

PROCESS FOR THE MANUFACTURE OF AN ALCOHOLIC BEVERAGE

FIELD OF THE INVENTION

The invention relates to the technical field of processes for the manufacture of alcoholic beverages. In particular, the invention relates to extraction processes for the manufacture of flavoured alcoholic beverages.

BACKGROUND OF THE INVENTION

Flavour and fragrance materials originating from natural resources have been documented for thousands of years. The global market within this industry was estimated at the end of 2018 to be in excess of 50 billion US dollars. Meanwhile, the global alcoholic beverage market itself is estimated to be worth in excess of 1.5 trillion US dollars.

Flavoured spirits are an increasingly popular beverage. Flavoured spirits may be drunk neat without the addition of diluting components such as mixers or they may be drunk when combined with mixers (for example, the combination of flavoured gins with tonic).

Within the alcoholic beverage industry, the production of flavoured spirits frequently require long maceration times that can often approach a year. Maceration is the process of leaving fruit in alcohol for a long period of time. Often, the alcohol is then distilled afterwards. Long maceration times lead to an inability to respond to changing demand, increased storage costs, alcohol duty costs if not suspended, and ingredient costs, that can all lead to significant restraints on business. A process to produce flavoured alcoholic beverages in reduced time without sacrificing quality has long been considered desirable.

Whilst flavoured alcoholic beverages can be produced using synthetic aroma molecules, there is an increasing concern regarding synthetic aroma molecules, in part due to the rise in allergies and increased public awareness. Thus, the alcoholic beverage industry is increasingly focused upon the extraction of natural flavours for use in beverages.

The ability of using fresh produce in bars and restaurants to produce flavoured alcoholic beverages is challenging, which has led to the adoption of expensive lab grade equipment such as high speed centrifuges and rotary evaporators to solve this problem. However, the

costs of acquiring necessary specialist equipment and the additional preparation time associated, make utilising existing drink techniques unattainable for many professionals. When bartenders are heavily reliant on alcoholic beverages produced elsewhere, creativity is severely limited. This has even led to the development of several businesses that rent out space with specialised equipment in, demonstrating a clear desire for a solution even when inconvenient.

Where fresh ingredients are used in bars and restaurants, rapid deterioration of the ingredients frequently results in food wastage. This is not only undesirable for sustainability, but also contributes to the costs of a business and increases the risk of using more expensive ingredients. In addition, the requirement to process fresh produce at the point of order increases service time, thus reducing sales in a given time period and increasing staff requirements.

Therefore, a process to take ingredients and easily extract flavour into a suitable medium for beverages, whilst in a typical restaurant, bar or kitchen environment, is still a desire that has otherwise not been achieved. In addition, the ability to capture the highest quality aroma materials has always been a desire within the fragrance industry and has led to the development of different techniques to try and achieve this.

Various processes have been developed in the art that attempt to effectively extract flavours and aromas from natural ingredients into alcohol so as to form flavoured alcoholic beverages.

An existing process involves the blending of fruit and liquor with pectin enzymes at room temperature. The blending causes the temperature of the solution to heat up to above 36°C. The enzymes help break down the structural polymer pectin present in the fruit. After blending, the solution is subjected to centrifugation at a force of 4000g for around 10 to 15 minutes in order to separate solids from liquids. Flavours from the fruit are dissolved in the liquor.

Another process involves adding alcohol with an ethanol content of 75% ABV to a thin juice such as a fruit juice at room temperature, followed by gentle mixing to aggregate pectin present in the juice and create a transparent liquid that can then be separated from the aggregated solids. The transparent liquid is the alcohol containing some flavour molecules extracted from the juice.

Another process is also known in which cellular material such as fruit and a liquid are sealed in a vessel, before rapid pressure changes are induced. In the process, the liquid and cellular material are placed under high dinitrogen monoxide pressure which increases intercellular dinitrogen monoxide concentration. Rapid decompression is then applied which causes the dinitrogen monoxide to rupture the cells, causing intracellular flavour molecules to be released into the liquid.

It is also known to extract flavour from cellular material by contacting the cellular material with alcohol and vacuum sealing the mixture. Flavour molecules are then extracted from the cellular material into the alcohol. However, such extractions are performed at temperatures above 5°C and typically with the application of heating to temperatures as high as 65°C. Higher temperatures are generally encouraged since they increase the rate at which the flavour molecules are extracted from the cellular material by the ethanol, and thus minimise the required extraction time period.

Another process involves blending herbs in alcohol at room temperature. The blending increases the surface area of the herbs increasing the efficiency of extraction of the flavour molecules from the herbs into the alcohol. The blended solution is then strained to remove solids and provide the flavoured alcoholic beverage.

Another process involves using liquid nitrogen to freeze herbs. The freezing renders the herbs brittle such that they can be shattered easily by a mortar into a large surface area. Room temperature alcohol is then added to the shattered herbs so as to extract flavour from the shattered herbs into the alcohol. The alcohol can then have acids, sugar syrups etc., and water or ice added to it before it is shaken and then strained so as to remove the shattered herbs and provide the alcoholic beverage.

In both the blender process and liquid nitrogen process, the consensus in the art is that the alcohol used in the extraction is as near to room temperature as possible in order to effectively extract the flavour molecules from the herbs within an appropriate time frame (for example within the few minutes it should ideally take to prepare a beverage once ordered). Whilst warmer temperatures would provide an increased extraction rate, warm drinks are obviously not desirable from a taste perspective.

SUMMARY OF THE INVENTION

The present invention is based, in part, on the inventor's appreciation that in the processes discussed above, the quality of the flavours and aromas of the drinks deteriorate both during and after extraction.

Drinks must be served and consumed reasonably quickly after preparation in order to minimise deterioration of flavour. The inventor has appreciated that this phenomenon is rapidly accelerated due to the flavour molecules being degraded by enzymes originating from the cellular material being present in the drink. For example, the blending or shattering processes that are carried out causes flavour-providing molecules that are present in the cellular material to come into contact with enzymes that catalyse and degrade the flavour-providing molecules. It has not been appreciated by the alcoholic beverage industry that when the cellular material is intact, the flavour-providing molecules and enzymes that degrade them are typically found within different organelles of the cell and so do not come into contact with one another. The processes discussed above such as blending typically cause cell lysis meaning that the structure of the cell and its organelles are broken down. This causes the flavour-providing molecules to be brought into contact with the various enzymes that degrade them. The enzymes thus quickly catalyse reactions with flavour-providing molecules causing flavours present to deteriorate. Accordingly, the flavour experienced by a consumer of flavoured alcoholic drinks is often not completely representative of the true flavour of the cellular material from which the flavour has been extracted.

Traditions of resting spirits in wooden barrels, in addition to the association between age and price, has led to dogma that spirits improve with age.

Appreciating the above-mentioned problems, the inventor has devised a process that alleviates said problems. Specifically, the inventor has appreciated the phenomenon of cold denaturation of proteins where cold temperatures cause a change in the conformational shape of the proteins. Enzymes are proteins that are heavily reliant on their conformational structure to effectively catalyse reactions of their substrates. Small changes in the enzyme structure can mean that their ability to catalyse reactions is destroyed or impeded. Accordingly, the inventor has appreciated that cold temperatures can be used to denature and alter the structure of the enzymes present in the cellular material, meaning that they are impeded or prevented from catalysing reactions of flavour-providing. Accordingly, when enzymes are brought into

contact with their flavour-providing or colour-providing molecule substrates, the flavour-providing or colour-providing molecules are not catalysed or degraded, or the extent to which they are catalysed or degraded is severely reduced.

According to a first aspect of the invention, there is thus provided a process for the manufacture of an alcoholic beverage, wherein the process comprises the following steps carried out in sequence:

- (a) forming an extraction mixture with an ethanol concentration of 20% or more by weight of ethanol by contacting a liquid extractant comprising from 21% to 100% by weight of ethanol with cellular material in a mass ratio of at least 1:4, thereby forming an extraction mixture;
- (b) reducing in size the cellular material present in the extraction mixture at a temperature of from -114°C to 5°C;
- (c) optionally, maintaining the extraction mixture at a temperature of from -114°C to 0°C for a time period of from 15 minutes to 5 years; and
- (d) separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage; or separating a portion or all of the cellular material from the extraction mixture and optionally further treating the extraction mixture thereby providing the alcoholic beverage.

The cellular material can comprise any suitable organism or component or extract thereof, for example, any organism that is edible and that comprises flavour-providing molecules. Suitably, the one or more organisms comprise one or more multicellular organisms. However, single-celled organisms such as yeast may also be used. It is preferable that the one or more organisms comprise one or more plants, although fungi such as mushrooms may also be used. Preferably, the one or more organisms comprise one or more plants. Most preferably, the one or more organisms comprise one or more edible fruits, vegetables, herbs or spices. Examples of organisms that can be used include berries such as strawberries, raspberries and blueberries. Fruits such as mangoes, apples, bananas, peaches, pears, plums, oranges, nectarines, grapes, cherries, lemons and limes etc. can also be used. Examples of herbs include basil, thyme and rosemary. Spices such as nutmeg and cloves may also be used. Accordingly, in preferred embodiments, the cellular material comprises one or more edible fruits, vegetables, herbs or spices, or components or extracts thereof.

The term cellular material as used herein encompasses cellular material that is still living, for example living plants. However, the term cellular material as used herein also encompasses dead cellular material such as a plant or other organism component or extract. For example, the term cellular material covers living intact organisms such as a whole plant or freshly obtained plant component. However, the term cellular material also covers components of plants that may cease to be living prior to collection such as the outer bark of an oak tree or cease to be living after collection, and also cellular material that has been further treated or processed such as drying (for example in the case of spices).

Preferably, the cellular material comprises at least 50% by weight of dead or alive intact cells. For example, the cellular material may comprise at least 60% by weight, at least 70% by weight, at least 80% by weight, or at least 90% by weight of dead or alive intact cells. More preferably, the cellular material comprises at least 75% by weight of dead or alive intact cells. Most preferably, the cellular material comprises at least 90% by weight of dead or alive intact cells.

Alternatively, as discussed in further detail below, the cellular material may be subjected to partial lysis prior to contacting step a), for example, in the embodiments where cellular material is juiced or pulped and separated into a solid pulp fraction and a liquid fraction. In such embodiments, the cellular material used in contacting step a) may have a lower percentage by weight of dead or alive intact cells than the amounts discussed above.

In some embodiments (such as in embodiments where the cellular material is subjected to lysis prior to contacting step a)), the cellular material used in contacting step a) preferably comprises cells that have not been heated above 50°C during lysis and either have been (i) lysed within 4 hours of the contacting in step a) or (ii) frozen after lysis and remain frozen until contact with the extractant in step a). Alternatively or additionally, in some embodiments, preferably, the cellular material used in contacting step a) comprises at least 50% by weight of solid material on contact with the extractant in step a). For example, in these embodiments, the cellular material used in contacting step a) may comprise at least 50% by weight, at least 60% by weight, at least 70% by weight, at least 80% by weight, or at least 90% by weight of solid material on contact with the extractant in step a). In some embodiments, the cellular material comprises at least 75% by weight of solid material, and more preferably at least 90% by weight of solid material on contact with the extractant in step a), and the cellular material used in contacting step a) comprises cells that have not been

heated above 50°C during lysis and either have been (i) lysed within 4 hours of the contacting in step a) or (ii) frozen after lysis and remain frozen until contact with the extractant in step a). The term solid material as used in the present paragraph is used in reference to the macroscopic rheological properties of the material, and not in reference to the dry weight of the material. For example, in some instances, a solid pulp fraction obtained by juicing of cellular material into solid and liquid fractions, may contain high amounts of water, but will appear macroscopically to be a solid, due in part to water being bound by polymers. For the purposes of the present paragraph, said solid pulp fraction is referred to as solid material.

