(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 March 2023 (30.03.2023)

WIPO | PCT

(10) International Publication Number
WO 2023/046859 A1

(51) International Patent Classification:
A23L 2/385 (2006.01) *A23L 7/20* (2016.01)
A23L 2/84 (2006.01) *A23L 2/52* (2006.01)
A23L 7/104 (2016.01)

(21) International Application Number:
PCT/EP2022/076431

(22) International Filing Date:
22 September 2022 (22.09.2022)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
21198993.4 24 September 2021 (24.09.2021) EP

(71) Applicant: **SOCIÉTÉ DES PRODUITS NESTLÉ S.A.** [CH/CH]; Avenue Nestlé 55, 1800 Vevey (CH).

(72) Inventors: **WAING, Seinn Lae**; Blk 457 Jurong West Street 41, No. 05-776, Singapore 640457 (SG). **ANANTA, Edwin**; Chemin de l'Eglise 27, 1066 Epalinges (CH). **JAIN, Vishist Kumar**; Block 606 Senja Road, 11-55, Singapore 670606 (SG).

(74) Agent: **ELLEBY, Gudrun**; Av. Nestlé 55, 1800 VEVEY (CH).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
— *of inventorship (Rule 4.17(iv))*

Published:
— *with international search report (Art. 21(3))*

WO 2023/046859 A1

(54) Title: METHOD FOR PROVIDING A WHOLE GRAIN CEREAL BASED EXTRACT

(57) Abstract: The present invention relates to a process for preparing a whole grain cereal based extract; said process comprises the steps of: (i) providing a whole grain cereal and cereal spent grain, preferably from 50 - 90 wt. % whole grain cereal, and 10 - 50 wt. % the cereal spent grain, based on the total whole grain cereal and the cereal spent grain, (ii) subjecting the whole grain cereal to a single grinding and subsequently combining the whole grain cereal, the spent grain and water, (iii) subjecting the ground whole grain cereal, the cereal spent grain and water to an enzymatic hydrolysis of macromolecular elements in the whole grain and the cereal spent grain providing a modified whole grain cereal, (iv) inactivating the enzymes, and (v) separating a soluble fraction of the modified whole grain cereal from an insoluble fraction of the modified whole grain cereal to obtain a modified whole grain cereal extract with soluble fractions from whole gran cereal and spent grain. The invention also relates to a beverage ingredient comprising a concentrate obtained by the process.

METHOD FOR PROVIDING A WHOLE GRAIN CEREAL BASED EXTRACT

Technical field of the invention

The present invention relates to a process for preparing a whole grain cereal based extract. In particular, the present invention relates to the preparation of a beverage comprising a beverage ingredient comprising the whole grain cereal based extract, which whole grain cereal extract maintain the nutritional value of the whole grain cereal and which makes it possible to provide the desired organoleptic properties of a beverage.

Background of the invention

Extracts of cereals such as malt extract have been used as an ingredient in beverages, such as in cocoa malted beverages. Malt extract, an example of a cereal extract, was produced based upon the classic process used by breweries for making beer. In this process cereals such as barley or wheat are harvested and dried so that they can be stored until required for use. The traditional malting process involves steeping the grain in water, germinating the grain for a period of days and stabilising the grain by carefully drying it to a low moisture content, typically around 5 % moisture. During the malting process enzymes for converting the starchy endosperm to soluble components are produced. Enzymes such as a-amylaase, b-amylase, b-glucanase, proteases, arabinoxylanases are synthesised in the germinating grain. During malting these enzymes also modify the structure of the cell wall allowing easier and more complete extraction of the soluble fraction of the cereal during later steps in the process.

The malted whole grain cereal is typically ground by milling to a heterogeneous powder where it is mixed with water in a ratio of 3-10 (or sometimes even more) parts water to 1 part grain. The initial temperature of the water may be around 40°C to 50°C to allow hydrolysis by proteases and cell-wall hydrolysing enzymes. Once this hydrolysis is sufficiently complete the temperature is raised to between 60°C and 70°C to allow hydrolysis of the starch by the α- and β-amylases. Once the hydrolysis is complete the temperature of the slurry is increased to around 80°C to inactivate the enzymes. The slurry is passed through a separating device

such as a lauter tun, decanter or plate and frame filter. The liquid portion is separated from the insoluble/partially soluble material by a process of filtration and leaching. Leaching involves washing the insoluble grain until all of the easily soluble material has been removed. The liquid portion is stabilised by drying to a powder or evaporating to a paste with typical dry-matter content above 78 % (w/w).

The powder or paste obtained may be used as an ingredient in the beverage. The residual insoluble material (spent grain) is typically sold as animal feed or disposed in land fill.

Recently beverages have been described that utilise cereals by simply adding finely milled cereals, cereal flour and physically modified cereals such as flakes, pellets etc. The cereal content in these drinks is restricted due to the impact on organoleptic properties and difficulty in dissolving or suspending the cereals into the drink. The resulting beverage can become highly viscous resembling more a smoothie than a drink or develop sediments or layers of cereal floating on the surface.

US 5,135,765 describes a process for producing a protein-rich product and/or a fibrous product which includes the steps of pressing brewer's spent grain in a wet state, and sieving water from the pressed brewer's spent grain in order to separate it into a protein-containing fraction and a fibrous fraction. US 5,135,765 describes that fine grinding of the fibrous material should be prevented because it may lead to difficulties in the subsequent separation of the protein fraction from the fibrous fraction. Furthermore, US 5,135,765 describes that the fibrous fraction obtained is used as feed or as a combustible fuel.

US 4,282,319 describes a process for the preparation of hydrolyzed products from whole grain, and such derived products. US 4,282,319 describes the use of a proteolytic enzyme to transform water insoluble proteins into water-soluble products, and further to treat the starch contents with an amylase to form water-soluble starch products. The product is further treated by removing the bran fraction and removing water to obtain a dry, semimoist, or liquid but concentrated derived product. The product is to be added as a sweetening agent in food

products such as bread, drinks, and cereal products, whereby the bran obtained can be used in bread as fibre additive. Thus, US 4,282,319 does not describe a fibre comprising beverage ingredient that maintains the nutritional value of the whole grain cereal and which has improved suspension properties.

