

A CONTINUOUS PROCESS AND SYSTEM FOR PREPARING A LIQUID
OAT BASE OR DRINK FROM AN OAT DERIVED MATERIAL

Technical field

The invention relates to a process and system for preparing a liquid oat base or drink from an oat derived material.

5 Background

There is a growing interest in refraining from consumption of dairy products and from meat products, for example for health reasons, religious reasons, and sustainability reasons. In addition, there is a growing trend to choose products for consumption in the daily life which contribute to a positive
10 climate impact. This may mean excluding or at least reducing intake of dairy based products as well as meat products.

Oat is well known for containing nutritious compounds and may be considered a sustainable vegetable ingredient in food production. Oat in different forms is therefore an often-used ingredient in healthy and nutritious
15 foods.

For example, use of oats in production of oat-containing aqueous liquid, often referred to as oat base, is well known. Such oat base may be used as ingredient or base for manufacturing of different food products, for example, analogues for dairy products. Oat beverage, such as oat drink is
20 one well known example.

Manufacturing of oat base, and oat drink, typically involves subjecting micronized oats to one starch degrading enzymatic treatment in aqueous suspension. Process parameters, such as temperature, have an effect on both enzymes and the micronized oats of the suspension. It is challenging
25 and problematic during the manufacturing to maintain the micronized oats in the aqueous suspension, in a form suitable for the enzymatic treatment. It is further problematic to control the enzymatic activities, as well as maintaining nutritious qualities from the oats, during the manufacturing process.

There is, thus, a need for providing improved control of manufacturing
30 process for the oat base, while at the same maintaining control of the quality of the end product, the oat base.

Summary of the invention

It is an objective of the present invention to, at least partly, improve the overall process of preparing an oat base or oat drink

- 5 According to a first aspect of the invention, these and other objects are achieved, in full or at least in part, by a process for preparing a liquid oat base or drink from an oat derived material. The process comprises, simultaneously, feeding a first enzymation section with the oat derived material and enzymes, enzymating the oat derived material in the first enzymation section, and
10 outputting a flow of enzymated oat derived material from the first enzymation section.

This is advantageous in that the process can run uninterruptedly using one enzymation section or enzymation tank only. This provides for major cost-savings since the process will be automatized and continuous.

- 15 The process may further comprise heating, by a first heating device fluidly connected to and arranged downstream of the first enzymation section, the flow of enzymised oat derived material to terminate the enzymation thereof.

- 20 The process may further comprise cooling the enzymised oat derived material after heating the flow of enzymised oat derived material.

The process may further comprise the step of steaming enzymised oat derived material after the step of heating the enzymised oat derived material to terminate the enzymation and before the step of cooling the enzymised oat derived material.

- 25 The process may further comprise, simultaneously, feeding a second enzymation section with the enzymated oat derived material and enzymes, enzymating the enzymised oat derived material in the second enzymation section, and outputting a flow of enzymated oat derived material from the second enzymation section.

- 30 In other words, the oat derived material may be subjected to two steps of enzymation, the first in the first enzymation section, and the second in the second enzymation section.

The enzymation of the oat derived material in the first enzymation section may be a first enzymation of oat derived material in aqueous suspension, wherein a first enzymatically treated suspension is formed.

5 The heating the oat derived material from the enzymation in the first enzymation section to terminate the enzymation thereof, may be heating the first enzymatically treated suspension, wherein a heat-treated suspension is formed.

10 The enzymation in the second enzymation section of the oat derived material from the heating may be a second enzymation of the heat-treated suspension, wherein a second enzymatically treated suspension is formed. The second enzymatically treated suspension, may, with or without further treatment, be an oat base or drink.

15 The further treatment may be, for example heating and/or removal of particulate matter or compounds such as for example fiber residues or other non-desired matter originating from the oat derived material after the second enzymation. For example, the further treatment may be sedimentation, decantation, and/or filtering.

20 The process may further comprise heating, by a second heating device fluidly connected to and arranged downstream of the second enzymation section, the flow of enzymised oat derived material to terminate the enzymation thereof.

The process may further comprise cooling the enzymised oat derived material after heating the flow of enzymised oat derived material.

25 The process may further comprise the step of steaming the enzymised oat derived material after the step of heating the enzymised oat derived material to terminate the enzymation and before the step of cooling the enzymised oat derived material.