In the process of the invention, the inventor has found that whilst the cold temperatures used in the extraction process effectively prevent or inhibit flavour-providing molecules from being catalysed by enzymes due to the cold temperature denaturing and lowering the activity of the enzymes from the cellular material, the rate of extraction of the flavour-providing molecules from the cellular material into the liquid extractant is reduced due to the cold temperature. Higher temperatures are better at increasing the rate of extraction and thus minimising the time period necessary for an effective extraction to occur. It has been found that the problem of the low reaction rate and extraction speed can be alleviated by reducing the cellular material in size so as to increase its surface area. The increased surface area thus reduces the time period necessary for an effective extraction, alleviating the problems associated with lower temperature use.

Accordingly, as discussed above, the process comprises step b) of reducing the size of the cellular material. This step comprises size reduction between contacting step a) and optional step c) of maintaining the extraction mixture at a temperature of from -114°C to 0°C for a time period of from 15 minutes to 5 years. In addition to step b), the process may further comprise reducing the size of the cellular material prior to step a).

Step b) may comprise reducing the size of the cellular material so as to comprise particles with a smallest dimension of 5mm or less, preferably 2 mm or less.

Preferably, step b) may comprise lysing the cellular material so as to comprise lysed cells. Typically, at least 25% of cells present in the cellular material are lysed, preferably wherein at least 50% of the cells present, more preferably at least 75% of the cells present, and most preferably at least 90% of the cells present are lysed.

Typically, step b) comprises reducing the size of the cellular material at a temperature of from -114°C to 5°C, preferably from -114°C to 0°C, more preferably from -35°C to 0°C, even more preferably from -35°C to -5°C and most preferably from -35°C to -10°C.

Typically, step b) comprises blending the cellular material. Preferably, the blending is performed for a short period of time only such as for less than 1 minute and preferably for less than 30 seconds. Shorter blending periods are preferable since they are effective to lyse or reduce the size of the cellular material but they are not so long that polymers such as pectin are damaged significantly. Polymers such as pectin have been found to provide a greater clarity to the alcoholic beverage product.

Typically, the liquid extractant is at a temperature of from -114°C to 5°C, preferably from -114°C to 0°C, more preferably from -35°C to -5°C and most preferably from -35°C to -10°C upon contact with the cellular material in step a). Preferably, the liquid extractant and the cellular material are at a temperature of from -114°C to 0°C, preferably from -35°C to -5°C and more preferably from -35°C to -10°C upon contact in step a).

The advantage of performing steps a) and b) at the low temperatures discussed above is that the lysed cellular material is maintained at a cold temperature so as to minimise interactions between the flavour providing molecules and enzymes that have been brought into contact by the lysis.

Typically, the cellular material is already frozen upon contact with the liquid extractant in step a), or frozen during step a). Preferably, the cellular material is already frozen upon contact with the liquid extractant in step a). This step has been found to be highly preferable for a variety of reasons. When polymeric molecules exist within a cell they typically are bound by water molecules in the form of a solvation/hydration shell. Freezing of cellular material prior to extraction has been found to aid in the full or partial removal of the hydration shell from the polymers increasing their precipitation within the cell. This reduces the binding of flavour molecules and the ethanol extraction solvent with cellular polymers, thus increasing the efficiency of the extraction. Freezing the cellular material prior to extraction thus has been found to improve flavour concentration and process yields and reduce costs. The freezing also results in a more brittle structure of the cellular material which minimises fibrous material from the cellular material wrapping around the rotary shaft of blending equipment which creates an operational deficiency. Additionally, it has been found that freezing the cellular

material prior to extraction results in a more efficient separation step d). For example, when the extraction mixture is filtered, where the cellular material has been frozen beforehand, liquid has been found to drain from the extraction mixture more efficiently than when not. When not frozen beforehand, the cellular material has a more hydrated polymer network which is harder for liquid to drain from.

As discussed above, additionally to step b), and prior to contacting step a), the cellular material may be reduced in size, optionally, wherein the cellular material is lysed, so as to comprise lysed cells, and optionally wherein at least 25% of cells present in the cellular material is lysed, preferably wherein at least 50% of the cells present, more preferably at least 75% of the cells present, and most preferably at least 90% of the cells present are lysed.

The liquid extractant used in the process comprises from 21% to 100% by weight of ethanol. Preferably, the liquid extractant comprises from 40% to 100% by weight of ethanol, more preferably from 60% to 100% by weight of ethanol, and most preferably from 80% to 100% by weight of ethanol. In preferable embodiments, the liquid extractant further comprises water. The high concentration of ethanol in the liquid extractant has been found to be advantageous for a variety of reasons. Firstly, a higher concentration of ethanol in the liquid extractant means that the liquid extractant has a depressed freezing point in comparison to extractants that comprise higher amounts of water. The depressed freezing point means that the extraction can be carried out at yet lower temperatures, meaning that the beneficial effects associated with low temperature discussed above can be more effectively realized. Additionally, it has been found that using a higher alcohol content (for example, even higher than what is required for effective freezing point suppression) reduces the polarity of the liquid extractant. This has been found to cause increased precipitation of undesired molecules from the extraction mixture that might otherwise be dissolved at a lower alcohol content. For example, after blending and lysing of cellular material, many molecules such as various biological molecules that do not contribute to the flavour of the extraction mixture may be present therein. The higher ethanol concentration causes many of said molecules to be precipitated from the extraction mixture before agglomerating. This means that said molecules can be removed by simple filtration during the separation step d), which is advantageous when said molecules are undesirable to be present in the alcoholic beverage.

The liquid extractant and the cellular material are contacted in a mass ratio of at least 1:4. Typically, the liquid extractant and cellular material are contacted in a mass ratio of from 1:4

to 9999:1. The particular weight ratio of components to use for a given extraction will be dependent upon the particular cellular material used in the extraction. For example, in the cases of dried spices such as nutmeg or cloves, a very low weight ratio of cellular material to liquid extractant would typically be used. In the case of, for example fruits, higher weight ratios would typically be used.

The extraction mixture formed comprises 20% or more by weight of ethanol. Typically, the extraction mixture comprises from 20% to 99.99% by weight of ethanol. Preferably, the extraction mixture comprises from 20% to 99% by weight of ethanol. More preferably, the extraction mixture comprises from 30% by weight to 99% by weight of ethanol. Still more preferably, the extraction mixture comprises from 40% by weight to 99% by weight of ethanol. Most preferably, the extraction mixture comprises from 55% by weight to 99% by weight of ethanol.

Typically, (i) the liquid extractant comprises from 26% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 25% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of 1:3 to 9999:1. In some embodiments, (ii) the liquid extractant comprises from 31% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 30% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 3:7 to 9999:1. In some embodiments, (iii) the liquid extractant comprises from 36% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 35% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 7:13 to 9999:1.

Preferably, (i) the liquid extractant comprises from 41% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 40% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of 2:3 to 9999:1. In some preferable embodiments, (ii) the liquid extractant comprises from 51% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 50% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 1:1 to 9999:1. In some preferable embodiments, (iii) the liquid extractant comprises from 61% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 60% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 3:2 to 9999:1.

In some embodiments, (i) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 20% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of 1:4 to 9999:1. In some embodiments, (ii) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 25% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 1:3 to 9999:1. In some embodiments, (iii) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 30% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 3:7 to 9999:1. In some embodiments, (iv) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 35% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 7:13 to 9999:1.

More preferably, (i) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 40% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of 2:3 to 9999:1. Still more preferably, (ii) the liquid extractant comprises from 70% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 40% or more by weight of ethanol; and the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 2:3 to 9999:1. Most preferably, (iii) the liquid extractant comprises from 80% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 40% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of at least 2:3 to 9999:1.

In preferable embodiments, the process further comprises step (c) of maintaining the extraction mixture at a temperature of from -114°C to 0°C for a time period of from 15 minutes to 5 years.

Preferably, the maintaining in step c) is carried out for a time period of from 1 hour to 168 hours, preferably from 12 hours to 72 hours, and more preferably from 18 hours to 30 hours.

Preferably, the maintaining in step c) is carried out at a temperature of from -114°C to -5°C, preferably from -80°C to -10°C, more preferably from -60°C to -15°C and most preferably from -35°C to -15°C.

Preferably, the extraction mixture is maintained at a temperature of from -114°C to 0°C for the entirety of the duration of the extraction. In other words, whilst the cellular material is in contact with the liquid extractant in the extraction mixture, the temperature of the extraction mixture does not exceed 0°C at any point.

In some embodiments, where cellular material used in the extractions comprises a low polymer content, polymer additives may be added to the extraction mixture. This is done so as to increase agglomeration of certain substances and thereby, alcoholic beverage clarity. Examples of suitable polymers that may be added include pectin.

Typically, step d) of separating a portion or all of the cellular material from the extraction mixture comprises filtering the extraction mixture. In some embodiments, the filtering step comprises pressing a solid portion of the cellular material present in the extraction mixture during filtering. This may be desirable to speed up the rate at which the liquid passes through the filter, thereby reducing the time period by which heat transfer can occur. Pressing the solid portion has also been found to increase agglomeration and yield. Preferably, the extraction mixture is filtered at a temperature of from -114°C to 5°C, preferably from -50°C to 0°C, more preferably from -35°C to -5°C, and most preferably from -35°C to -10°C. The advantages associated with filtering at these temperatures are the advantages discussed above associated with the use of cold temperature. A further benefit of filtering at these cold temperatures is that certain molecules present in the extraction mixture that do not contribute to the flavour of the beverage are caused to be precipitated as solids prior to filtration. These molecules may be precipitated and suspended in the extraction mixture either due to the cold temperatures used for filtration, or the cold temperatures used in storage step c). These solids can then be removed by filtration increasing the clarity of the alcoholic beverage.

At any stage of the process of the invention, the process may optionally also comprise adding ionic compounds such as salts such as sodium chloride to the extraction mixture, or to the liquid extractant, or to the cellular material. Such a step leads to increased precipitation and agglomeration of certain solids such as polymers that it is desirable to remove from the extraction mixture upon separation. Typically, the ionic compounds are added before step b)

or after step c) of the process. Where the extraction mixture is to be distilled as part of further treatment, the ionic compounds can be effectively separated from the extraction mixture by distillation such that they are not present in the alcoholic beverage.

Typically, further treating the extraction mixture comprises diluting the extraction mixture, wherein the ethanol concentration after dilution is 20% or more by weight of ethanol, preferably 30% or more by weight of ethanol and most preferably 40% or more by weight of ethanol. Preferably, further treating the extraction mixture comprises diluting the extraction mixture with ice, more preferably wherein further treating the extraction mixture comprises blending the extraction mixture with ice; wherein the ethanol concentration after dilution is 20% or more by weight of ethanol, preferably 30% or more by weight of ethanol and most preferably 40% or more by weight of ethanol. Typically, during dilution, the extraction mixture is at a temperature of from -114°C to 5°C, preferably from -50°C to 0°C, more preferably from -35°C to -5°C, and most preferably from -35°C to -10°C. Dilution may be desirable, for example, to achieve a desired alcohol concentration of the alcoholic beverage. Dilution with ice is particularly preferred over dilution with water. For the reasons discussed above, it is desirable to maintain the temperature the beverage as low as possible and to not increase the temperature above 0°C. Ethanol dilution with water is an exothermic process and thus increases the temperature of the extraction mixture. In contrast, dilution with ice causes the temperature of the extraction mixture to fall even lower (lower than the temperature of both the ice and the extraction mixture before dilution) due to the endothermic nature of ice melting. Whilst the melting point of ice is 0°C, the ice can still melt in temperatures lower than this due to the formation of the water/ethanol mixture upon melting which has a lower freezing point. This same mechanism occurs during the step of blending the cellular material discussed above when the cellular material is frozen beforehand, which can help mitigate any temperature increase due to friction caused by the blending.

In some embodiments, the process of manufacture does not comprise a distillation step. It is advantageous to avoid distillation. An advantage of the present invention is that distillation is not required. However, in some embodiments, distillation may still be desirable. Accordingly, in some embodiments, further treating the extraction mixture comprises distilling the extraction mixture to provide the alcoholic beverage, preferably wherein the distillation is carried out under vacuum. Vacuum distillation is preferred since higher temperatures are preferably avoided.