The products and processes described above is associated with the following drawbacks:

From the traditional cereal extract approach, as described above, a portion of the cereal is not used in the beverage, but rather sold as animal feed. This unused portion comprises a range of value added nutritional components such as fibres, proteins, polypeptides or amino acids, vitamins and minerals.

A further drawback of the traditional cereal extract is that it is especially unsuitable for cereals that generate a large portion of insoluble material after hydrolysis, such as barley and wheat.

An even further drawback is the action of simply adding e.g. milled cereals or cereal flakes, because these ingredients tend to result in a beverage with an increased viscous texture due to swelling of the fibres and separation of the cereal components as sediments and/or floaters on the surface of the beverage.

Hence, there is a need for providing a method and a beverage ingredient where the nutritional value of the whole grain cereal is maintained or close to being maintained, where the suspension properties of the beverage ingredient are improved and/or which makes it possible to provide a beverage with the desired organoleptic properties.

Summary of the invention

The present invention provides that the nutritional value of the whole grain cereal is maintained or close to being maintained, where the suspension properties of

the beverage ingredient are improved and/or which makes it possible to provide a beverage with the desired organoleptic properties.

In a first aspect of the invention relates to a process for preparing a whole grain cereal based extract; said process comprises the steps of:

(i) providing a whole grain cereal and cereal spent grain, preferably from 50 to 90 wt. % whole grain cereal, and 10 to 50 wt. % the cereal spent grain, based on the total whole grain cereal and the cereal spent grain,

(ii) subjecting the whole grain cereal to a single grinding and subsequently combining the whole grain cereal, the spent grain and water,

(iii) subjecting the ground whole grain cereal, the cereal spent grain and water to an enzymatic hydrolysis of macromolecular elements in the whole grain and the cereal spent grain providing a modified whole grain cereal,

(iv) inactivating the enzymes, and

(v) separating a soluble fraction of the modified whole grain cereal from an insoluble fraction of the modified whole grain cereal to obtain a modified whole grain cereal extract with soluble fractions from whole gran cereal and spent grain.

Preferably the whole grain cereal and cereal spent grain is present in the ranges 50 to 60 wt. % whole grain cereal and 40 to 50 wt. % cereal spent grain.

It has surprisingly been found that a single milling of the whole grain cereal is sufficient to obtain a desirable mouthfeel in the final product.

Advantageously, the cereal based fraction comprising particles having a particle size below 100 µm, preferably below 50 µm, more preferably 30 µm.

Furthermore, it has surprisingly been found that incorporating the cereal spent grain in un-malted whole grain cereal, in particular un-malted barley process did

not have impact on the filtration time. Furthermore, the nutritional profile of the modified malt extract was better than the 100% green barley-based malt extract. The taste of the final beverage made using modified malt extract according to the invention was like a beverage made using whole 100% green barley-based malt extract. Interestingly and surprisingly, total available carbohydrates were also lower in modified malt extract compared to 100% green barley-based malt extract. It was furthermore surprisingly found that with the yield of a process with 50 % green barley and 50 % spent grain was similar to the 100 % green barley process and thus no impact on the productivity was found. It was also found that the filtration rate compared to processes utilizing 100 % green barley is still the same.

The process according to the invention is furthermore a simpler process. It makes use of a side stream or waste material that are generally lower in price then green barley. Nevertheless, the final product is better nutritionally due to higher fiber content and higher protein. The final beverage product which can be produced with the concentrate obtained by the process according to the invention still gets a good texture and sensory properties without grittiness and taste is comparable to 100 wt. % green barley concentrate.

In a second aspect, the invention relates to a beverage ingredient comprising a concentrate obtained with a process according to the invention.

Brief description of the figures

Figure 1 shows comparative profiling of beverage made using 100% green barley extract compared to beverage made using 50-50 (wt%) modified malt extract.

Figure 2 shows a schematic representation of a process of brewing on the left hand side creating spent grain and an embodiment of the process according to the invention on the right hand side of the drawing using the spent grain in the preparation of a modified whole grain cereal extract.

The present invention will now be described in more detail in the following.

Detailed description of the invention

It has surprisingly been found that by treating a whole grain cereal in a special manner it becomes possible to improve the suspension properties of the insoluble fraction without compromising the organoleptic properties. This reduction in suspension properties may result in the insoluble fraction becoming more suitable as a beverage ingredient. By reincorporating the processed insoluble fraction in the process for obtention of a whole grain cereal based extract it is possible to provide a beverage having specially desired organoleptic properties. Higher amount of whole grain cereals may be added to the beverage because the suspension properties of the beverage ingredient are improved and the reduced size of the insoluble fraction results in a reduced influence on the viscosity of the beverage.

The process according to the invention for preparing a whole grain cereal based extract; said process comprises the steps of:

(i); providing a whole grain cereal and cereal spent grain, preferably from 50 to 90 wt. % whole grain cereal, and 10 to 50 wt. % the cereal spent grain, based on the total whole grain cereal and the cereal spent grain,

(ii) subjecting the whole grain cereal to a single grinding and subsequently combining the whole grain cereal, the spent grain and water,

(iii) subjecting the ground whole grain cereal, the cereal spent grain and water to an enzymatic hydrolysis of macromolecular elements in the whole grain and the cereal spent grain providing a modified whole grain cereal,

(iv) inactivating the enzymes, and

(v) separating a soluble fraction of the modified whole grain cereal from an insoluble fraction of the modified whole grain cereal to obtain a modified whole grain cereal extract with soluble fractions from whole grain cereal and spent grain.

The process according to the present invention may be as shown in the flowchart in figure 2. The process illustrated begins with a whole grain cereal which may be allowed to malt before it is subjected to grinding.

In the present context the term "grinding", any physical destruction of the whole grain with the purpose to have the macromolecular structure of the whole grain available, for example to water and/or enzymes.

In the present context the term "cereal spent grain" is an insoluble fraction of whole grain obtained after enzymatic hydrolysis or mashing.

The insoluble part of cereal spent grain is in the present context selected from cereal fibers, cereal bran, and cereal spent grain or a combination thereof.

