly comprising water and a fraction (6) comprising ethanol and volatile flavour components.

4. The method according to claim 3, wherein the fraction (6) comprising ethanol and volatile flavour components (4) obtained form the fractionation process is subjected to the next concentration step (B) comprising an adsorption process, adsorbing at least part of the volatile flavour components from the fraction (6) and subsequently eluting the adsorbed volatile flavour components in a volume of water or ethanol to obtain a concentrated fraction of volatile flavour components.

5. The method according to claims 3 or 4, wherein the left-over fraction obtained from the fractionation process is subjected to the next concentration step (B) comprising freeze concentration to obtain a concentrated extract fraction.

6. Use of a fraction comprising volatile flavour components or of a concentrated fraction comprising volatile flavour components obtained by a method as identified in any of claims 1 to 4 as an ingredient for beer or cider, as a component in beer or cider reconstitution or as a flavour component to be added to a beer or cider.

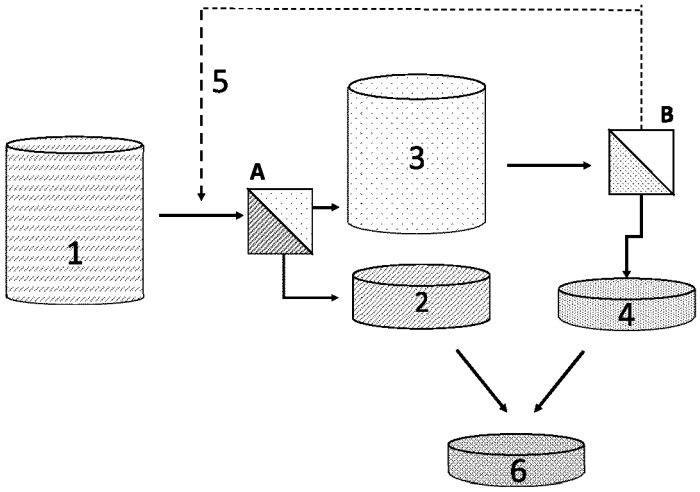

Fig. 1

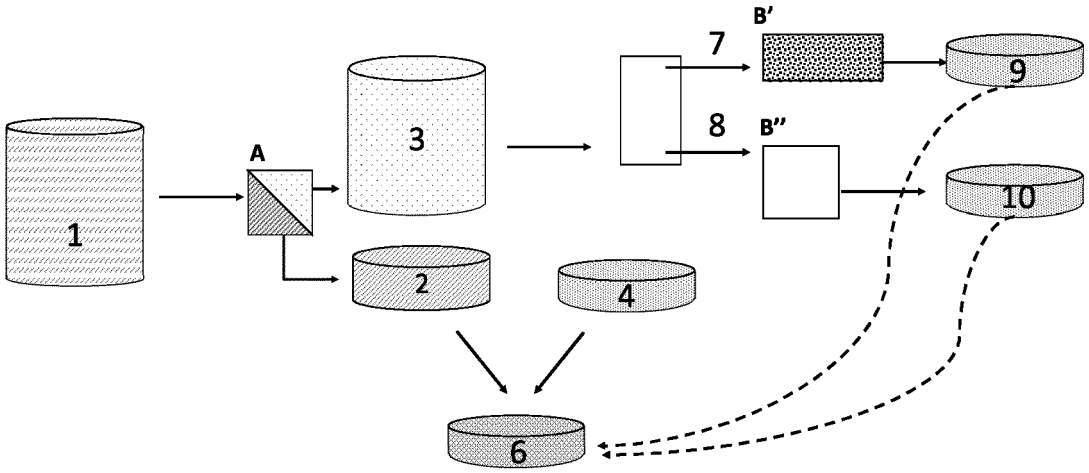

Fig. 2

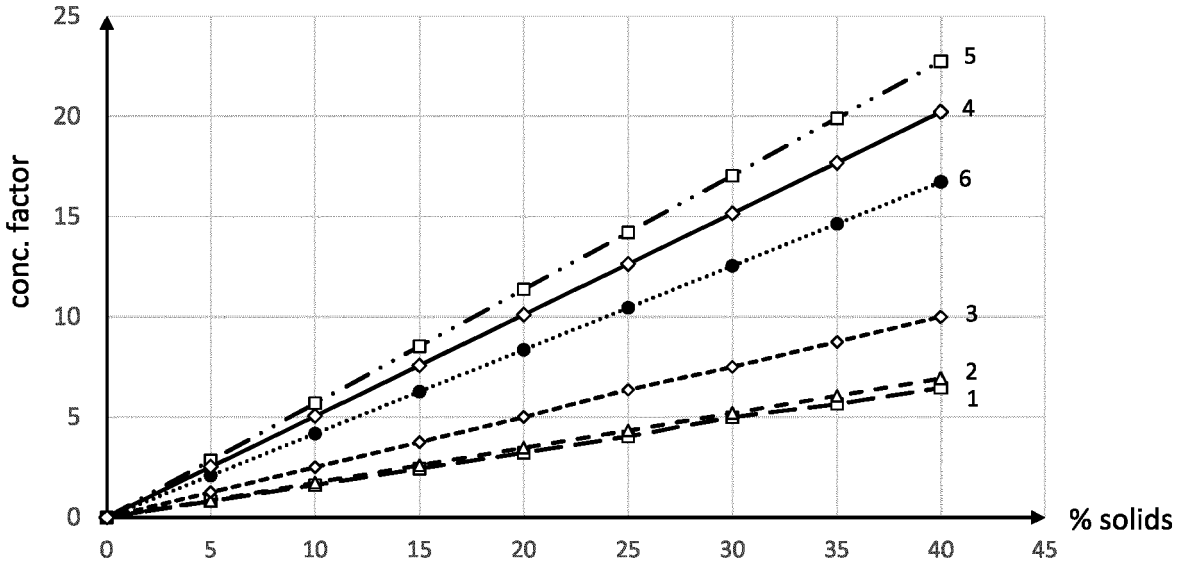

Fig. 3

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 16 20 1535

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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