In some embodiments, the process further comprises the addition of carbon dioxide to the extraction mixture, optionally wherein carbon dioxide is added to the extraction mixture in a mass ratio of 1:999 to 999:1 (mass of carbon dioxide: mass of the extraction mixture). The carbon dioxide is used as a cosolvent which modifies the solubility of the flavour-providing molecules in the ethanol. Typically, the carbon dioxide increases the solubility of the flavour-providing molecules in the ethanol. Carbon dioxide is more soluble in ethanol than water, meaning that higher concentrations of carbon dioxide in the ethanol are possible at the same pressure (particularly in view of the high ethanol concentration). This is also helped by the low temperatures used. In some embodiments, step d) of separating a portion or all of cellular material from the extraction mixture comprises blending the extraction mixture after filtering the extraction mixture. The blending may be carried out before, after, or during the dilution step if included. Blending aids in the release of dissolved carbon dioxide from the extraction mixture. The inclusion of carbon dioxide may also be desirable since a small proportion thereof reacts to form carbonic acid which lowers the pH of the extraction mixture, causing increased precipitation and agglomeration of cellular material leading to improved filtration. Carbon dioxide may also aid in reducing oxidation if utilised to displace gaseous oxygen above the extraction mixture, thus changing the oxygen concentration gradient at the liquid-gas interface and thereby the oxygen concentration that may be dissolved within the extraction mixture as the equilibrium shifts.

In some embodiments, it may be desirable to repeat steps c) and d) of the method several times thereby carrying out several extractions with cellular material that has not been previously extracted to increase the concentration of flavour molecules in the final beverage. Accordingly, in some embodiments, carbon dioxide is added to the extraction mixture in the manner described above and in the amounts described above in step a), and steps c) and d) are repeated once or several times more with cellular material that has not been previously extracted. In these embodiments, the extraction mixture in repeated step c) may have additional carbon dioxide added in the manner discussed above. This ensures sufficient carbon dioxide concentration in the extraction mixture.

Typically, the alcoholic beverage is stored after manufacture at a temperature of from -114°C to 5°C, preferably from -50°C to 0°C, more preferably from -35°C to -5°C, and most preferably from -35°C to -10°C, preferably wherein the alcoholic beverage is stored in the absence of oxygen.

In some embodiments, prior to step a), the cellular material is pulped or pressed into a liquid fraction and a solid pulp fraction, wherein the solid pulp fraction is used as the cellular material in step a). This step may be highly preferable when for example, the cellular material comprises a high water content. Prior art extraction processes have been carried out where the organisms are pulped, pressed or juiced into a solid fraction and a liquid fraction. However, in said prior processes, the liquid fraction has been focused upon so as to provide the flavours for the alcoholic beverage. In these processes, the solid pulp fraction is typically considered a waste product of little value and is discarded. The inventor has appreciated that said solid fractions actually contain a great deal of flavour-providing molecules that it is desirable to extract into the alcoholic beverages. This is particularly the case with cellular material that has a high water content such as watermelon. The steps discussed above are useful for reducing the water and sugar content of the cellular material prior to extraction which reduces the water and sugar content of the beverage product. Such steps can also be used to lower the fat content of beverages in the case of cellular material with high fat content such as nuts and olives.

The inventor has also appreciated a problem in the art of the difficulty in accurately determining the water content and hence alcohol concentration of an alcoholic beverage produced by ethanol extraction of flavour molecules from the cellular material. Processes of extracting flavour molecules from cellular material into ethanol typically cause water from the cellular material to end up within the extraction mixture and alcoholic beverage. Given the multicomponent nature of the alcoholic beverage or extraction mixture, the use of simple analytical equipment to determine the water content of the beverage is not possible. Therefore, many alcoholic beverage companies will either invest in highly expensive and complex analytical equipment or send samples off to an external laboratory. Appreciating these problems, the inventor has devised an accurate and simple way of determining the water content of the alcoholic beverages. Based upon that over time, an ethanol extraction will approach an approximate equilibrium water content where water from the cellular material will end up within the extraction mixture, the inventor has appreciated that by knowing the water content of the cellular material, it can be determined how much water from the cellular material ends up within the extraction mixture with a reasonable degree of accuracy. If the initial water content of the ethanol extractant is known, the water and ethanol content of the alcoholic beverage can thus be determined with a reasonable degree of accuracy. This degree of accuracy is further increased by the advantages of cold temperatures and high ethanol

concentration as discussed above to reduce the solvation/hydration shell of polymeric molecules.

Accordingly, the process further comprises determining the water content of the cellular material, or the solid pulp fraction.

Whilst the water content of cellular material can be determined from published data if available, such data will not necessarily be representative of the specific cellular material used in the extraction. Accordingly, in preferred embodiments, determining the water content of the cellular material comprises actually measuring the water content of a sample of the particular cellular material to be used in the extraction. For example, if berries such as raspberries are being used in the extraction, the water content of a representative sample of the raspberries can be determined so as to give an indication of the water content of the other berries present that will be used in the extraction. Traditional scientific methods to determine water content often require long dehydration times and specialist equipment and so are not practical. The inventor has appreciated that the use of a microwave allows the water content to be determined very quickly and easily. A sample can be weighed before it is microwaved. Any change in weight upon microwaving is relative to the water content of the sample that has been lost. Accordingly, the water content of cellular material can be determined easily with a microwave.

Accordingly, in preferred embodiments, the step of determining the water content of the cellular material or the solid pulp fraction comprises microwaving the cellular material or the solid pulp fraction thereby providing microwaved material, and determining the difference in weight between the microwaved material and the cellular material or the solid pulp fraction before microwaving, wherein the difference in weight is indicative of the water content of the cellular material or the solid pulp fraction.

The inventor has further appreciated that the accuracy of the microwave method discussed above for determining water content can be further improved by freezing the cellular material beforehand. Water crystallisation during freezing damages cell structure, improving the ability of water to be lost from the cells upon microwaving. Additionally, the reduction in temperature will reduce the bound water content of cellular molecules meaning said water is more easily lost upon microwave heating. As a result, less energy is required to drive off all water from the cellular material meaning that a faster and more accurate result can be

obtained. By carrying out this method just prior to extraction, a more accurate result can be obtained as any potential moisture loss or excess water that has been introduced to the cellular material (for example, by washing) will be taken into account in the calculation.

Accordingly, in preferable embodiments, the cellular material or the solid pulp fraction are frozen prior to microwaving, optionally wherein the cellular material or the solid pulp fraction have a temperature of from -210°C to 0°C at the start of microwaving.

Once the water content of the cellular material has been determined, if the ethanol concentration of the liquid extractant is known, the ethanol concentration of the extraction mixture or alcoholic beverage product can be easily determined.

Accordingly, preferably, the process further comprises determining the ethanol concentration of the extraction mixture or alcoholic beverage from the determined water content of the cellular material or the solid pulp fraction; and the ethanol concentration of the liquid extractant. In some embodiments, where the liquid extractant is further diluted after separation so as to provide the alcoholic beverage, the methods discussed above can be used to determine the dilution necessary to provide the alcoholic beverage with a specifically desired alcohol content. Accordingly, in some embodiments, further treating the extraction mixture comprises diluting the extraction mixture, preferably wherein further treating the extraction mixture comprises diluting the extraction mixture with ice, more preferably wherein further treating the extraction mixture comprises blending the extraction mixture with ice and wherein the process comprises determining the dilution necessary to provide a desired ethanol concentration of the alcoholic beverage, wherein the determining is based upon the ethanol concentration of the liquid extractant and the determined water content of the cellular material or the solid pulp fraction.

Alternatively or additionally, the methods described above for determining water content can be used to determine the quantity of cellular material to use to achieve a specific alcohol content of the extraction mixture or alcoholic beverage. For example, if the water content by weight of the cellular material is known, and the ethanol content of the liquid extractant is known, the amount of cellular material to be used relative to the amount of liquid extractant can be selected to produce an alcoholic beverage with a desired alcohol and water content.

Accordingly, in some embodiments, the process comprises determining the weight ratio of the cellular material or the solid pulp fraction for use in step a) to the liquid extractant for use in step a) to achieve a desired alcohol concentration of the extraction mixture or alcoholic beverage, wherein the determining is based upon the ethanol concentration of the liquid extractant and the determined water content of the cellular material or the solid pulp fraction.

A further advantage of the process of the invention is that it does not require the addition of enzymes during any steps of the extraction process. Thus, preferably, the process of the invention does not comprise adding additional enzymes or other additives to the extraction mixture, alcoholic beverage, liquid extractant or cellular material at any point. This is in contrast to prior known techniques where enzymes are typically added to catalyse reactions in the extraction mixture or beverage, and where warmer temperatures are applied to increase the reaction rate. The process of the invention can thus produce a beverage without the need to use enzymes and other additives that can be difficult to source, add additional costs and make the product unsuitable for some with dietary requirements.

Typically, the alcoholic beverage produced by the methods of the first aspect of the invention comprises a neutral flavoured alcoholic beverage. Examples of neutral flavoured alcoholic beverages are known in the art and include vodka. The term “neutral flavoured alcoholic beverage” as used herein is used to refer to high alcohol content beverages such as beverages with an alcohol content higher than 25 weight percent, that have not had any additional flavourings added (other than of course, the flavourings imparted to said beverages by the process of the invention). Typically, the alcoholic beverage of the invention, and the liquid extractant for use in the process of the first aspect of the invention are neutral flavoured alcoholic beverages.

According to highly preferred embodiments, the process of the first aspect of the invention comprises a process for the manufacture of an alcoholic beverage, wherein the process comprises the following steps carried out in sequence:

(a) forming an extraction mixture with an ethanol concentration of 20% or more by weight of ethanol by contacting a liquid extractant comprising from 60% to 100% by weight of ethanol with cellular material in a mass ratio of at least 1:4, thereby forming an extraction mixture, wherein the cellular material comprises one or more edible fruits, vegetables, herbs, spices, or components thereof, or a combination thereof;

- (b) reducing in size the one or more edible fruits, vegetables, herbs, spices, or components thereof, or a combination thereof present in the extraction mixture at a temperature of from -114°C to 5°C;
- (c) optionally, maintaining the extraction mixture at a temperature of from -114°C to -5°C, preferably -35°C to -5°C and more preferably -35°C to -15°C for a time period of from 1 hour to 168 hours; and
- (d) separating a portion or all of the one or more edible fruits, vegetables, herbs, spices, or components thereof, or a combination thereof from the extraction mixture thereby providing the alcoholic beverage; or separating a portion or all of the one or more edible fruits, vegetables, herbs, spices, or components thereof, or a combination thereof from the extraction mixture and optionally further treating the extraction mixture thereby providing the alcoholic beverage.

In these highly preferred embodiments, the one or more edible fruits, vegetables, herbs, spices, or components thereof, or a combination thereof are already frozen upon contact with the liquid extractant in step a), or frozen during step a).

Preferably, step b), comprises reducing the size of the one or more edible fruits, vegetables, herbs, spices, or components thereof, or a combination thereof at a temperature of from -35°C to 0°C; the liquid extractant and the one or more edible fruits, vegetables, herbs, spices, or components thereof, or a combination thereof are at a temperature of from -35°C to 0°C upon contact in step a); step d) of separating a portion or all of the cellular material from the extraction mixture comprises filtering the extraction mixture at a temperature of from -35°C to 0°C; and if the process further comprises a step of diluting the extraction mixture or storing the alcoholic beverage after manufacture, the dilution and storage are both carried out at from -35 to 0°C.

Even more preferably, step b) comprises reducing the size of the one or more edible fruits, vegetables, herbs, spices, or components thereof at a temperature of from -35°C to -5°C; the liquid extractant and the one or more edible fruits, vegetables, herbs, spices, or components thereof, or a combination thereof are at a temperature of from -35°C to -5°C upon contact in step a); step d) of separating a portion or all of the cellular material from the extraction

mixture comprises filtering the extraction mixture, at a temperature of from -35°C to -5°C and wherein if the process further comprises a step of diluting the extraction mixture or storing the alcoholic beverage after manufacture, the dilution and storage are both carried out at from -35 to -5°C.