The ground (malted) whole grain cereal may then be mixed with water and optionally enzymes to modify the whole grain cereal. When the whole grain cereal has been sufficiently modified the enzymes are inactivated and the insoluble fraction of the whole grain cereal may be separated from the soluble fraction of the whole grain cereal.

In an embodiment of the present invention the soluble fraction (or a fraction hereof) and the cereal based fraction (or a fraction hereof) are derived from different whole grain cereals. Thus, the soluble fraction and the cereal based fraction do not necessarily have to come from the same whole grain.

In the present invention the term "whole grain cereal based extract" relates to an extract obtained from treating cereals by the process according to the present invention. Preferably, the whole grain cereal based extract comprises at least part of the insoluble fraction of the whole grain cereal.

In the present invention the term "cereal based fraction" relates to a fraction obtained from treating the insoluble fraction of a modified whole grain cereal by the process presented in the present invention. Preferably, the cereal based fraction comprises the insoluble fraction of the whole grain cereal.

In the present context the term "insoluble fraction" relates to a fraction obtained from the whole grain cereal comprising the insoluble fibres, i.e. the insoluble dietary fibres that are not fermented in the large intestine or only slowly digested

by the intestinal microflora. Examples of insoluble fibres include celluloses, hemicelluloses, resistant starch type 1 and lignins. Further benefits of insoluble fibres include promotion of the bowel function through stimulation of the peristalsis, which causes the muscles of the colon to work more, become stronger and function better. There is also evidence that consumption of insoluble fibres may be linked to a reduced risk of gut cancer.

Dietary fibres are the edible parts of plants that are not broken down by digestion enzymes. Dietary fibres are fermented in the human large intestine by the microflora. There are two types of fibres: soluble fibres and insoluble fibres. Both soluble and insoluble dietary fibres can promote a number of positive physiological effects, including a good transit through the intestinal tract which helps to prevent constipation, or a feeling of fullness. Health authorities recommend a consumption of between 20 and 35 g per day of fibres, depending on the weight, gender, age and energy intake.

In contrast to the insoluble fraction there is the soluble fraction which is obtained from the process described by the present invention. The soluble fraction comprises the soluble fibres and the other soluble parts of the whole grain, e.g. proteins, vitamins, minerals, sugars, etc.

In the present context "soluble fibres" may also include dietary fibres that undergo complete or partial fermentation in the large intestine. Examples of soluble fibres from cereals include beta-glucans, arabinoxylans, arabinogalactans and resistant starch type 2 and 3, and oligosaccharides deriving from the latter. Soluble fibres from other sources include pectins, acacia gum, gums, alginate, agar, polydextrose, inulins and galacto-oligosaccharides for instance. Some soluble fibres are called prebiotics, because they are a source of energy for the probiotics present in the large intestine. Further benefits of soluble fibres include blood sugar control, which is important in diabetes prevention, control of cholesterol, or risk reduction of cardiovascular disease.

In an embodiment of the present invention the soluble fraction may be a malt extract.

The starting material in the present process may be a whole grain cereal. Whole grain cereal is a product made from cereal grains comprising the entire edible parts of a grain, i.e. germ, endosperm and bran.

In an embodiment of the present invention the whole grain cereal may be provided from whole grain cereal, a cereal product as disclosed in EP 0 031 050, liquid whole grain (LWG), milled whole grain cereal or cereal flour or any combination thereof.

In the present context the term "cereal" relates to monocotyledonous plants of the Poaceae family (grass family) cultivated for their edible, starchy grains.

In an embodiment of the present invention the whole grain cereal is selected from the group consisting of barley, brown rice, wild rice, bulgur, corn, millet, oat, sorghum, spelt, triticale, rye, wheat, wheat berries, teff, canary grass, Job's tears, fonio and pseudocereals. Plant species that do not belong to the grass family, but also produce starchy seeds or fruits that may be used in the same way as cereal grains, are called pseudocereals. Examples of pseudocereals include amaranth, buckwheat, tartar buckwheat and quinoa.

Preferably the cereal spent grain originating from cereals selected from the group consisting of barley, sorghum, rice, wheat, oat and combinations thereof. Preferably the cereal spent grain originates from barley.

In yet an embodiment of the present invention the terms "cereal" and/or "whole grain cereal", include both cereal and pseudocereals. Preferably, the terms "cereal" and/or "whole grain cereal" does not include pseudocereals.

In a preferred embodiment of the present invention the whole grain cereal is a malted whole grain cereal.

One advantage of the insoluble fraction provided by the process described in the present invention may be that the suspension properties of the insoluble fraction are improved. This improvement is considered relative to the suspension

properties of an unprocessed insoluble fraction, e.g. having a main particle size above 100 µm.

In the present context the term "suspension properties" relate to the extent the insoluble fraction is to be suspended in a liquid phase. Normally the insoluble particles may be dispersed throughout the liquid phase by mechanical agitation, stirring or shaking. Suspensions are solutions where the insoluble fraction eventually settles or at least part of the insoluble fraction eventually settles over time if left undisturbed.

In a preferred embodiment of the process according to the invention the whole grain cereal is un-malted whole grain cereal.

It is preferred that the cereal spent grain used in the process is obtained from a malted or un-malted cereal process,

In a preferred embodiment the soluble fraction obtained from the separation in step (iv) of the process according to the invention is concentrated, preferably to a to a residual starch level of below 40% (w/w), preferably below 30 % (w/w).

Advantageously the beverage ingredient comprising a concentrate obtained with a process according to the invention wherein with residual starch below 30% (w/w) starch, preferably below 5% (w/w) starch, more preferably below 2 % (w/w).

Advantageously, the concentrate obtained with the process according to the invention comprises at least 10 % and up to 97.5 % (w/w) of the soluble fraction before concentration.

The hydrolysis in the process according to the invention may be carried out using mix of enzymes with different functionalities selected from the group consisting of alpha amylase, protease, xylanase, cellulase, beta-glucanase, pullulanase, lipases or a combination there.

Another aspect of the present invention relates to a whole grain cereal based extract obtainable from the above process.

Still another aspect of the present invention is to provide a process for preparing a beverage having improved organoleptic and/or improved nutritional value, said process comprises the steps of:

(a) providing a beverage ingredient according to the present invention,

(b) mixing the beverage ingredient of step (a) with a liquid component, and obtaining the beverage.