30 The oat derived material may comprise micronized oats or micronized oat-kernels, or oat-flour and/or fractions of oat. For example, the oat derived material may, thus, be in form of milled, crushed or ground oat derived material, or a combination thereof. As another example, the fractions of oat may be oat bran or fiber reduced oat flour.

The oat derived material may be a mixture of oat and water. For example, the oat derived material may be a mixture of oat and water an aqueous or water-based suspension or slurry of one or more of micronized oat-kernels, oat-flour and/or fractions of oat.

5 If the oat derived material comprises or is in form of micronized oats or micronized oat-kernels, or oat-flour, or fractions of oat, the oat derived material may be oat derived material provided for or entering the first enzymation. Such oats, for example micronized oats, will in the process be at least partially degraded or transformed, for example by means of the first and
10 second enzymation, and it shall be understood that as it progresses in the process it may cease to be in the provided form of micronized oats or oat-kernels.

 The oat derived material may be selected from heat-treated wet milled oats, heat-treated dry milled oats, heat-treated oat bran, heat-treated dehulled
15 or hulled/naked dry milled oat flour.

 The oat derived material may be provided as an aqueous or water suspension, slurry or paste. Thereby, the oat derived material can be pumped and mixed and efficiently subjected to heating. Further, such oat derived material may be efficiently enzymatically treated. The content of oat derived
20 material in water may be, for example, 5-30% by weight dry substance, such as 10-25% by weight dry substance based on the weight of the oat derived material in water.

 The oat derived material comprising oat starch may be subjected to a partial hydrolysis by a starch degrading enzyme, such as amylase. The
25 amylase may be one or more of α -amylase and β -amylase.

 The oat derived material comprising proteins may be subjected to a protein solubilizing enzyme such as a protein deamidase, preferably protein glutaminase.

 Thereby, the liquid oat base or drink having an improved soluble oat
30 protein content may be provided. A desirable and synergistic effect, which improves levels of solubilized proteins, is achievable from the combination of using starch degrading enzymes and protein solubilizing enzymes.

Enzymation of the product in two separate steps will make it possible to provide a product with a more even quality.

After the step of enzymation in the first enzymation section the oats may be subjected to higher temperatures of the heating. This is believed to be, at least in part, a result of starch degradation in the first step of enzymation, which results in lower degree of gelatinization during the heat treatment as compared to heat treatment without a preceding first step of enzymation.

Other enzymes for solubilizing proteins may be used than the protein deamidase or protein glutaminase. Solubilization of proteins, as used herein, is intended to describe an increase of solubility of the proteins in water or aqueous liquid as compared to prior to or without the treatment, such that at least a portion of the proteins present in the oat derived material may be provided in aqueous or water solution. Solubilization may be realized, for example, by enzymes modifying amino acids of the proteins, such as side chains of amino acids, into more hydrophilic form, for example by converting amide groups of the side chains. Any type of enzymes suitable for this purpose in providing an oat base or oat drink may be considered for the purpose. Converting the proteins into a more water-soluble form, or solubilizing proteins, allows for more efficient process for preparing a liquid oat base or drink from an oat derived material, as well as improved properties of the oat base or drink. Increase solubility may, for example, improve extraction of proteins from an oat derived material matrix during the process, thus increasing levels of oat protein in the oat base or drink.

According to a second aspect of the invention, these, and other objects, and/or advantages that will be apparent from the following description, are achieved, in full or at least in part, by a system for preparing a liquid oat base or drink from an oat derived material. The system comprises a first enzymation section adapted for a first enzymation of the oat derived material flowing therethrough, the first enzymation section having a continuous infeed and outfeed, and a first heating device fluidly connected to and arranged downstream of the first enzymation section and adapted to heat the oat derived material from the first enzymation, wherein the first

enzymation section comprises a first volume, the first volume being selected such that the oat derived material is enzymised during a predetermined time-period.

5 The first volume and a first flow rate of the oat derived material flowing through the first volume may be selected such that the time-period in which the oat derived material is enzymised in the first volume yields a satisfactory enzymation, such as for example 30-90 minutes, preferably, 50-70 minutes.

The first heating device may be adapted to both heat the enzymised oat derived material in a first step and thereafter cool the enzymised oat
10 derived material in a second step.

The heating device may comprise a heat exchanger and/or a steam injector.