The process may further comprise preparing the alcoholic beverage for consumption. For example, the alcoholic beverage may be placed within a container. In preferable embodiments, the alcoholic beverage is bottled and sealed in a container. More preferably, the alcoholic beverage is bottled and sealed within a container so as to minimise the level of oxygen in the headspace.

In some embodiments, the container comprising the alcoholic beverage has a reduced amount of oxygen present within the headspace of the container. In some embodiments, the headspace of the container comprises less than 15% by volume of oxygen of the total volume of gases present in the headspace. In some embodiments, the headspace of the container is substantially free of oxygen. In some embodiments, the headspace of the container is completely free of oxygen. In some embodiments, at the point in time immediately after the container has been filled with the alcoholic beverage and then sealed, the headspace of the container comprises less than 10% by volume of oxygen of the total volume of gases present in the headspace. In some embodiments, at the point in time immediately after the container has been filled with the alcoholic beverage and then sealed, the headspace of the container comprises less than 5% by volume of oxygen of the total volume of gases present in the headspace. In some embodiments, at the point in time immediately after the container has been filled with the alcoholic beverage and then sealed, the headspace of the container is substantially free of oxygen. In some embodiments, at the point in time immediately after the container has been filled with the alcoholic beverage and then sealed, the headspace of the container is completely free of oxygen.

It is preferable that the headspace of the container is free of oxygen or has a reduced oxygen content since it is believed that any oxygen present will react with flavour-providing molecules present in the beverage and potentially degrade the flavour of the beverage.

In some embodiments, preparing the beverage for consumption further comprises unsealing and opening the container at a temperature below 0°C, and preferably below -10°C. Without being limited by theory, it is believed that when the container is opened and the alcoholic

beverage is exposed to oxygen, the lower temperatures inhibit or impede the degradation reactions involving oxygen that cause the flavour-providing molecules to react or degrade. In some embodiments, the container comprises labelling with instructions stating that the container should be opened at a temperature of less than 0°C, and preferably less than -10°C.

In some embodiments, the process may further comprise, prior to step a), providing the liquid extractant in a container with a total capacity of from 350 ml to 3000 ml, wherein the container comprises a weight x of the liquid extractant such that an addition of 0.16 x of water at atmospheric pressure and 25°C to the container does not cause the container to overflow; and optionally carrying out all or a portion of steps a) and/or c) in the container. In some embodiments, the process may further comprise, after step d), providing the alcoholic beverage in a sealed container with the same total capacity of the container that the liquid extractant is provided in prior to step a). Typically, this container is the same container as the liquid extractant is provided in prior to step a).

In the embodiments described above, where the liquid extractant is provided in the container prior to step a), the container preferably comprises a weight x of the liquid extractant, such that an addition of 0.31 x ; more preferably 0.53 x ; and most preferably 0.83 x of water at atmospheric pressure and 25°C to the container does not cause the container to overflow.

According to a second aspect of the invention, there is provided an alcoholic beverage obtained or obtainable by a process of the invention.

Once the alcoholic beverage of the invention has been manufactured, the beverage can be consumed immediately, or the beverage can be stored. If the beverage of the invention is to be stored before consumption, the beverage is preferably stored at a temperature of less than 5°C, and more preferably below 0°C. The advantages of storage at cold temperature are the same as those discussed above. Any enzymes that have not been removed from the alcoholic beverage at for example separation step remain inactivated or with reduced activity at the cold temperatures and so do not catalyse reactions of the flavour molecules present in the beverage. Accordingly, preferably the beverage is stored at temperatures of less than -20°C.

The beverage can be consumed without further dilution such as by water or other ingredients such as mixers (for example, coca cola, lemonade, tonics etc.). Alternatively, it may be desirable to dilute the alcoholic beverage prior to consumption.

In some embodiments, the alcoholic beverage of the invention may be mixed with oils so as to form a flavoured oil infusion. After separation, this oil can be used in food preparation.

According to a third aspect of the invention, there is provided the use of a liquid extractant comprising from 21% to 100% by weight of ethanol in the extraction of flavour providing compounds from cellular material; wherein the use comprises forming an extraction mixture with an ethanol concentration of 20% or more by weight of ethanol by contacting the liquid extractant comprising from 21% to 100% by weight of ethanol with cellular material in a mass ratio of at least 1:4, thereby forming an extraction mixture; reducing in size the cellular material present in the extraction mixture at a temperature of from -114°C to 5°C; optionally, maintaining the extraction mixture at a temperature of from -114°C to 0°C for a time period of from 15 minutes to 5 years; and (i) separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage, or (ii) separating a portion or all of the cellular material from the extraction mixture and optionally further treating the extraction mixture thereby providing the alcoholic beverage.

Preferably, the use, the liquid extractant, the extraction mixture; or the cellular material are as described above in accordance with the first aspect of the invention.

The term flavour providing molecule or flavour providing compound as used herein is used to refer to the organic molecules present in cellular material that give the cellular material a particular flavour and/or aroma. Such molecules are typically referred to in the art as aroma molecules. Accordingly, the flavour providing molecules preferably comprise aroma molecules. In order to provide a particular flavour or aroma, molecules generally need to be sufficiently volatile so as to be transported to the olfactory system in the upper nose and detected as a flavour or smell. As such, such molecules typically have low molecular weights such as molecular weights of less than 300. Accordingly, in preferable embodiments, the flavour providing molecules comprise aroma molecules with molecular weights of less than 300.

According to a fourth aspect of the invention, there is provided a process for manufacturing an alcoholic beverage with a desired alcohol concentration (w), wherein the process comprises:

- i) determining the water content (x) of cellular material;

- ii) providing a liquid extractant comprising ethanol, with an ethanol concentration (y); and
- iii) either (a) contacting the cellular material and liquid extractant in a weight ratio (z) thereby forming the alcoholic beverage with the desired alcohol concentration (w), wherein the weight ratio (z) is selected based upon the determined water content (x) and the ethanol concentration (y), and wherein the weight ratio (z) is selected to provide the desired alcohol concentration (w) of the alcoholic beverage;
- (b) contacting the cellular material and liquid extractant in a weight ratio (z) thereby forming an extraction mixture, wherein the weight ratio (z) is selected based upon the determined water content (x) and the ethanol concentration (y), and wherein the weight ratio (z) is selected to provide the desired alcohol concentration (w) of the alcoholic beverage; and separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage with a desired alcohol concentration (w);
- (c) contacting the cellular material and liquid extractant in a weight ratio (z) thereby forming an extraction mixture; and adding one or more additional substances to the extraction mixture in a weight ratio (v) to provide the alcoholic beverage with alcohol concentration (w); wherein the weight ratio (v) is selected based upon the determined water content (x), the ethanol concentration (y) and the weight ratio (z), and wherein the weight ratio (v) is selected to provide the desired alcohol concentration (w) of the alcoholic beverage; or
- (d) contacting the cellular material and liquid extractant in a weight ratio (z) thereby forming an extraction mixture; separating a portion or all of the cellular material from the extraction mixture; and adding one or more additional substances to the extraction mixture in a weight ratio (v) to provide the alcoholic beverage with alcohol concentration (w); wherein the weight ratio (v) is selected based upon the determined water content (x), the ethanol concentration (y) and the weight ratio (z), and wherein the weight ratio (v) is selected to provide the desired alcohol concentration (w) of the alcoholic beverage.

Preferably, the one or more additional substances in steps (c) and (d) comprise water, sugar, salt, acid or a combination thereof. Preferably, the one or more substances comprise water.

In embodiments of the process where steps (c) and (d) are carried out, whilst it is preferable, it is not essential that determining step i) of the method is carried out prior to contacting the

cellular material one or more organisms or components or extracts thereof and liquid extractant in a weight ratio (z). For example, after the contacting in weight ratio (z), a separate sample of the cellular material that has not been used in the contacting can be used for the determination of water content. After the determination of the water content of the cellular material, the extraction mixture can then have an additional substance such as water added thereto in a weight ratio (v) in order to provide the alcoholic beverage with desired ethanol concentration (w). The weight ratio (v) as described herein thus refers to the weight ratio of the one or more additional substances to the weight of the extraction mixture to which it is added.

According to a fifth aspect of the invention, there is provided a process for manufacturing an alcoholic beverage comprising:

- (a) determining the water content of cellular material;
- (b) (i) contacting the cellular material with a liquid extractant comprising from 20% to 100% by weight of ethanol thereby forming an extraction mixture; and separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage; or
(ii) contacting the cellular material with a liquid extractant comprising from 20% to 100% by weight of ethanol thereby forming the alcoholic beverage; and
- (c) determining the alcohol concentration of the alcoholic beverage based upon the water content of the cellular material and a water content of the liquid extractant.

In some embodiments, steps a) to c) of the process are carried out consecutively. However, this is not essential. In some embodiments, steps a) and c) may be carried out after or during step b). In such embodiments, the water content of the cellular material used in the process is determined and this determination is then used to determine the alcohol content of the alcoholic beverage. For example, several pieces of fruit (for example, grapes, strawberries, raspberries etc.) can be used in contacting step b). Separate pieces of fruit in the form of a representative sample, such as grapes or raspberries etc. can then be used in determining step a), and then this determination can be used to determine the alcohol concentration of the alcoholic beverage formed in step b).

Preferably, the processes of manufacture of the fourth and fifth aspects of the invention are as described above in accordance with the first aspect of the invention. The steps of determining are also as described above in accordance with the first aspect of the invention.

Prior to the step of determining the water content of cellular material, the cellular material may be pulped or pressed into a liquid fraction and a solid pulp fraction, and the solid pulp fraction may be used as the cellular material component or extract in step a) of determination.

Preferably, the step of determining the water content of the cellular material or the solid pulp fraction comprises microwaving the cellular material or the solid pulp fraction thereby providing microwaved material, and determining the difference in weight between the microwaved material and the cellular material or the solid pulp fraction beforehand, wherein the difference in weight is indicative of the water content of the cellular material or the solid pulp fraction. Preferably, the cellular material or the solid pulp fraction are frozen prior to microwaving, optionally wherein the cellular material or the solid pulp fraction have a temperature of from 210°C to 0°C at the start of microwaving.

In the processes of the fourth and fifth aspect of the invention, the alcoholic beverage may be further diluted so as to provide a desired alcohol concentration of the beverage. Preferably, diluting the alcoholic beverage comprises diluting the alcoholic beverage with ice, and more preferably wherein further treating the alcoholic beverage comprises blending the alcoholic beverage with ice. The process may comprise determining the dilution necessary to provide a desired ethanol concentration of the alcoholic beverage. Alternatively or additionally, the processes may comprise the addition of one or more substances such as sugar to the alcoholic beverage. In some embodiments, the amount of sugar added is based upon the determined alcohol concentration of the alcoholic beverage.

The ability to determine the alcohol by weight of an alcoholic beverage or to provide an alcoholic beverage with a particular desired alcohol by weight content has been found by the inventor to be particularly beneficial for carrying out the separation step by filtration in the process of the invention, since it ensures that the extraction mixture has a sufficiently high alcohol content for effective filtration. As discussed above, the agglomeration of polymers in the extraction mixture happens less at lower alcohol concentrations, meaning that their effective separation by filtration from the extraction mixture is harder to achieve. The ability to calculate alcohol by weight is also useful as expensive analytical equipment can be avoided. The exact dilution necessary to provide a particular concentration can also be determined simply and the cost of the alcoholic beverage calculated. Additionally, where the beverage is to be stored at cold temperatures prior to consumption, knowledge of the exact

alcohol by weight concentration allows the beverage to not be stored at too cold a temperature that would cause the beverage to freeze. Colder temperatures are preferable, but not so cold that the beverage freezes. Since freezing point is affected by alcohol concentration, the knowledge of the alcohol by weight content allows storage to be optimised.