An even further aspect of the present invention is to provide a beverage consisting of:

(1) a liquid component; and

(2) a beverage ingredient according to the present invention.

The invention also relates to use of the modified whole grain cereal extract with soluble fractions from whole gran cereal and spent grain in culinary sauces, chocolate, binder for cereal bar, and breakfast cereal.

Compared to existing malt extract, the concentrate obtained with the method according to the invention has higher soluble proteins and dietary fiber from cereals, it is lower in lower in sugars and more sustainable due to the use of by product or side streams or spent grain from flour or cereal mashing process. The product is therefore potentially also lower in cost of production due to using by product and less cereal compared to regular malt extract.

In order to control the organoleptic properties of the beverage and/or improve the nutritional value of the beverage it is preferred that at least 50% of the insoluble fraction comprise particles having a particle size as mentioned above, such as at least 75% of the insoluble fraction comprise particles having a particle size as mentioned above, e.g. at least 90% of the insoluble fraction comprise particles having a particle size as mentioned above, such as at least 95% of the insoluble fraction comprise particles having a particle size as mentioned above, e.g. at least 98% of the insoluble fraction comprise particles having a particle size as mentioned above.

In an embodiment of the present invention the grinding in step is performed by use of a method selected from the group consisting of milling, ultrasound, micronisation, high pressure homogenisation, extrusion and combinations thereof.

Furthermore, water may be added to the grinding of the whole grain cereal in order to make the grinding process more effective.

Following the grinding process the ground whole grain cereal may be subjected to a hydrolysis of the macromolecular elements of the whole grain cereal. For example, the ground whole grain cereal may be subjected to a hydrolysis of carbohydrates and/or protein, and/or lipid, and/or other organic components (for example, polyphenols).

In an embodiment of the present invention the hydrolysis, for example, of carbohydrates and/or protein (in step (iii)), may be an enzymatic modification. Preferably, the enzymatic modification may be performed at a temperature in the range of 10°C-122°C, preferably in the range of 20°C -100°C, such as in the range of 20°C -40°C or in the range of 40°C-65°C.

In yet an embodiment of the present invention the hydrolysis, for example, of carbohydrates and/or protein (in step (iii)), may be performed until substantially complete modification of the starch has taken place. The term "substantially complete modification" relates to at most 10% of the original starch content, may be remaining after modification, such as at most 5% e.g. at most 2% e.g. at most 1%, such as at most 0.5% of the original starch content, may be remaining after modification.

The hydrolysis, for example, of carbohydrates and/or protein in step (iii), may be performed by one or more endogenous enzyme(s) and/or by the addition of one or more exogenous enzyme(s) or by the combination thereof.

In respect of the one or more exogenous enzyme(s), such exogenous enzyme(s) may be selected from the group consisting of proteases, dextrinases, cell-wall hydrolyzing enzymes, amylases and amyloglucosidases, fragments thereof and

any combination thereof. Preferably, a mixture of several of the above enzymes may be used.

In order to preserve the nutritional value of the whole grain cereal at least one of the one or more exogenous enzyme(s) may be enzyme(s) showing no modifying activity towards dietary fibers when in the active state.

In an embodiment of the present invention at least one of the endogenous enzyme(s) and/or the exogenous enzyme(s) is a protease and/or an amylase. The protease may be active in alkaline, neutral and/or acid pH conditions.

In yet an embodiment of the present invention the proteases may be a metaloprotease, threonine protease, cysteine protease, aspartate protease, glutamic acid protease, serine protease or a combination hereof.

The amylase may preferably be an alpha-amylase, such as 1,4-α-D-glucan glucanohydrolase or glycogenase, a beta-amylase, such as 1,4-α-D-glucan maltohydrolase or saccharogen amylase, a gluco-amylase, such as amyloglucosidase or Exo-1,4-α-glucosidase or any combination hereof.

When the hydrolysis for example, of carbohydrates and/or protein, has reached a substantially complete modification the process may further comprise a step of inactivating the enzymatic activity. This inactivation may be performed by changing the temperature to a temperature in the range of 40°C -130°C, preferably in the range of 75°C-85°C. Preferably the inactivation may be performed for a period of time of at least 15 seconds, such as at least 30 seconds, e.g. at least 1 minute, such as at least 5 minutes, e.g. at the least 10 minutes, such as at least 20 minutes, e.g. at least 30 minutes.

Hydrolysis of the different macromolecular elements of the whole grain cereal can also be achieved by any other means known in the art, such as chemical modification, e.g. acid hydrolysis.

When the hydrolysis has ended and the soluble parts of the whole grain cereal have been liberated from the insoluble parts the soluble fraction and insoluble

fraction may be separated. Thus, in an embodiment of the present invention the separation of the soluble fraction from the insoluble fraction (in step (iv)) may be selected from the group consisting of filtration, centrifugation, decanting and a combination thereof.

Depending on the application of the soluble fraction it may be further treated in order to provide different fractions comprising specific components or it may be concentrated. Preferably the soluble fraction obtained from the separation (in step (iv)) is concentrated. The concentrate may comprise at least 10 % and up to 97.5 % (w/w) of the soluble fraction before concentration. The final concentrate may be in the form of a liquid, a gel or a powder.

The insoluble fraction obtained may also be subjected to further processing.

In an embodiment of the present invention the insoluble fraction of the modified whole grain cereal (obtained from the separation step (v)) may be subjected to a second enzymatic treatment, a chemical treatment, a fermentation or a combination thereof before, during or after the second grinding (in step (v)).

The further processing step may be a second enzyme treatment. Preferably, the second enzyme treatment is performed by one or more exogenous enzyme(s). In an embodiment of the present invention the one or more exogenous enzyme(s) is a cell-wall hydrolyzing enzyme, preferably selected from the group consisting of arabinoxylanases, beta-glucanases, cellulases, endoxylanase, including endo-1,4-β-xylanase, E.C.3.2.1.8, β-xylosidase, including xylan 1,4-β-xylosidase, E.C.3.2.1.37, α-glucuronidase, including α-glucosiduronase, E.C.3.2.1.139, α-arabinofuranosidase, including α-L-arabinofuranosidase, E.C.3.2.1.55, acetylxylan esterase, including E.C. 3.1.1.72, β-xylosidase and fragments thereof.