The system may further comprise a second enzymation section fluidly connected downstream to the first heating device and adapted for a second
15 enzymation of the oat derived material flowing therethrough, the second enzymation section having a continuous infeed and outfeed, and a second heating device fluidly connected to and arranged downstream of the second enzymation section and adapted to heat the oat derived material from the second enzymation, wherein the second enzymation section comprises a
20 second volume, the second volume being selected such that the oat derived material is enzymised during a predetermined time-period.

The second volume and a second flow rate of the oat derived material flowing through the second volume may be selected such that the time-period in which the oat derived material is enzymised in the second volume yields a
25 satisfactory enzymation.

The second heating device may be adapted to both heat the enzymised oat derived material in a first step and thereafter cool the enzymised oat derived material in a second step.

The heating device may comprise a heat exchanger and/or a second
30 steam injector.

The first enzymation section and the second enzymation section may comprise a conduit or a reservoir, such as a tank, respectively.

Effects and features of the second aspect of the present invention are largely analogous to those described above in connection with the first aspect of the inventive concept. Examples mentioned in relation to the first aspect of the present invention are largely compatible with the further aspects of the invention.

Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached claims, as well as from the drawings. It is noted that the invention relates to all possible combinations of features.

Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to “a/an/the [element, device, component, means, step, etc.]” are to be interpreted openly as referring to at least one instance of the element, device, component, means, step, etc., unless explicitly stated otherwise.

The oat base or drink material may comprise, by dry weight, 5-20% protein, and 3-15% fat, and optionally 10-80% carbohydrates, including sugars. Typically, the oat base or oat drink may comprise sugars 2-8%, fibers 0.2-3% (out of which 0.1-1% of the oat drink are beta glucans), fat 0.0-2.5%, and proteins 0.5-2.5%, by weight of the oat base or drink. The liquid oat base or drink may comprise an oat derived material with 5-20% by weight dry substance, based on the weight of the liquid oat base or drink.

Herein is disclosed a process for preparing the liquid oat base or drink from the oat derived material. It shall be understood that the oat derived material changes in the process. In the present disclosure, in an attempt to improve understanding and clarity of the disclosure, the term oat derived material is sometimes used to describe and refer to oat derived material having undergone different treatment in the process, and, thus, one oat derived material may not be the same as another oat derived material. Sometimes herein, if deemed to improve clarity, the term oat derived material is further specified, for example, by defining it as an oat derived material from the first enzymation, or an oat derived material from the heating etc. Some examples of changes, which the oat derived material may undergo in the

process, will now be given. Oat derived material in the first enzymation and the second enzymation may, for example, be subjected to starch degrading enzymes, which enzymes may degrade starch present in the oat derived material and, thus, change the oat derived material. As a further example, the heating the oat derived material may involve swelling of starch in the oat derived material, thus changing the oat derived material. To further exemplify, oat derived material early in the first enzymation may be micronized oat kernels with essentially intact starch, while oat derived material at the end of the first enzymation may be oat derived material comprising degraded starch.

The oat base or drink from the process may be mixed with additional additives and may then be referred to a liquid oat composition.

Herein is disclosed a process for preparing the liquid oat base or drink from the oat derived material by contacting the oat derived material with the enzyme such as the starch degrading enzyme, and the protein solubilizing enzyme. It shall be understood that the contact may be performed in many different ways such as for example by mixing the oat derived material and the enzyme in a supply or vessel such as a tank and/or a pipe. The mixing may be performed by any known mixing techniques such as in a mixing tank comprising impellers or blades.

As used herein, the term “comprising”, and variations of that term are not intended to exclude other additives, components, integers, or steps.

Brief description of the drawings

The above, as well as additional objects, features, and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of the present invention, with reference to the appended drawings, where the same reference numerals may be used for similar elements, and wherein:

Fig. 1A and 1B are flow charts of two examples of a process for preparing a liquid oat base or drink from an oat derived material.

Fig. 2 is a schematic view of one example of a system for preparing a liquid oat base or drink from an oat derived material.

Fig. 3 is a schematic view of another example of the system for preparing a liquid oat base or drink from an oat derived material.

Fig. 4 is a schematic view of a heating device in the system for preparing a liquid oat base or drink from an oat derived material.

5 Fig. 5a and 5b are schematic views of further examples of the system for preparing a liquid oat base or drink from an oat derived material.

Detailed description

The present inventive concept will now be described more fully
10 hereinafter with reference to the accompanying drawings, in which currently preferred variants of the inventive concept are shown. This inventive concept may, however, be implemented in many different forms and should not be construed as limited to the variants set forth herein; rather, these variants are provided for thoroughness and completeness, and fully convey the scope of
15 the present inventive concept to the skilled person.