It has been appreciated by the inventor that the knowledge of alcohol by weight of an ethanol/water mixture is very useful for a variety of reasons. Typically, alcoholic beverages are sold with labelling displaying the alcohol content by volume. Knowledge of the alcohol by weight is particularly useful when the alcoholic beverage is to be used in the process of the first aspect of the invention as the liquid extractant. For example, calculation of the extraction parameters, drink parameters and final alcohol concentration can be achieved, without having to use complex formulae or look up tables due to the non-linear volume relationship.

The presentation of alcohol by weight on the alcoholic beverage container has been found to provide advantages when the beverage is to be used as the liquid extractant in the first aspect of the invention. For example, knowledge of the alcohol by weight means that the minimum temperature that the extraction can be carried out without freezing can be determined and sufficient agglomeration to achieve a high yield.

Presentation of alcohol by weight also enables accurate and simple measurements using scales whilst creating both extractions and drinks, compared to more awkward volume measurements.

Thus, according to a sixth aspect of the invention, there is provided a container comprising an alcoholic beverage that comprises from 20% to 100% alcohol by weight, more preferably from 30% to 100% alcohol by weight, wherein the container comprises labelling specifying (i) the alcohol by weight content of the alcoholic beverage contained within the container; and/or (ii) the weight of the container when empty.

According to a seventh aspect of the invention, there is provided an alcoholic beverage comprising from 20% to 100% alcohol by weight, more preferably from 30% to 100% alcohol by weight, wherein the alcoholic beverage is contained within a container comprising labelling specifying the (i) alcohol by weight content of the alcoholic beverage; and/or (ii) the weight of the container when empty.

The container of the sixth aspect of the invention or the alcoholic beverage of the seventh aspect of the invention can comprise any one or more of the following features:

- (i) the container has a total capacity of from 20 ml to 3000 ml;
- (ii) the alcoholic beverage comprises from 60% to 100% alcohol by weight, preferably from 96% to 100% alcohol by weight;
- (iii) the alcoholic beverage comprises a neutral flavoured alcoholic beverage; and/or
- (iv) the alcoholic beverage is according to the second aspect of the invention.

In preferred embodiments, labelling specifies both (i) the alcohol by weight content of the alcoholic beverage within the container; and (ii) the weight of the container when empty. Knowledge of the weight of the container when empty is also particularly useful when known in combination with the alcohol by weight content of the beverage within the container, or known in its own right. For example, how much beverage has been manufactured by a process according to the first aspect of the invention can be determined so as to enable determination of pour costs. Determination of the remaining beverage weight can also be calculated so as to determine how many more drinks can be produced from the beverage bottle during any given service. Determination of the remaining beverage weight can also be determined during a stock take.

According to an eighth aspect of the invention, there is provided a sealed container with a total capacity of from 350 ml to 3000 ml, wherein the container comprises an alcoholic beverage comprising from 60% to 100% alcohol by weight; wherein the container comprises a weight x of the alcoholic beverage, such that an addition of $0.16 x$ of water at atmospheric pressure and 25°C to the container does not cause the container to overflow.

According to a ninth aspect of the invention, there is provided an alcoholic beverage contained within a container according to the eighth aspect of the invention.

The term sealed container, as used herein in the context of the invention, is used to refer to a beverage container that has been filled with alcoholic beverage and then sealed as one of the final steps of the manufacture and bottling of the alcoholic beverage. The seal of such a beverage container can be irreversibly broken by opening the container. Whilst, such a beverage container can be subsequently closed (for example by the application of a lid), it is not possible to reseal the beverage container since the initial opening of the beverage container irreversibly breaks the seal. The term sealed container as used herein is thus not

used to refer to a beverage container that has been opened before being reclosed by the application of, for example, a screwable lid or a bottle stopper. The term sealed thus refers to the irreversible seal applied to the container during the final stages of bottling an alcoholic beverage within the container.

The container of the eighth aspect of the invention or the alcoholic beverage of the ninth aspect of the invention preferably comprises a weight x of the alcoholic beverage, such that an addition of $0.31\ x$; preferably $0.53\ x$; and more preferably $0.83\ x$ of water at atmospheric pressure and 25°C to the container does not cause the container to overflow.

Preferably, the beverage within the container of the eighth aspect of the invention or the alcoholic beverage of the ninth aspect of the invention are an alcoholic beverage according to the second aspect of the invention.

Preferably, the container is a bottle.

The use of said containers has been found advantageous when used in the processes of the present invention, for example, for containing the extraction mixture in maintaining step c) of the first aspect of the invention, or for containing the liquid extractant for use in the process of the first aspect of the invention. In particular, it has been found very useful for containers of the invention to contain the liquid extractant prior to use in processes of the invention. The containers can then also be used to contain the extraction mixture for the duration of maintaining step c) due to their volume. The containers can then contain the alcoholic beverage once produced.

The produced alcoholic beverage or extraction mixture will typically have a greater volume than the initial liquid extractant volume, for example, because of dilution or addition of the cellular material. The use of additional storage vessels to contain each of the liquid extractant, extraction mixture and alcoholic beverage can thus be avoided. Additionally, a consistent aesthetic appearance for the liquid extractant and the manufactured alcoholic beverage can be provided. As a further advantage, the extraction parameters, drink parameters and ingredient details can be specified on a label of the container.

Accordingly, according to a tenth aspect of the invention, there is provided a method of manufacturing an alcoholic beverage, the method comprising:

- (a) contacting a liquid extractant comprising from 60% to 100% by weight of ethanol with cellular material, thereby forming an extraction mixture;
- (b) optionally, maintaining the extraction mixture for a time period of from 15 minutes to 5 years;
- (c) separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage; or separating a portion or all of the cellular material from the extraction mixture and optionally further treating the extraction mixture thereby providing the alcoholic beverage;

wherein, (i) prior to step a), the liquid extractant is provided in a container with a total capacity of from 350 ml to 3000 ml, wherein the container comprises a weight x of the liquid extractant, such that an addition of $0.16 x$ of water at atmospheric pressure and 25°C to the container does not cause the container to overflow; and optionally (ii) the method further comprises providing the alcoholic beverage in a container with the same total capacity of the container that the liquid extractant is provided in prior to step a), preferably, wherein the container is the same container that the liquid extractant is provided in prior to step a).

Preferably, features (i) and (ii) described in the paragraph above are present in the method.

Preferably, the method further comprises carrying out all or a portion of steps (a) and (b) in the container.

Preferably, contacting step (b) comprises a step of maintaining the extraction mixture at a temperature of from -114°C to 0°C for a time period of from 15 minutes to 5 years.

Preferably, the method is as described above in accordance with the first aspect of the invention.

In the embodiments described above, where the liquid extractant is provided in the container prior to step a), the container preferably comprises a weight x of the liquid extractant, such that an addition of $0.31 x$; more preferably $0.53 x$; and most preferably $0.83 x$ of water at atmospheric pressure and 25°C to the container does not cause the container to overflow.

It has also been found by the inventor that the use of certain drinks containers are particularly useful for containing the alcoholic beverage of the present invention, the liquid extractant for use in the process of the first aspect of the invention, or the extraction mixture in the process

of the first aspect of the invention. In some embodiments, the same container can be used for containing and storing the liquid extractant, storing the extraction mixture at cold temperatures, and the containing and serving the alcoholic beverage once produced.

Thus, according to an eleventh aspect of the invention, there is provided a container comprising a neutral flavoured alcoholic beverage that comprises from 25% to 100% alcohol by weight, wherein the container is capable of being sealed by a crown cap, and wherein the container comprises coloured glass that reflects light with a wavelength of from 495 nm to 620 nm.

According to a twelfth aspect of the invention, there is provided a neutral flavoured alcoholic beverage that comprises from 25% to 100% alcohol by weight, wherein the alcoholic beverage is contained within a container capable of being sealed by a crown cap, and wherein the container comprises coloured glass that reflects light with a wavelength of from 495 nm to 620 nm.

Preferably, the container is sealed by a crown cap. Alternatively, the container is sealed with a stopper closure.

More preferably, the container is sealed with a crown cap and adapted to be sealed with a stopper closure once the crown cap is removed.

The use of a stopper is advantageous as it allows sealing with cork or glass, thus avoiding the use of plastics, and providing ease of closure and recyclability. The use of a crown cap retains elevated pressures for use in carbonated extraction processes. The use of a crown cap also allows reuse for re-bottling drinks once the container is opened and also minimises oxygen ingress and oxidation reactions during storage.

The container also preferably comprises a lip below the crown cap. This structure causes liquid to drip off the glass, and avoids any issues created due to surface tension that leads to liquid running down the side of the bottle. Pouring accuracy is also improved.

Preferably, the container further comprises a label comprising heat insulating material. This feature is particularly useful since it means that the container can be held without exposing the handler to overly cold temperatures when the container has been stored below 0°C.

Preferably, the label is not coated. Preferably, the label is capable of being written on with ink or another marker such that the container can be effectively labelled (for example with the extraction parameters or other product details). Preferably, the label is configured so as to allow a gap, such as a 1 cm gap, so that the internal contents of the container can be visually inspected. Preferably, the label has a grid design background to assist and facilitate writing upon the label.

Preferably, the container is a champagne bottle. The use of a generic bottle design increases manufacturing ease and simplicity.

The container comprises coloured glass that reflects light with a wavelength of from 495 nm to 620 nm. As a result, the container has a green or brown or red appearance.

It has been found that it is particularly useful when the containers of the invention contain alcoholic beverages according to the second aspect of the invention where the beverages are carbonated. The containers are also particularly useful for containing the extraction mixture in the process of the first aspect of the invention during maintaining step c), where the extraction mixture is carbonated for the duration of or some of this step. The use of green or brown or red glass reduces light mediated reactions which can damage the flavour molecules present in the alcoholic beverage or extraction mixture. The use of a crown cap is also very useful since it allows rebottling when the container is to be used to store the liquid extractant and the extraction mixture and/or the alcoholic beverage once produced. The use of a crown cap also permits carbonated extraction.

Preferably, the alcoholic beverage comprises one or more of the following features:

- (i) the alcoholic beverage is according to the second aspect of the invention; and/or
- (ii) the alcoholic beverage comprises from 40% to 100% alcohol by weight, preferably from 60% to 100% alcohol by weight.

Preferably, the alcoholic beverage used in the eleventh and twelfth aspects of the invention is manufactured by a process according to the first aspect of the invention, or is according to the second aspect of the invention.

As discussed above, it has been found advantageous to bottle alcoholic beverages in a container whilst minimising the level of oxygen, or at least with no oxygen present in the headspace of the container. It has further been found advantageous that when alcoholic beverages in sealed containers are opened thus exposing the beverages to oxygen, it is advantageous that said containers are opened at temperatures less than 0°C, as discussed in detail above.

Accordingly, according to a thirteenth aspect of the invention, there is provided a container comprising an alcoholic beverage that comprises from 20% to 100% alcohol by weight, wherein a headspace of the container is substantially free of oxygen, preferably completely free of oxygen, and wherein the container comprises labelling with instructions stating that the container should be opened at a temperature of less than 0°C, and preferably less than -10°C. In preferable embodiments, the headspace of the container comprises 15% or less oxygen by volume of the total volume of gases present in the headspace, more preferably the headspace of the container comprises 10% or less oxygen by volume of the total volume of gases present in the headspace, most preferably the headspace of the container comprises 5% or less oxygen by volume of the total volume of gases present in the headspace. The term headspace as used herein is used to refer to the section of a filled and sealed container that contains gas and is situated above the liquid present at the bottom of the container.

According to a fourteenth aspect of the invention, there is provided an alcoholic beverage comprising from 20% to 100% alcohol by weight, wherein the alcoholic beverage is sealed within a container, wherein a headspace of the container is substantially free of oxygen, preferably completely free of oxygen, and wherein the container comprises labelling with instructions stating that the container should be opened at a temperature of less than 0°C, and preferably less than -10°C.

The containers can be bottled and sealed with the alcoholic beverage in the absence of oxygen using methods known in the art.