The outcome of the one or more exogenous enzyme(s) may be a change in the structural properties and/or improve functionality such as taste and nutritional properties of the whole grain cereal and/or the insoluble fraction.

The processed insoluble fraction obtained from the process described herein is called cereal based fraction. This cereal based fraction may preferably be used directly as a beverage ingredient.

In an embodiment of the present invention the beverage ingredient comprising a cereal based fraction. The cereal based fraction issued from the modification of the insoluble part of a grinded and hydrolyzed whole grain cereal, comprises particles having a particle size of at the most 100 µm, such as at the most 50 µm, e.g. at the most 30 µm and residual starch level of at the most 20% (w/w) starch, such as at the most 5% (w/w) starch, e.g. at the most 3% (w/w) starch, such as at the most 2% (w/w) starch, e.g. at the most 1% (w/w) starch.

In the present context the term "whole grain cereal based extract" relates to a whole grain cereal base extract comprising the insoluble fraction or a combination of the soluble fraction and the insoluble fraction.

In another embodiment of the present invention the beverage ingredient comprises 5-30% (w/w) dietary fibre, such as 8-25% (w/w) dietary fibre, e.g. 10-20% (w/w) dietary fibre, such as 12-17% (w/w) dietary fibre.

In yet another embodiment of the modified cereal based fraction comprises 25-75% (w/w) dietary fibres; 10-35% (w/w) protein and 10-35% (w/w) carbohydrate.

As mentioned above the whole grain cereal based extract may be a combination of both the soluble fraction and the insoluble fraction. In an embodiment of the present invention the beverage ingredient comprises at least 15 % (w/w) of a soluble fraction of a modified whole grain cereal, such as at least 25%, e,g. at least 50%, e.g. at least 75%.

In an embodiment of the present invention the beverage ingredient comprises at most 70% (w/w) protein or fragments hereof, such as at the most 50% (w/w) protein or fragments hereof, e.g. at the most 20% (w/w) protein or fragments hereof, such as at the most 2% (w/w) protein or fragments hereof, e.g. at the most 1% (w/w) protein or fragments hereof.

In another embodiment of the present invention the beverage ingredient comprises at least 5% (w/w) protein or fragments hereof, such as at least 10% (w/w) protein or fragments hereof, e.g. at least 25% (w/w) protein or fragments hereof, such as at least 50% (w/w) protein or fragments hereof, e.g. at least 60% (w/w) protein or fragments hereof.

It may be advantageous that the present beverage ingredient may be a high sugar beverage ingredient or a low sugar beverage ingredient. When the beverage is a high sugar beverage ingredient the beverage ingredient comprises above 50% (w/w) sucrose and at most 95% (w/w) sucrose, such as at most 85% (w/w) sucrose, e.g. at most 75% (w/w) sucrose, such as at most 65% (w/w) sucrose. When the beverage ingredient is a low sugar beverage ingredient the beverage ingredient comprises at most 50% (w/w) sucrose, such as at most 40% sucrose, e.g. at most 25% sucrose, such as at most 15% sucrose, e.g. at most 10% sucrose, such as at most 5% sucrose, e.g. 0% sucrose.

In order to control and/or improve the sensory impression of the beverage and the beverage ingredient the beverage ingredient comprises a flavour component. In an embodiment of the present invention the flavour component may be selected from the group consisting of cocoa, coffee, fruit, malt, soya, tea, vegetable, and any combination thereof.

The beverage ingredient may also comprise a fat component. In an embodiment of the present invention the fat component may be a vegetable fat component, a fish oil component or a combination thereof.

The beverage ingredient may further comprise a milk component, such as a skimmed milk component and/or milk component.

Depending on the application of the beverage ingredient and the production conditions, the beverage ingredient may be in the form of a liquid, a concentrate, a puree or a powder.

In the present case, malt extract may be considered as soluble fraction of the modified whole grain cereal.

In another embodiment of the present invention the beverage ingredient comprises, on a dry matter basis, 10-50% (w/w) of a modified cereal based fraction, preferably about 30% (w/w); 15-45% (w/w) of a skimmed milk powder, preferably about 20% (w/w); 8-30% (w/w) sucrose, preferably about 15 % (w/w).

In a preferred embodiment of the beverage ingredient it has 10 - 15 wt. % protein, and 5 - 10 wt. % fibers.

The beverage ingredient may preferably be used for the preparation of a beverage. In particular, the beverage ingredient may be used for the preparation of a beverage having improved organoleptic properties and/or an improved nutritional value.

This beverage may be prepared by:

(a) providing a beverage ingredient as described in the present invention,

(b) mixing the beverage ingredient of step (a) with a liquid component, and obtaining the beverage.

The liquid component may be any kind of consumable liquid component. Preferably, the liquid component may be selected from the group consisting of water, milk, fruit juice, vegetable juice or any combination thereof.

The milk component may be selected from the group consisting of whole milk, whey fractions, casein, any combination hereof

Hence, a beverage may be provided consisting of:

(1) a liquid component; and

(2) a beverage ingredient as described in the present invention.

In the present context the term "beverage" refers to a composition in the form of a dry powder, a slurry or a liquid. It is to be understood that the dry powder may

be reconstituted in any applicable liquid suitable for consumption. The slurry or the liquid may be further diluted using any applicable liquid suitable for consumption.

Said beverage may comprise at least at least 5 % (w/w) on a ready to drink basis of the soluble fraction of a modified whole grain cereal, such as at least 10% (w/w) on a ready to drink basis of the soluble fraction of a modified whole grain cereal, e.g. at least 20% (w/w) on a ready to drink basis of the soluble fraction of a modified whole grain cereal, such as at least 30% (w/w) on a ready to drink basis of the soluble fraction of a modified whole grain cereal, e.g. at least 50% (w/w) on a ready to drink basis of the soluble fraction of a modified whole grain cereal.