Fig. 1A is a flow chart illustrating the steps of a process for preparing a liquid oat base or drink from an oat derived material. Below, the different steps are described in more detail. Even though illustrated in a specific order, the steps of the process 100 may be performed in any suitable order, as well
20 as multiple times and in parallel.

A first enzymation section is fed S102 with the oat derived material and enzymes. The oat derived material may comprise micronized oats or micronized oat-kernels, or oat-flour. The oat derived material may be provided as an aqueous or water suspension or slurry.

25 The oat derived material in the first enzymation section is enzymated S104. The enzymation S104 may comprise contacting the oat derived material with starch degrading enzymes. The starch degrading enzymes may preferably be amylase. Alternatively, the enzymation S104 may comprise contacting the oat derived material with protein solubilizing enzyme. The
30 protein solubilizing enzyme may preferably be protein deamidase or protein glutaminase.

A flow of enzymated oat derived material is outputted S106 from the first enzymation section. Enzymised oat derived material may be interpreted as oat derived material which has been subject to any degree of enzymation.

The steps of feeding S102 the first enzymation section, enzymating
5 S104 the oat derived material in the first enzymation section and outputting S106 a flow of enzymised oat derived material is performed simultaneously. In other words, the first enzymation section is continuously fed with new oat derived material and at the same time continuously outputting enzymated oat derived material. Thus, the oat derived material is enzymated during the time
10 which it flows through the first enzymation section. The time which the oat derived material flows through the first enzymation section may be such that the oat derived material is enzymated to a predetermined enzymation level. Put differently, the time it takes from when the oat derived material enters the enzymation section to when the oat derived material exits the enzymation
15 section may be the same as an enzymation time t_e , where the enzymation time t_e is the time it takes for the oat derived material to be enzymised to the predetermined level. The oat derived material may also be fed with a first rate different from a second rate of outputting enzymated oat derived material.

The flow of enzymised oat derived material may be heated S108 to
20 terminate the enzymation thereof. The enzymation may be entirely terminated. Alternatively, the enzymation may be only partly terminated. The heating process may have the effect of making the oat derived material more susceptible to enzymes. In other words, the oat derived material may be more accessible for other enzymes.

25 For example, the heating of the oat derived material may gelatinize starch present in the oat derived material and allow swelling of starch and swelling of any present oat derived material granules, thereby providing open oat derived material. Open oat derived material may also be referred to as open oat particles, swelled starch, or hydrated starch.

30 It shall be understood that as oat derived material is treated in the process, for example by enzymes acting on the oat derived material, or the oat derived material being heated, the oat derived material typically changes, for example resulting from depletion of starch from the oat derived material.

Oat derived material having undergone, for example the enzymation in the first enzymation section S104, may therefore, herein, be referred to as oat derived material from the first enzymation section, to differentiate it from e.g., oat derived material provided before the enzymation in the first

5 enzymation section. Oat derived material which has been subject to any degree of enzymation may alternatively be referred to as enzymised oat derived material.

Fig. 1B is a flow chart illustrating the steps of the process for preparing a liquid oat base or drink from an oat derived material as described above in connection with Fig. 1A but with some optional additional steps. Below, the
10 different steps are described in more detail. Even though illustrated in a specific order, the steps of the process 100 may be performed in any suitable order, as well as multiple times and in parallel.

The flow of enzymised oat derived material may be heated by a first
15 heating device. The heating device may be fluidly connected to and arranged downstream of the first enzymation section.

The enzymised oat derived material may be cooled S112. The cooling of the enzymised oat derived material may be performed after heating S108 the continuous flow of enzymised oat derived material.

20 The enzymized oat derived material may be steamed S114. In other words, the enzymised oat derived material may be injected with steam to increase the heat of the oat derived material. Thus, further terminating the enzymation. The steaming S114 of the enzymised oat derived material may be performed after the heating S114 of the enzymised oat derived material.
25 The steaming S114 of the enzymised oat derived material may be performed before the cooling S116 of the enzymised oat derived material.

A second enzymation section may be fed S114 with the oat derived material and enzymes. The second enzymation section may be fed with the enzymated oat derived material from the first heating device.