The containers of the sixth, eighth, eleventh and thirteenth aspects of the invention may comprise any of the features discussed in relation to containers according to different aspects of the invention. For example, a container according to the eighth aspect of the invention may comprise the features discussed in the context of a different aspect of the invention, such as a container according to the sixth aspect of the invention. Similarly, alcoholic beverages

according to the seventh, ninth, twelfth and fourteenth aspects of the invention may comprise any of the features discussed in relation to alcoholic beverages according to different aspects of the invention. For example, an alcoholic beverage according to the twelfth aspect of the invention may comprise the features discussed in the context of a different aspect of the invention, such as an alcoholic beverage according to the ninth aspect of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The process of the invention can be carried out with standard kitchen equipment known in the art, and the use of expensive laboratory grade analytical and preparatory equipment can be avoided, unlike certain processes for ethanol extraction of natural ingredients known in the art.

For example, the freezing and cooling of ingredients to the stated temperatures and maintaining them at said temperatures can be done with commonly available freezers and fridges found in kitchens. Blending or lysing steps can be performed with standard blenders and food processors. The juicing steps to produce solid pulp fractions and liquid fractions can be carried out with common kitchen juicers or pulping equipment. Separation steps can be carried out with common filtration equipment designed for kitchen use. Distillation and carbonation steps can be carried out using standard equipment known in the art. Standard kitchen microwaves and scales can be used for the water content analysis and weighing steps. Suitable vessels to conduct each process step in are also known in the art. Typically, standard kitchen grade glassware such as glass beverage bottles and containers may be used for any storing and contacting of ingredients.

The particular weight ratio of ethanol to cellular material to use for a particular extraction process; the optimum pre-processing of the cellular material before the extraction such as size reduction; and the appropriate time period for a given extraction will be dependent upon the nature of the specific cellular material that flavours are being extracted from. Appropriate weight ratios, extraction times, and any optimum pre-processing will be chosen based on intention and known properties of a given cellular material ingredient. For example, for the extraction of dried spices such as nutmeg or cloves or other ingredients with intense flavours such as herbs, a lower weight ratio of ingredient to ethanol would typically be used. For less intense flavours, a higher weight ratio may be preferable. Ingredients that have a natural smaller surface area to volume ratio such as apples, oranges and other fruits would typically

be reduced in size either prior to or after contact with the ethanol liquid extractant. The pulping and pressing of ingredients to obtain a solid fraction for use in the extraction would typically be done to ingredients with higher water, sugar or fat content such as melons, mangos, olives, seeds or nuts etc.

Examples

The following methods are examples of methods of the present invention. However, the invention is not limited to such methods and suitable modifications and adaptations may be made to the methods as desired.

Example 1

The following method steps may be carried out as an example of a preferred method of the present invention.

- a) Calculate the possible concentration range for cellular material in the extraction mixture, to ensure a minimum ethanol concentration after and during separation is not exceeded. Determine cellular material concentration from range.
- b) Calculate the possible range of ethanol concentrations in the alcoholic beverage, if dilution is to be carried out after separation. Determine alcoholic beverage ethanol concentration from range.
- c) Calculate the cell ratio, the value that upon multiplication with the extractant weight, determines the required weight of cellular material. As the extractant is pre-weighed, subsequently calculate the cellular material weight required.
- d) Annotate the extractant label with the extraction parameters.
- e) Refrigerate cellular material to a temperature between 0°C and 5°C.
- f) Wash cellular material thoroughly with cold water to remove any insects, pesticides and soil.
- g) Separate cellular material into the cells desired for extraction.
- h) Weigh out cells for extraction.
- i) Freeze cells for extraction.
- j) Weigh out representative cell sample for water analysis.
- k) Freeze representative cell sample for water analysis in the same conditions as the cells for extraction.
- l) Chill extractant bottle below 0°C.

- m) Zero scale.
- n) Weigh empty temperature resistant vessel.
- o) Add water analysis cell sample to vessel and reweigh.
- p) Microwave at full power until dry and brittle, or until no sustained reduction in weight upon further microwaving.
- q) Weigh dry cell sample and vessel.
- r) Calculate the water content of the cells.
- s) Calculate the extraction ethanol concentration.
- t) Calculate the dilution ratio.
- u) Annotate the extractant label with the extraction parameters.
- v) Chill extraction equipment to below 0°C. If necessary, blend ice and water and use the mixture for cooling. Wait a minimum of several minutes to allow thermal conduction. Discard mixture prior to use.
- w) Pour the entire pre-weighed contents of the extractant bottle directly from cold storage into a blender. Chill the empty bottle below 0°C. This pre-weighed extractant has already been calculated so that after dilution, it will not overflow the bottle.
- x) Add the pre-weighed frozen cells, ensuring they are submerged in the extractant if possible.
- y) Blend at low speed for around 5 seconds, or just enough time to cut cells into smaller pieces, in order to allow the mixture to behave as a homogeneous liquid.
- z) Immediately follow this by around 5 seconds at high speed.
- aa) Immediately decant, before cells settle out and impede pouring. If this occurs, the calculated ethanol concentration equilibrium may not be reached. Use a chilled inert wide mouth container as it allows for easy pouring, decanting and cleaning.
- bb) Seal the container and chill it to below 0°C for the desired extraction period.
- cc) Just prior to the end of the desired extraction period, chill separation equipment to below 0°C. If necessary, blend ice and water and use the mixture for cooling. Wait a minimum of several minutes to allow thermal conduction. Discard mixture prior to use.
- dd) After the desired extraction period, remove the extraction mixture from cold storage.
- ee) As some separation will normally occur, swirl to re-suspend any precipitate and ensure it is all poured out.
- ff) Place a blender jug on a scale. Record the weight in case the scale resets. Tare scale so it reads 0.0 grams.

- gg) Place a 75 micron filter bag made of nylon above the jug and pour the extraction mixture through it. Whilst wearing powder-free nitrile gloves, squeeze the bag to create an almost powder residue.
- hh) Remove the filter bag and record the weight.
- ii) Calculate the weight of ice required. This calculation is done by multiplying the weight of the filtered extract by the dilution ratio.
- jj) Add the calculated weight of ice and blend it together with the filtered extract on a low speed until each piece of ice is no larger than a few millimetres, approximately several seconds.
- kk) Remove the empty extractant bottle from cold storage. The thermal mass helps rapidly lower the extract temperature when decanted, without the need for a blast freezer or other rapid cooling methods. This should be coloured glass, within the appropriate range, to minimise light mediated reactions.
- ll) Using a funnel, pour the alcoholic beverage into the bottle.
- mm) Seal with a stopper and chill the bottle in cold storage. Optionally, displace oxygen to further minimise any oxidation. Gases that can be easily sourced include CO₂, N₂, N₂O and Ar.
- nn) Optionally, perform a secondary finer filtration step to reduce any remaining precipitate. A paper filter can provide a sufficient filter medium for this purpose.
- oo) Weigh the bottle containing the alcoholic beverage and using the empty bottle weight, calculate costings and servings.
- pp) Ideally, store below 0°C. Otherwise, remove oxygen and reduce temperature below 0°C prior to opening.

Example 2

The following method steps may be carried out as an example of a preferred method of the present invention. The following method is an example of where a solid pulp portion is separated from cellular material before extraction, and the solid pulp fraction used in the extraction.

- a) Refrigerate cellular material to a temperature between 0°C and 5°C.
- b) Chill extraction equipment to below 0°C. If necessary, blend ice and water and use the mixture for cooling. Wait a minimum of several minutes to allow thermal conduction. Discard mixture prior to use.

- c) Wash cellular material thoroughly with cold water to remove any insects, pesticides and soil.
- d) Separate cellular material into the cells desired for extraction.
- e) Cut the cells into pieces that will easily pass through the juicer. Ideally, use a ceramic knife to avoid any potential oxidation with steel and ensure it is sharp to minimise cell damage.
- f) Start juicing the cells.
- g) At the beginning, remove a representative sample of the pulp to carry out water analysis.
- h) Continue juicing the cells whilst the sample is being analysed. This will minimise oxidation and save time.
- i) Zero scale.
- j) Weigh empty temperature resistant vessel.
- k) Add water analysis cell sample to vessel and reweigh.
- l) Microwave at full power until dry and brittle, or until no sustained reduction in weight upon further microwaving.
- m) Weigh dry cell sample and vessel.
- n) Calculate the water content of the cells.
- o) Determine alcoholic beverage ethanol concentration.
- p) Calculate the cell ratio, the value that upon multiplication with the extractant weight, determines the required cellular material weight. As the extractant is pre-weighed, subsequently calculate the cellular material weight required.
- q) Annotate the extractant label with the extraction parameters.
- r) Pour the entire pre-weighed contents of the extractant bottle directly from cold storage into a blender. Chill the empty bottle below 0°C. This pre-weighed extractant has already been calculated so that after dilution, it will not overflow the bottle.
- s) Weigh out the calculated amount of solid pulp cell fraction into the extractant, ensuring it is submerged in the extractant where possible.
- t) Blend at low speed for around 5 seconds, or just enough time to cut cells into smaller pieces, in order to allow the mixture to behave as a homogeneous liquid.
- u) Immediately follow this by around 5 seconds at high speed.
- v) Immediately decant, before cells settle out and impede pouring. If this occurs, the calculated ethanol concentration equilibrium may not be reached. Use a chilled inert wide mouth container as it allows for easy pouring, decanting and cleaning.
- w) Seal the container and chill below 0°C for the desired extraction period.

- x) Just prior to the end of the desired extraction period, chill separation equipment to below 0°C. If necessary, blend ice and water and use the mixture for cooling. Wait a minimum of several minutes to allow thermal conduction. Discard mixture prior to use.
- y) After the desired extraction period, remove the extraction from cold storage.
- z) As some separation will normally occur, swirl to re-suspend any precipitate and ensure it is all poured out.
- aa) Place a 75 micron filter bag made of nylon above a vessel and pour the extraction through it. Whilst wearing powder-free nitrile gloves, squeeze the bag to create an almost powder residue.
- bb) Remove the empty extractant bottle from cold storage. The thermal mass helps rapidly lower the extract temperature when decanted, without the need for a blast freezer or other rapid cooling methods. This should be coloured glass, within the appropriate range, to minimise light mediated reactions.
- cc) Using a funnel, pour the alcoholic beverage into the bottle.
- dd) Seal with a stopper and chill the bottle below 0°C. Optionally, displace oxygen to further minimise any oxidation. Gases that can be easily sourced include CO₂, N₂, N₂O and Ar.
- ee) Optionally, perform a secondary finer filtration step to reduce any remaining precipitate. A paper filter can provide a sufficient filter medium for this purpose.
- ff) Weigh the bottle containing the alcoholic beverage and using the empty bottle weight, calculate costings and servings.
- gg) Ideally, store below 0°C. Otherwise, remove oxygen and reduce temperature below 0°C prior to opening.

Example 3

The following method steps may be carried out as an example of a preferred method of the present invention. The following method is an example of where carbon dioxide is used as a cosolvent in the extraction.

- a) Calculate the possible concentration range for cellular material in the extraction mixture, to ensure a minimum ethanol concentration after and during separation is not exceeded. Determine cellular material concentration from range.