The concentration of the cereal based fraction may be at least 5 %(w/w) of the beverage, on a ready to drink basis, such as at least 10% (w/w) of the beverage, on a ready to drink basis, e.g. at least 20% (w/w) of the beverage, on a ready to drink basis, such as at least 20% (w/w) of the beverage, on a ready to drink basis, e.g. at least 30% (w/w) of the beverage, on a ready to drink basis, such as at least 50% (w/w) of the beverage, on a ready to drink basis, e.g. at least 75% (w/w) of the beverage, on a ready to drink basis.

Furthermore, the beverage may have a concentration of protein or fragments thereof of at least 5% (w/w) of the beverage, such as at least 10% (w/w) of the beverage, e.g. at least 15% (w/w) of the beverage, such as at least 20% (w/w) of the beverage, e.g. at least 25% (w/w) of the beverage.

Due to the possibility to increase the content of whole grain cereal in the beverage it is considered that the beverage is capable of bringing a health benefit to the consumer.

Such health benefit may be selected from improving the gastro-intestinal health, for providing a better immune system, for providing healthy aging, for reducing constipation, for lowering cholesterol, for reducing the incidence of cardiovascular diseases, for reduced obesitas, reducing the incidence of diabetes or any combination thereof.

In the present context the term "(w/w)" relates to a weight by weight ratio of a compound or product on a dry-matter basis unless any this else is stated.

It should be noted that embodiments and features described in the context of one of the aspects of the present invention also apply to the other aspects of the invention.

All patent and non-patent references cited in the present application, are hereby incorporated by reference in their entirety.

Several advantages of having a cereal based fraction with improved suspension properties exist:

I. An increase in whole grain cereal and fiber content may be provided in the final product, e.g. the beverage, while the organoleptic parameters of the product are substantially not affected;
II. The nutritional value of the whole grain cereal may be preserved;
III. Greater sense of satiety substantially without affecting the organoleptic parameters of the product and slower digestion. Currently, there are limitations for enriching beverages with whole grain due to non-flowable viscosity, grainy texture, and taste issues. However, the use of whole grain cereals treated according to the present invention in beverages allow for providing the desired viscosity, desired organoleptic parameters, a smooth texture, minimal flavor impact, and added nutritional health and wellness values;
IV. An additional advantage may be to improve the carbohydrate profile of the final products by replacing traditional externally supplied sweeteners such as glucose syrup, high fructose corn syrup, invert sugar, maltodextrine, sucrose, fiber concentrate, etc. with a more wholesome sweetener source.

The invention will now be described in further details in the following non-limiting examples.

Examples

Example 1 – Comparative profiling of beverage made using 100% green barley extract compared to beverage made using 50-50 (wt%) modified malt extract

Table 1 shows a comparison of filtration, leaching rates and yield between 100% green barley-based malt extract process and modified malt extract process. The leaching process in the current context is carried out after filtration process whereby water is passed through the spent grain to further extract the soluble matter trapped in the spent grain to maximize the yield of the overall process. Yield in the present context is defined as the amount of dry matter extracted per 100 g dry matter of the initial material.

Table 1

Process	Avg Filtration (ml/min)	Avg Leaching (ml/min)	Yield (%)
100% green barley	6.8	6.7	60
50-50 (wt%)	7.11	5.33	61

Table 2 shows a comparison of nutritional profile of 100% green barley-based malt extract and modified malt extract at 80% total solids. Protein and fiber are significantly higher in modified malt extract compared to 100% green barley malt extract with concurrent decline in available carbohydrates.

Table 2

Nutrients (g/100g)	100% green barley malt extract	50-50 (wt%) modified malt extract
Fat	0.1	1.6
Protein	1.832	8.8

Available carbohydrate	76.72	66.4
Total fiber	0.48	8.8
Ash	1.3	3.2
Moisture	20	20
Total	100	100

Figure 1 shows comparative profiling of beverage made using 100% green barley extract compared to beverage made using 50-50 (wt%) modified malt extract. 11 tasters were involved in the tasting. The data suggests that except phase separation, none of the attributes deviate beyond +1/-1 showing that differences are not significant.

Example 2 – Enzymatic hydrolysis of wet spent grain to improve nutritional properties of extract

Wet spent grain obtained as insoluble matter from the malted barley filtration process is combined with malted barley grist in 1:1 fraction and subjected to enzymatic hydrolysis process. This processing is to further solubilize the insoluble present in the wet spent grain to obtain filtrate which undergo evaporation step to increase total solids content. The goal of further solubilizing the wet spent grain is to modulate the nutritional profile of the extract called as modified malt extract. This modified malt extract can have higher protein and dietary fiber content.

Example 3 - Cacao beverage with modified whole grain and bran malt-extract

A powder that is dosed at 15 g per 100 ml water and with 1 serving being defined as 28-30 gram. A powder containing 30-40 % modified whole grain and bran malt extract preferably about 38% 15-40 % skimmed milk powder preferably about -21 %), 10-20 % sugar (preferably 15 %), 10-20 % cocoa (preferably 12%) and 5-15 % fat (10 %), of which the whole grain and bran malt extract contains around 1-5 % valorised spent grain which consists of ca. 50 % insoluble fibers, ca. 25 % protein and ca. 25 %carbohydrates. The beverage has a caloric value below 255

kcal per serving and is intended to become consumed as a major part of the meal (e.g. breakfast).

Claims

1. A process for preparing a whole grain cereal based extract; said process comprises the steps of:

(i) providing a whole grain cereal and cereal spent grain, preferably from 50 to 90 wt. % whole grain cereal, and 10 to 50 wt. % the cereal spent grain, based on the total whole grain cereal and the cereal spent grain,

(ii) subjecting the whole grain cereal to a single grinding and subsequently combining the whole grain cereal, the spent grain and water,

(iii) subjecting the ground whole grain cereal, the cereal spent grain and water to an enzymatic hydrolysis of macromolecular elements in the whole grain and the cereal spent grain providing a modified whole grain cereal,

(iv) inactivating the enzymes, and

(v) separating a soluble fraction of the modified whole grain cereal from an insoluble fraction of the modified whole grain cereal to obtain a modified whole grain cereal extract with soluble fractions from whole grain cereal and spent grain.

2. The process according to claim 1, wherein the whole grain cereal is un-malted whole grain cereal.

3. The process according to any of the proceeding claims, wherein the cereal spent grain is obtained from a malted or un-malted cereal process,

4. The process according to any of the proceeding claims, wherein the cereal spent grain originating from cereals selected from the group consisting of barley, sorghum, rice, wheat, oat and combinations thereof.