30 The oat derived material in the second enzymation section may be enzymated S116. The enzymation S116 may comprise contacting the oat derived material with starch degrading enzymes. The starch degrading enzymes may preferably be amylase. Alternatively, the enzymation S116 may

comprise contacting the oat derived material with protein solubilizing enzyme. The protein solubilizing enzyme may preferably be protein deamidase or protein glutaminase.

The first and second enzymation S104, S116 may be performed in the same way. For example, both the first and second enzymation S104, S116 may comprise using starch degrading enzymes. Alternatively, both the first and second enzymation S104, S116 may comprise using protein solubilizing enzymes. Even though the same enzymes may be used, a ratio between oat derived material and enzyme of the respective enzymation may be different. For example, more enzyme may be added in the first enzymation S104 than the second enzymation S116, or the opposite. Similarly, the enzymation time during which the oat derived material is enzymised in the first and second enzymation section S104, S116 respectively may be different.

As another example, the enzymation in the first and/or second enzymation S104, S116 may comprise using both the starch degrading enzymes and the protein solubilizing enzymes.

The first and second enzymation 104, 116 may be performed in different ways. For example, the first enzymation 104 may comprise using starch degrading enzymes while the second enzymation S116 may comprise using protein solubilizing enzymes. Further, the ratio between enzymes and oat derived material in the respective enzymation may be different, as well as the time-period in which the oat derived material is enzymised.

A flow of enzymated oat derived material may be outputted S118 from the second enzymation section.

The steps of feeding S114 the second enzymation section, enzymating S116 the oat derived material in the second enzymation section and outputting S118 a flow of enzymised oat derived material may be performed simultaneously. In other words, the second enzymation section may be continuously fed with new oat derived material and at the same time continuously outputting enzymated oat derived material. Thus, the oat derived material is enzymated during the time which it flows through the second enzymation section. The time which the oat derived material flows through the second enzymation section may be such that the oat derived material is

enzymated to a predetermined enzymation level. Put differently, the time it takes from when the oat derived material enters the enzymation section to when the oat derived material exits the enzymation section may be the same as an enzymation time t_e , where the enzymation time t_e is the time it takes for
5 the oat derived material to be enzymised to the predetermined level. The predetermined level of enzymation in the second enzymation S116 may be different from the predetermined level of enzymation in the first enzymation S102.

The flow of enzymised oat derived material from the second
10 enzymation may be heated S120 to terminate the enzymation thereof. The enzymation may be entirely terminated. Alternatively, the enzymation may be only partly terminated. The second heating S120 of the enzymised oat derived material may cause the enzymation of the oat derived material to be terminated to a higher degree than the first heating S108. The flow of
15 enzymised oat derived material may be heated by a second heating device. The second heating device may be fluidly connected to and arranged downstream of the second enzymation section.

The enzymised oat derived material may be cooled S124. The cooling of the enzymised oat derived material may be performed after heating S120
20 the continuous flow of enzymised oat derived material.

The enzymized oat derived material may be steamed S122. In other words, the enzymised oat derived material may be injected with steam to increase the heat of the oat derived material. Thus, further terminating the enzymation. The steaming S122 of the enzymised oat derived material may
25 be performed after the heating S120 of the enzymised oat derived material. The steaming S122 of the enzymised oat derived material may be performed before the cooling S124 of the enzymised oat derived material.

In an alternative, the oat derived material may be heated in a pre-heating step S126, before feeding S102 the first enzymation section. The
30 heat treatment of the oat derived material in the pre-heating step S126 may be milder than the first and/or second heating S108, S120. In other words, the oat derived material may be heated to a lower temperature during the pre-heating S126, than during the first and second heating S108, S120.

Fig. 2 – The system for carrying out the method, one step of cont. enzymation Fig. 2 schematically illustrates one example of a system 200 for preparing a liquid oat base or drink from an oat derived material.

The system 200 comprises a first enzymation section 202. The first
5 enzymation section 202 may be adapted for a first enzymation of the oat derived material flowing therethrough. The first enzymation section 202 has a continuous infeed and outfeed. The first enzymation section 202 may thus be configured to receive the oat derived material 204 and enzymes 206. Put
10 differently, the first enzymation section 202 may be fluidly connected to a supply (not shown) of oat derived material. Further, the first enzymation section 202 may be fluidly connected to a supply (not shown) of enzymes. The enzymes 206 may be added to the oat derived material 204 prior to entering the first enzymation section 202. Thus, the first enzymation section 202 may have only one inlet.