- b) Calculate the possible range of ethanol concentrations in the alcoholic beverage, if dilution is to be carried out after separation. Determine alcoholic beverage ethanol concentration from range.
- c) Calculate the cell ratio, the value that upon multiplication with the extractant weight, determines the required weight of cellular material. As the extractant is pre-weighed, subsequently calculate the cellular material weight required.
- d) Annotate the extractant label with the extraction parameters.
- e) Refrigerate cellular material to a temperature between 0°C and 5°C.
- f) Wash cellular material thoroughly with cold water to remove any insects, pesticides and soil.
- g) Separate cellular material into the cells desired for extraction.
- h) Weigh out cells for extraction.
- i) Freeze cells for extraction.
- j) Weigh out representative cell sample for water analysis.
- k) Freeze representative cell sample for water analysis in the same conditions as the cells for extraction.
- l) Chill extractant bottle below 0°C.
- m) Zero scale.
- n) Weigh empty temperature resistant vessel.
- o) Add water analysis cell sample to vessel and reweigh.
- p) Microwave at full power until dry and brittle, or until no sustained reduction in weight upon further microwaving.
- q) Weigh dry cell sample and vessel.
- r) Calculate the water content of the cells.
- s) Calculate the extraction ethanol concentration.
- t) Calculate the dilution ratio.
- u) Annotate the extractant label with the extraction parameters.
- v) Chill extraction equipment to below 0°C. If necessary, blend ice and water and use the mixture for cooling. Wait a minimum of several minutes to allow thermal conduction. Discard mixture prior to use.
- w) Pour the entire pre-weighed contents of the extractant bottle directly from cold storage into a blender. Chill the empty bottle below 0°C. This pre-weighed extractant has already been calculated so that after dilution, it will not overflow the bottle.

- x) Add the pre-weighed frozen cells, ensuring they are submerged in the extractant if possible.
- y) Blend at low speed for around 5 seconds, or just enough time to cut cells into smaller pieces, in order to allow the mixture to behave as a homogeneous liquid.
- z) Immediately follow this by around 5 seconds at high speed.
- aa) Immediately decant to a pressure rated container before cells settle out and impede pouring. If this occurs, the calculated ethanol concentration equilibrium may not be reached.
- bb) Seal the container and add carbon dioxide within safety limits. Preferably, release pressure to purge the airspace and repeat the carbon dioxide addition.
- cc) Either maintain the cold temperature of the container or decant into the pressure rated bottle, crown cap and chill below 0°C for the desired extraction period. Decanting allows the ability to use longer extraction periods where equipment cannot be chilled easily or there is limited availability of equipment.
- dd) Just prior to the end of the desired extraction period, chill separation equipment to below 0°C. If necessary, blend ice and water and use the mixture for cooling. Wait a minimum of several minutes to allow thermal conduction. Discard mixture prior to use.
- ee) After the desired extraction period, remove the extraction mixture from cold storage and release the carbon dioxide pressurisation.
- ff) As some separation will normally occur, swirl to re-suspend any precipitate and ensure it is all poured out.
- gg) Place a blender jug on a scale. Record the weight in case the scale resets. Tare scale so it reads 0.0 grams.
- hh) Place a 75 micron filter bag made of nylon above the jug and pour the extraction mixture through it. Whilst wearing powder-free nitrile gloves, squeeze the bag to create an almost powder residue.
- ii) Remove the filter bag and record the weight.
- jj) Calculate the weight of ice required. This calculation is done by multiplying the weight of the filtered extract by the dilution ratio.
- kk) Add the calculated weight of ice and blend it together with the filtered extract on a low speed until each piece of ice is no larger than a few millimetres, approximately several seconds. If no dilution is required, this blending step is still desirable to rapidly reduce the dissolved carbon dioxide concentration.

- ll) Remove the empty extractant bottle from cold storage. The thermal mass helps rapidly lower the extract temperature when decanted, without the need for a blast freezer or other rapid cooling methods. This should be coloured glass, within the appropriate range, to minimise light mediated reactions.
- mm) Using a funnel, pour the alcoholic beverage into the bottle.
- nn) Seal with a stopper and chill the bottle in cold storage. Optionally, displace oxygen to further minimise any oxidation. Gases that can be easily sourced include CO₂, N₂, N₂O and Ar.
- oo) Optionally, perform a secondary finer filtration step to reduce any remaining precipitate. A paper filter can provide a sufficient filter medium for this purpose.
- pp) Weigh the bottle containing the alcoholic beverage and using the empty bottle weight, calculate costings and servings.
- qq) Ideally, store below 0°C. Otherwise, remove oxygen and reduce temperature below 0°C prior to opening.

Example 4

The following method steps may be carried out as an example of a method of the present invention. The following method steps are examples of a method of the invention where after separation, the extraction mixture is distilled so as to produce the alcoholic beverage.

- a) Determine cellular material concentration.
- b) Determine alcoholic beverage ethanol concentration. Calculate the cell ratio, the value that upon multiplication with the extractant weight, determines the required cellular material weight. As the extractant is pre-weighed, subsequently calculate the cellular material weight required.
- c) Refrigerate cellular material to a temperature between 0°C and 5°C.
- d) Wash cellular material thoroughly with cold water to remove any insects, pesticides and soil.
- e) Separate cellular material into the cells desired for extraction.
- f) Weigh out cells for extraction.
- g) Freeze cells for extraction.
- h) Chill extractant bottle below 0°C.

- i) Chill extraction equipment to below 0°C. If necessary, blend ice and water and use the mixture for cooling. Wait a minimum of several minutes to allow thermal conduction. Discard mixture prior to use.
- j) Pour the entire pre-weighed contents of the extractant bottle directly from cold storage into a blender. Chill the empty bottle below 0°C. This pre-weighed extractant has already been calculated so that after dilution, it will not overflow the bottle.
- k) Add the pre-weighed frozen cells, ensuring they are submerged in the extractant if possible.
- l) Optionally, add ionic compounds, such as sodium chloride.
- m) Blend at low speed for around 5 seconds, or just enough time to cut cells into smaller pieces, in order to allow the mixture to behave as a homogeneous liquid.
- n) Immediately follow this by around 5 seconds at high speed.
- o) Immediately decant, before cells settle out and impede pouring. Use a chilled inert wide mouth container as it allows for easy pouring, decanting and cleaning.
- p) Seal the container and chill it below 0°C for the desired extraction period.
- q) After the desired extraction period, remove the extraction mixture from cold storage.
- r) As some separation will normally occur, swirl to re-suspend any precipitate and ensure it is all poured out.
- s) Vacuum distill.
- t) Measure distillate ethanol concentration and weight.
- u) Calculate the dilution required.
- v) Add the calculated weight in the form of ice and blend it together with the filtered extract on a low speed until each piece of ice is no larger than a few millimetres, approximately several seconds. Alternatively, add a chilled ethanol solution if the cellular material concentration is to be lowered; the process of creating a concentrated distillate may be adopted to increase distillation efficiency. Cold temperatures after distillation are not required but are preferable.
- w) Remove the empty extractant bottle from cold storage. The thermal mass helps rapidly lower the extract temperature when decanted, without the need for a blast freezer or other rapid cooling methods. This should be coloured glass, within the appropriate range, to minimise light mediated reactions.
- x) Using a funnel, pour the alcoholic beverage into the bottle.
- y) Seal with a stopper and chill the bottle in cold storage. Optionally, displace oxygen to further minimise any oxidation. Gases that can be easily sourced include CO₂, N₂, N₂O and Ar.

- z) Weigh the bottle containing the alcoholic beverage and using the empty bottle weight, calculate costings and servings.
- aa) Ideally, store below 0°C. Otherwise, remove oxygen and reduce temperature below 0°C prior to opening.

CLAIMS

1. A process for the manufacture of an alcoholic beverage, wherein the process comprises the following steps carried out in sequence:

- (a) forming an extraction mixture with an ethanol concentration of 20% or more by weight of ethanol by contacting a liquid extractant comprising from 21% to 100% by weight of ethanol with cellular material in a mass ratio of at least 1:4, thereby forming an extraction mixture;
- (b) reducing in size the cellular material present in the extraction mixture at a temperature of from -114°C to 5°C;
- (c) optionally, maintaining the extraction mixture at a temperature of from -114°C to 0°C for a time period of from 15 minutes to 5 years; and
- (d) separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage; or separating a portion or all of the cellular material from the extraction mixture and optionally further treating the extraction mixture thereby providing the alcoholic beverage.

2. A process according to Claim 1, wherein the cellular material comprises one or more plants, or components or extracts thereof, preferably, wherein the one or more plants or components or extracts thereof comprise one or more edible fruits, vegetables, herbs, spices, components or extracts thereof, or a combination thereof.

3. A process according to Claim 1 or Claim 2, wherein the liquid extractant comprises from 40% to 100% by weight of ethanol.

4. A process according to any preceding claim, wherein the liquid extractant comprises from 60% to 100% by weight of ethanol, and preferably from 80% to 100% by weight of ethanol.

5. A process according to any preceding claim, wherein (i) the liquid extractant comprises from 26% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 25% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 1:3 to 9999:1; preferably (ii) the liquid extractant comprises from 31% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 30% or more by weight of ethanol; and wherein the liquid extractant and

cellular material are contacted in step a) in a mass ratio of 3:7 to 9999:1; more preferably (iii) the liquid extractant comprises from 36% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 35% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 7:13 to 9999:1.

6. A process according to any preceding claim, wherein (i) the liquid extractant comprises from 41% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 40% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 2:3 to 9999:1; preferably (ii) the liquid extractant comprises from 51% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 50% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 1:1 to 9999:1; more preferably (iii) the liquid extractant comprises from 61% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 60% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 3:2 to 9999:1.

7. A process according to any preceding claim, wherein (i) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 20% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 1:4 to 9999:1; preferably (ii) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 25% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 1:3 to 9999:1; more preferably (iii) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 30% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 3:7 to 9999:1; and most preferably (iv) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 35% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 7:13 to 9999:1.

8. A process according to any preceding claim, wherein (i) the liquid extractant comprises from 60% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 40% or more by weight of ethanol; and wherein the liquid extractant and cellular

material are contacted in step a) in a mass ratio of 2:3 to 9999:1; preferably (ii) the liquid extractant comprises from 70% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 40% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 2:3 to 9999:1; more preferably (iii) the liquid extractant comprises from 80% to 100% by weight of ethanol; the extraction mixture formed in step a) comprises 40% or more by weight of ethanol; and wherein the liquid extractant and cellular material are contacted in step a) in a mass ratio of 2:3 to 9999:1.

9. A process according to any preceding claim, wherein the liquid extractant further comprises water.

10. A process according to any preceding claim, wherein the maintaining in step c) is carried out for a time period of from 1 hour to 168 hours, preferably from 12 hours to 72 hours, and more preferably from 18 hours to 30 hours.

11. A process according to any preceding claim, wherein the maintaining in step c) is carried out at a temperature of from -114°C to -5°C, preferably from -80°C to -10°C, more preferably from -60°C to -15°C and most preferably from -35°C to -15°C.

12. A process according to any preceding claim, wherein step b) comprises reducing the size of the one or more organisms, or components or extracts thereof so as to comprise particles with a smallest dimension of 5mm or less, preferably 2 mm or less.

13. A process according to any preceding claim, wherein step b) comprises lysing the cellular material so as to comprise lysed cells.

14. A process according to Claim 13, wherein at least 25% of cells present in the cellular material are lysed, preferably wherein at least 50% of the cells present, more preferably at least 75% of the cells present, and most preferably at least 90% of the cells present are lysed.

15. A process according to any preceding claim, wherein step b) comprises reducing the size of the cellular material at a temperature of from -114°C to 0°C, preferably from -35°C to 0°C, more preferably from -35°C to -5°C and most preferably from -35°C to -10°C.

16. A process according to any preceding claim, wherein step b) comprises blending the cellular material.
17. A process according to any preceding claim, wherein the liquid extractant is at a temperature of from -114°C to 0°C, preferably from -35°C to -5°C and more preferably from -35°C to -10°C upon contact with the cellular material in step a); preferably wherein the liquid extractant and the cellular material are at a temperature of from -114°C to 0°C, preferably from -35°C to -5°C and more preferably from -35°C to -10°C upon contact in step a).
18. A process according to any preceding claim, wherein the cellular material is already frozen upon contact with the liquid extractant in step a), or frozen during step a).
19. A process according to any preceding claim, wherein prior to step a), the cellular material is reduced in size, optionally, wherein cellular material is lysed, so as to comprise lysed cells, and optionally wherein at least 25% of cells present in the cellular material are lysed, preferably wherein at least 50% of the cells present, more preferably at least 75% of the cells present, and most preferably at least 90% of the cells present are lysed.
20. A process according to any preceding claim, wherein step d) of separating a portion or all of the cellular material from the extraction mixture comprises filtering the extraction mixture, optionally wherein the filtering step comprises pressing a solid portion of the cellular material present in the extraction mixture during filtering.
21. A process according to Claim 20, wherein the extraction mixture is filtered at a temperature of from -114°C to 5°C, preferably from -50°C to 0°C, more preferably from -35°C to -5°C, and most preferably from -35°C to -10°C.
22. A process according to any preceding claim, wherein further treating the extraction mixture comprises diluting the extraction mixture, preferably wherein further treating the extraction mixture comprises diluting the extraction mixture with ice, more preferably wherein further treating the extraction mixture comprises blending the extraction mixture with ice; wherein the ethanol concentration after dilution is 20% or more by weight of ethanol, preferably 30% or more by weight of ethanol and most preferably 40% or more by weight of ethanol.