5. The process according to any one of the proceeding claims, wherein the soluble fraction obtained from the separation in step (v) is concentrated, preferably to a to a residual starch level of below 40% (w/w), preferably below 30 % (w/w).

6. The process according to claim 5, wherein the concentrate comprises at least 10 % and up to 97.5 % (w/w) of the soluble fraction before concentration.

7. The process according to any of the proceeding claims, wherein the hydrolysis is carried out using a mix of enzymes with different functionalities selected from the group consisting of alpha amylase, protease, xylanase, cellulase, beta-glucanase, pullulanase, lipases or a combination there.

8. A beverage ingredient comprising a concentrate obtained with a process according to any of claims 5 to 7 with residual starch below 30% (w/w) starch, preferably below 5% (w/w) starch, more preferably below 2 % (w/w).

9. The beverage ingredient according to claim 8, wherein the ingredient comprises, on a dry matter basis, 25-45 % (w/w) of a concentrated modified cereal based fraction, preferably 34-38% (w/w); 15-25% (w/w) of a skimmed milk powder, preferably 18-22% (w/w); 10-20% (w/w) carbohydrate, preferably 14-18% (w/w); 10-20% (w/w) cocoa, preferably 12-15% (w/w), and 5-15% (w/w) of a fat component, preferably 8-12% (w/w).

10. A process for preparing a beverage having improved organoleptic and/or improved nutritional value, said process comprises the steps of:

(a) providing a beverage ingredient according to claims 8 and 9,
(b) mixing the beverage ingredient of step (a) with a liquid component, and obtaining the beverage.

11. The process according to claim 10, wherein the liquid component is selected from the group consisting of water, milk, fruit juice, vegetable juice or any combination thereof.

12. A beverage consisting of:

(1) a liquid component; and

(2) a beverage ingredient according to claims 8 and 9.

5

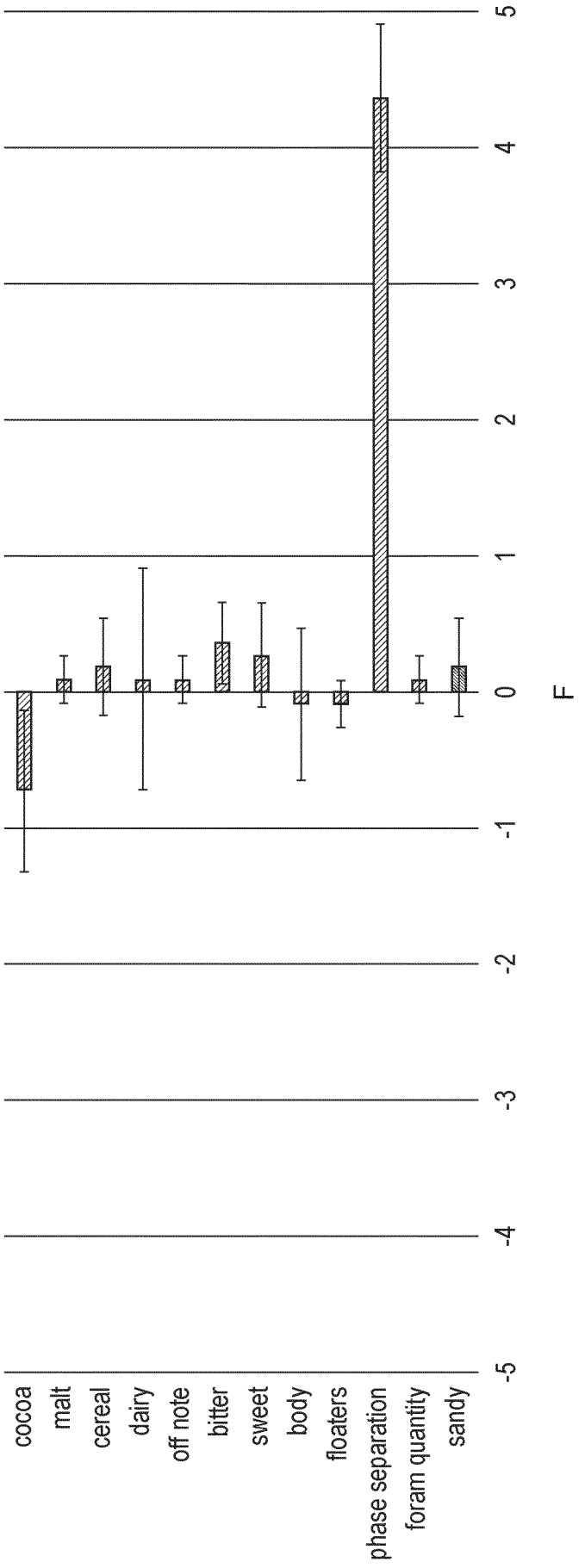
5
4
3
2
1
0
-1
-2
-3
-4
-5
F
cocoa
malt
cereal
dairy
off note
bitter
sweet
body
floaters
phase separation
foram quantity
sandy