15 The system 200 further comprises a first heating device 400a. The first heating device 400a may be fluidly connected to the first enzymation section 202. The first heating device 400a may be arranged downstream from the first enzymation section 202. Thus, the first heat exchanger 400a may receive the enzymised oat derived material 210 outputted from the first enzymation
20 section 202. The first heating device 400a may heat the oat derived material 204 from the first enzymation section 202. The first heating device 400a may heat the enzymised oat derived material 210 from a first temperature T to a second temperature T'. The first heating device 400a may heat the enzymised oat derived material 210 to terminate the enzymation process. The
25 first heating device 400a is further described in connection to Fig. 4.

The first enzymation section 202 comprises a first volume 208a. The first volume 208a being selected such that the oat derived material 204 is enzymised during a predetermined time-period.

The first volume 208a and a first flow rate of the oat derived material
30 204 flowing through the first volume 208a may be selected such that the time-period in which the oat derived material 204 is enzymised in the first volume 208a yields a satisfactory enzymation. Put differently, the first volume 208a may be fixed such that the oat derived material 204 is present in the first

enzymation section 202 during enough time for the oat derived material to be enzymised, i.e., equal to the enzymation time t_e . The enzymation time t_e may be 30-70 minutes, or more preferably 50 minutes,

In other words, during the time it takes from that the oat derived material 204 enters the first enzymation section 202 to that the oat derived material exits the first enzymation section 202 as enzymised oat derived material 210, the oat derived material has been enzymised to the satisfactory level. The flow rate of the oat derived material may also be considered when deciding the first volume 208a. The satisfactory enzymation may be when the oat derived material has reached a predetermined level of enzymation. The predetermined level of enzymation may be that the oat derived material 204 has reached a desired viscosity. Alternatively, the predetermined level of enzymation may be that the oat derived material 204 is only partly enzymised.

Fig. 3 – The system with a second cont. enzymation section Fig. 3 schematically illustrates another example of the system 200 for preparing the liquid oat base or drink from the oat derived material.

In addition to what is described in connection to Fig. 2, the example of the system 200 illustrated herein may further comprise a second enzymation section 212. The second enzymation section may be adapted for a second enzymation of the oat derived material 210. The second enzymation section 212 may be fluidly connected to the first heating device 400a. The second enzymation section 212 may be arranged downstream the first heating device 400a. The second enzymation section 212 may be adapted for a second enzymation of the enzymised oat derived material 210. The second enzymation section 212 may thus be configured to receive oat derived material from the first heating device 400a and enzymes from a supply of enzymes (not shown). Even though the inlet of the enzymes 208 is illustrated as separate from the enzymised oat derived material 210, they may be combined. Put differently, the enzymes 208 may be mixed with the oat derived material prior to entering the second enzymation section 212.

The second enzymation section 212 may output enzymised oat derived material 210. The enzymised oat derived material outputted from the second enzymation section 212 may be enzymised to a higher degree than the

enzymised oat derived material outputted from the first enzymation section 202. Alternatively, the enzymised oat derived material outputted from the second enzymation section 212 may be enzymised in a different way from the enzymised oat derived material outputted from the first enzymation section

5 202.

The system 200 further may further comprise a second heating device 400b. The second heating device 400b may be fluidly connected to the second enzymation section 212. The second heating device 400b may be arranged downstream from the second enzymation section 212. Thus, the
10 second heat exchanger 400b may receive the enzymised oat derived material 210 outputted from the second enzymation section 212. The second heating device 400b may heat the oat derived material 210 from the second enzymation section 212. The second heating device 400b may heat the enzymised oat derived material 210 from a third temperature T'' to a fourth
15 temperature T''' . The second heating device 400b may heat the enzymised oat derived material 210 to terminate the enzymation process. The second heating device 400b is further described in connection to Fig. 4.

The second enzymation section 212 may comprise a second volume 208b. The second volume 208b may be selected such that the oat derived
20 material 210 is enzymised during a predetermined time-period.

The second volume 208b and a second flow rate of the oat derived material 210 flowing through the second volume 208b may be selected such that the time-period in which the oat derived material 210 is enzymised in the second volume 208b yields a satisfactory enzymation. Put differently, the
25 second volume 208b may be such that the oat derived material 210 is present in the second enzymation section 212 during enough time for the oat derived material to be enzymised, i.e., equal to the enzymation time t_e . In other words, during the time it takes from that the oat derived material 210 enters the second enzymation section 212 to that the oat derived material exits the
30 second enzymation section 212 as enzymised oat derived material 210, the oat derived material has been enzymised to the satisfactory level. For this, also the flow rate of the oat derived material may be considered. The satisfactory enzymation may be reaching a predetermined level of

enzymation. The predetermined level of enzymation may be that the oat derived material 210 has reached a desired viscosity. Alternatively, the predetermined level of enzymation may be that the oat derived material 210 is only partly enzymised.