23. A process according to Claim 22, wherein during dilution, the extraction mixture is at a temperature of from -114°C to 5°C, preferably from -50°C to 0°C, more preferably from -35°C to -5°C, and most preferably from -35°C to -10°C.
24. A process according to any preceding claim, wherein further treating the extraction mixture comprises distilling the extraction mixture to provide the alcoholic beverage, preferably wherein the distillation is carried out under vacuum.
25. A process according to any preceding claim, wherein the process further comprises the addition of carbon dioxide to the extraction mixture, optionally wherein the carbon dioxide is added to the extraction mixture in a mass ratio of 1:999 to 999:1 (mass of carbon dioxide: mass of the extraction mixture).
26. A process according to Claim 25, when dependent on any one of Claims 20 to 25, wherein step d) of separating a portion or all of the cellular material from the extraction mixture comprises blending the extraction mixture after filtering the extraction mixture.
27. A process according to any preceding claim, wherein the alcoholic beverage is stored after manufacture at a temperature of from -114°C to 5°C, preferably from -50°C to 0°C, more preferably from -35°C to -5°C, and most preferably from -35°C to -10°C, preferably wherein the alcoholic beverage is stored in the absence of oxygen.
28. A process according to Claim 27, wherein the alcoholic beverage is maintained at a temperature of less than 5°C and preferably less than 0°C until at least 24 hours, preferably 12 hours, more preferably 4 hours, and most preferably 1 hour prior to the consumption of the alcoholic beverage.
29. A process according to any preceding claim, wherein prior to step a), the cellular material is pulped or pressed into a liquid fraction and a solid pulp fraction, wherein the solid pulp fraction is used as the cellular material in step a).
30. A process according to any preceding claim, wherein step c), if present, comprises maintaining the extraction mixture at a temperature of from -35°C to -5°C; wherein step b) comprises reducing the size of the cellular material at a temperature of from -35°C to 0°C; wherein the liquid extractant and the cellular material are at a temperature of from -35°C to

0°C upon contact in step a); wherein step d) of separating a portion or all of the cellular material from the extraction mixture comprises filtering the extraction mixture at a temperature of from -35°C to 0°C; and wherein if the process further comprises a step of diluting the extraction mixture or storing the alcoholic beverage after manufacture, the dilution and storage are both carried out at from -35 to 0°C; preferably, wherein step c), if present, comprises maintaining the extraction mixture at a temperature of from -35°C to -15°C; wherein step b) comprises reducing the size of the cellular material at a temperature of from -35°C to -5°C; wherein the liquid extractant and the cellular material are at a temperature of from -35°C to -5°C upon contact in step a); wherein step d) of separating a portion or all of the cellular material from the extraction mixture comprises filtering the extraction mixture, at a temperature of from -35°C to -5°C and wherein if the process further comprises a step of diluting the extraction mixture or storing the alcoholic beverage after manufacture, the dilution and storage are both carried out at from -35 to -5°C.

31. A process according to any preceding claim, wherein the process further comprises determining the water content of the cellular material, or the solid pulp fraction.

32. A process according to Claim 31, wherein the step of determining the water content of the cellular material or the solid pulp fraction comprises microwaving the cellular material or the solid pulp fraction thereby providing microwaved material, and determining the difference in weight between the microwaved material and the cellular material or the solid pulp fraction, wherein the difference in weight is indicative of the water content of the cellular material or the solid pulp fraction.

33. A process according to Claim 32, wherein the cellular material or the solid pulp fraction are frozen prior to microwaving, optionally wherein the cellular material or the solid pulp fraction have a temperature of from -210°C to 0°C at the start of microwaving.

34. A process according to any one of Claims 31 to 33, wherein the process further comprises determining the ethanol concentration of the extraction mixture or alcoholic beverage from the determined water content of the cellular material or the solid pulp fraction; and the ethanol concentration of the liquid extractant.

35. A process according to Claim 34, wherein further treating the extraction mixture comprises diluting the extraction mixture, preferably wherein further treating the extraction

mixture comprises diluting the extraction mixture with ice, and more preferably wherein further treating the extraction mixture comprises blending the extraction mixture with ice, wherein the process comprises determining the dilution necessary to provide a desired ethanol concentration of the alcoholic beverage, wherein the determining is based upon the ethanol concentration of the liquid extractant and the determined water content of the cellular material or the solid pulp fraction.

36. A process according to any one of Claims 31 to 35, wherein the process comprises determining the weight ratio of the cellular material or the solid pulp fraction for use in step a) to the liquid extractant for use in step a) to achieve a desired alcohol concentration of the extraction mixture or alcoholic beverage, wherein the determining is based upon the ethanol concentration of the liquid extractant and the determined water content of the cellular material or the solid pulp fraction.

37. A process according to any preceding claim, wherein the alcoholic beverage comprises a neutral flavoured alcoholic beverage.

38. A process according to any preceding claim, wherein the process further comprises preparing the alcoholic beverage for consumption, wherein preparing the alcoholic beverage for consumption comprises bottling and sealing the alcoholic beverage within a container.

39. A process according to Claim 38, wherein the alcoholic beverage is bottled and sealed within the container whilst minimising the level of oxygen in the headspace.

40. A process according to Claim 39, wherein preparing the alcoholic beverage for consumption further comprises unsealing and opening the container at a temperature below 0°C.

41. An alcoholic beverage obtained or obtainable by a process according to any preceding claim.

42. Use of a liquid extractant comprising from 21% to 100% by weight of ethanol in the extraction of flavour providing compounds from cellular material; wherein the use comprises forming an extraction mixture with an ethanol concentration of 20% or more by weight of ethanol by contacting the liquid extractant comprising from 21% to 100% by weight of

ethanol with cellular material in a mass ratio of at least 1:4, thereby forming an extraction mixture; reducing in size the cellular material present in the extraction mixture at a temperature of from -114°C to 5°C; optionally, maintaining the extraction mixture at a temperature of from -114°C to 0°C for a time period of from 15 minutes to 5 years; and (i) separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage, or (ii) separating a portion or all of the cellular material from the extraction mixture and optionally further treating the extraction mixture thereby providing the alcoholic beverage.

43. Use according to Claim 42, wherein the liquid extractant; extraction mixture; cellular material; or use are as defined in any one of Claims 1 to 40.

44. A process for manufacturing an alcoholic beverage with a desired alcohol concentration (w), wherein the process comprises:

- i) determining the water content (x) of cellular material;
 - ii) providing a liquid extractant comprising ethanol, with an ethanol concentration (y);
- and

iii) either (a) contacting the cellular material and liquid extractant in a weight ratio (z) thereby forming the alcoholic beverage with the desired alcohol concentration (w), wherein the weight ratio (z) is selected based upon the determined water content (x) and the ethanol concentration (y), and wherein the weight ratio (z) is selected to provide the desired alcohol concentration (w) of the alcoholic beverage;

(b) contacting the cellular material and liquid extractant in a weight ratio (z) thereby forming an extraction mixture, wherein the weight ratio (z) is selected based upon the determined water content (x) and the ethanol concentration (y), and wherein the weight ratio (z) is selected to provide the desired alcohol concentration (w) of the alcoholic beverage; and separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage with a desired alcohol concentration (w);

(c) contacting the cellular material and liquid extractant in a weight ratio (z) thereby forming an extraction mixture; and adding one or more additional substances to the extraction mixture in a weight ratio (v) to provide the alcoholic beverage with alcohol concentration (w); wherein the weight ratio (v) is selected based upon the determined water content (x), the

ethanol concentration (y) and the weight ratio (z), and wherein the weight ratio (v) is selected to provide the desired alcohol concentration (w) of the alcoholic beverage; or

(d) contacting the cellular material and liquid extractant in a weight ratio (z) thereby forming an extraction mixture; separating a portion or all of the cellular material from the extraction mixture; and adding one or more additional substances to the extraction mixture in a weight ratio (v) to provide the alcoholic beverage with alcohol concentration (w); wherein the weight ratio (v) is selected based upon the determined water content (x), the ethanol concentration (y) and the weight ratio (z), and wherein the weight ratio (v) is selected to provide the desired alcohol concentration (w) of the alcoholic beverage.

45. A process for manufacturing an alcoholic beverage comprising:

- (a) determining the water content of cellular material;
- (b) (i) contacting the cellular material with a liquid extractant comprising from 20% to 100% by weight of ethanol thereby forming an extraction mixture; and separating a portion or all of the cellular material from the extraction mixture thereby providing the alcoholic beverage; or
- (ii) contacting the cellular material with a liquid extractant comprising from 20% to 100% by weight of ethanol thereby forming the alcoholic beverage; and
- (c) determining the alcohol concentration of the alcoholic beverage based upon the water content of the cellular material and a water content of the liquid extractant.

46. A process according Claim 44 or Claim 45, wherein the process is further defined as in any one of Claims 1 to 40.

47. A container comprising an alcoholic beverage that comprises from 20% to 100% alcohol by weight, more preferably from 30% to 100% alcohol by weight, wherein the container comprises labelling specifying (i) the alcohol by weight content of the alcoholic beverage contained within the container; and/or (ii) the weight of the container when empty.

48. A container according to Claim 47 wherein:

- (i) the container has a total capacity of from 20 ml to 3000 ml;
- (ii) the alcoholic beverage comprises from 60% to 100% alcohol by weight, preferably from 96% to 100% alcohol by weight;
- (iii) the alcoholic beverage comprises a neutral flavoured alcoholic beverage; and/or

(iv) the alcoholic beverage is according to Claim 41.

49. A sealed container with a total capacity of from 350 ml to 3000 ml, wherein the container comprises an alcoholic beverage comprising from 60% to 100% alcohol by weight; wherein the container comprises a weight x of the alcoholic beverage, such that an addition of $0.16 x$ of water at atmospheric pressure and 25°C to the container does not cause the container to overflow.

50. A container according to Claim 49, wherein the container comprises a weight x of the alcoholic beverage, such that an addition of $0.31 x$; preferably $0.53 x$; and more preferably $0.83 x$ of water at atmospheric pressure and 25°C to the container does not cause the container to overflow.

51. A container according to Claim 49 or 50, wherein the alcoholic beverage is according to Claim 41.

52. A container comprising a neutral flavoured alcoholic beverage that comprises from 25% to 100% alcohol by weight, wherein the container is capable of being sealed by a crown cap, and wherein the container comprises coloured glass that reflects light with a wavelength of from 495 nm to 620 nm.

53. A container according to Claim 52, wherein the container is sealed with a crown cap.

54. A container according to Claim 52, wherein the container is sealed with a stopper closure.

55. A container according to any one of Claims 52 to 54, further comprising a label comprising heat insulating material.

56. A container according to any one of Claims 52 to 55, wherein:

- (i) the alcoholic beverage is according to Claim 41; or
- (ii) the alcoholic beverage comprises from 40% to 100% alcohol by weight, preferably from 60% to 100% alcohol by weight.

57. A sealed container comprising an alcoholic beverage that comprises from 20% to 100% alcohol by weight, wherein the headspace of the container is substantially free of oxygen, and wherein the container comprises labelling with instructions stating that the container should be opened at a temperature of less than 0°C, and preferably less than -10°C.