FIG. 1

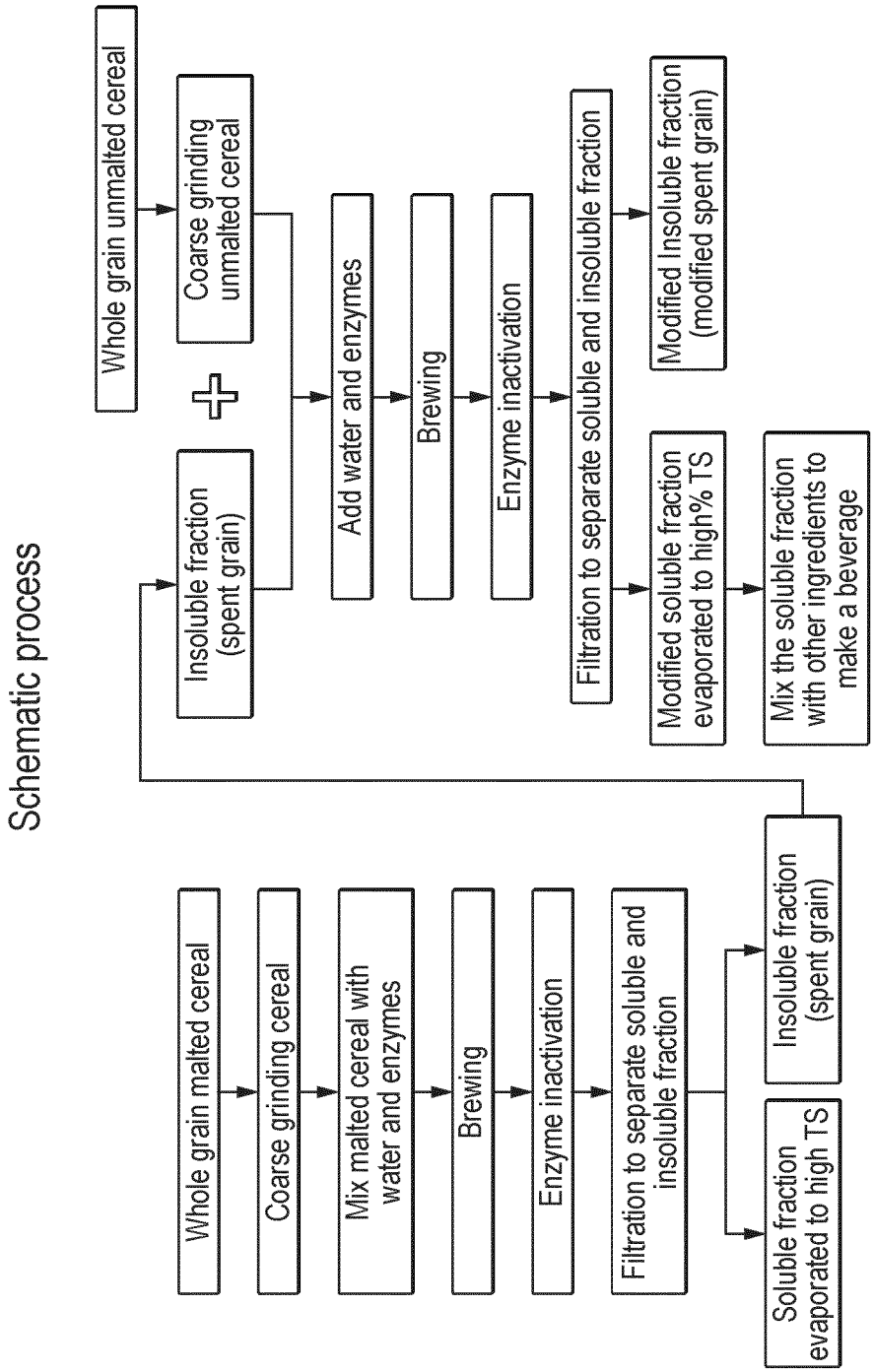
Schematic process
Whole grain malted cereal
Coarse grinding cereal
Mix malted cereal with water and enzymes
Brewing
Enzyme inactivation
Filtration to separate soluble and insoluble fraction
Soluble fraction evaporated to high TS
Insoluble fraction (spent grain)
Whole grain unmalted cereal
Insoluble fraction (spent grain)
Coarse grinding unmalted cereal
Add water and enzymes
Brewing
Enzyme inactivation
Filtration to separate soluble and insoluble fraction
Modified soluble fraction evaporated to high% TS
Modified Insoluble fraction (modified spent grain)
Mix the soluble fraction with other ingredients to make a beverage

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2022/076431

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23L2/385 A23L2/84 A23L7/104 A23L7/20 A23L2/52
ADD.

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

B. FIELDS SEARCHED

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

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/017356 A1 (TE BIESEBEKE ROB [CH] ET AL) 16 January 2014 (2014-01-16) paragraphs [0034], [0082] - [0085]; claims 1-15; figure 1; example 3	1-12
A	US 2013/280378 A1 (AICHINGER PIERRE-ANTON [CH] ET AL) 24 October 2013 (2013-10-24) claim 1; example 1	1-12
A	WO 2021/078996 A1 (CIRCULAR FOOD TECH APS [DK]) 29 April 2021 (2021-04-29) claims 1-22; examples 9, 10	1-12
A	EP 3 085 243 A1 (TECH UNIVERSITÄT BERLIN [DE]; UNIV GRIFFITH [AU]) 26 October 2016 (2016-10-26) claims 1-15	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 November 2022	09/12/2022

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	van Klompenburg, Wim

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2022/076431

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014017356 A1	16-01-2014	AR 085563 A1	09-10-2013
		AU 2012230336 A1	17-10-2013
		BR 112013024419 A2	13-06-2017
		CL 2013002734 A1	14-03-2014
		CN 103547171 A	29-01-2014
		EP 2688420 A1	29-01-2014
		MY 168938 A	10-01-2019
		RU 2013147377 A	27-04-2015
		SG 193604 A1	30-10-2013
		US 2014017356 A1	16-01-2014
		WO 2012126972 A1	27-09-2012
US 2013280378 A1	24-10-2013	AU 2010365332 A1	06-06-2013
		BR 112013013924 A2	16-08-2016
		CA 2818264 A1	14-06-2012
		CN 103249316 A	14-08-2013
		EP 2648544 A1	16-10-2013
		RU 2013131108 A	20-01-2015
		SG 190840 A1	31-07-2013
		TW 201230968 A	01-08-2012
		US 2013280378 A1	24-10-2013
		WO 2012076053 A1	14-06-2012
WO 2021078996 A1	29-04-2021	AU 2020371240 A1	18-11-2021
		CN 115023144 A	06-09-2022
		EP 4048083 A1	31-08-2022
		WO 2021078996 A1	29-04-2021
EP 3085243 A1	26-10-2016	AU 2016251493 A1	02-11-2017
		CA 2983168 A1	27-10-2016
		CN 107734975 A	23-02-2018
		DK 3085243 T3	14-01-2019
		EP 3085243 A1	26-10-2016
		ES 2705075 T3	21-03-2019
		JP 2018512887 A	24-05-2018
		US 2018135000 A1	17-05-2018
		WO 2016169835 A1	27-10-2016