5 Fig. 4 schematically illustrates the heating device 400 in the system 200 for preparing the liquid oat base or drink from the oat derived material. The heating device 400 illustrated herein may thus constitute the first heating device 400a and/or second heating device 400b illustrated in Fig. 2 and Fig. 3. The heating device may change the temperature of the oat derived material
10 from a temperature T1 to a temperature T5. The temperature T5 may be higher than the temperature T1. Alternatively, the temperature T5 may be the same as the temperature T1. Alternatively, the temperature T5 may be lower than the temperature T1.

 The heating device 400 may comprise a heat exchanger 402. The heat
15 exchanger 402 may increase the temperature of the oat derived material from the temperature T1 to a temperature T2. The heat exchanger 402 may further heat the oat derived material a second time from a temperature T3 to a temperature T4. The heating device 400 may further comprise a cooling section 404. The cooling section 400 may be part of the heat exchanger 402.
20 Thus, the heating device 400 may be adapted to both heat the oat derived material and cool the oat derived material. The cooling section 404 may reduce the temperature of the oat derived material from the temperature T4 to the temperature T5. Thus, even though the temperature T1 of the inputted oat derived material may be the same as, or lower than, the temperature T5 of
25 the outputted oat derived material, the oat derived material may still have been heated to a higher temperature as some point thus terminating the enzymation of the oat derived material.

 The heating device 400 may further comprise a steam injector 406. The steam injector may be connected to the heat exchanger 402 and
30 arranged downstream from the heat exchanger 402. The steam injector 406 may be adapted to steam the oat derived material, thus increasing the temperature of the oat derived material from the temperature T2 to the temperature T3.

As illustrates herein, the heat exchanger 402 may be arranged to exchange heat between the oat derived material before the steam injector 406 and the oat derived material after the steam injector 406. This may be advantageous in that heat energy produced by the steam injector can be re-
5 used in the heating of the oat derived material from the temperature T1 to the temperature T2, thus saving energy. Further, the oat derived material from the steam injector 406 can be cooled from the temperature T3 to the temperature T4, thus reducing the amount of cooling needed by the cooling section 404.

10 The heating device 400 is not limited to comprising a heat exchanger and/or steam injector. The heating device 400 may be any device suitable for the cause. For example, the heating device 400 may comprise a device for heating the oat derived material by using microwaves. The heating device 400 may be an immersion heater. The heating device may comprise tubular
15 heating elements. The heating device 400 may be a circulation heater. The heating device 400 may be an electrode heater.

The cooling section 404 may be a heat exchanger connected to a cooling medium.

The heating process may take approximately 5-10 minutes. The time of
20 the heating process in the first and second heating device may be different.

The temperatures T1-T5 may be different in the first heating device 400a and the second heating device 400b.

For example, in the first heating device 400a, the temperature T5 may be 60 degrees C. The temperature T5 may correspond to the second
25 temperature T'' as illustrated in Fig. 2. The temperature T3 may be 110 degrees C.

For example, in the second heating device 400b, the temperature T5 may be 5 degrees C. The temperature T5 may in this case correspond to the fourth temperature T''' as illustrates in Fig. 3. The temperature T3 may be 90
30 degrees C.

Temperature T1 may be 55 to 65 degrees, or more preferably 60 degrees. Temperature T2 may be 75 to 85 degrees, or more preferably 80 degrees. Temperature T3 may be 85 to 95 degrees, or more preferably 90

degrees. Temperature T4 may be 65 to 75 degrees, or more preferably 70 degrees. Temperature T5 may be 55 to 65 degrees, or more preferably 60 degrees.

Fig. 5a and 5b schematically illustrates further examples of the system 200 for preparing the liquid oat base or drink from the oat derived material 204. More specifically, Fig. 5a and 5b illustrates two different examples of the volume 208 which is comprised in the enzymation sections 202, 212. In other words, the volume 208 illustrated herein may be the first and/or second volume 208a, 208b as described in connection with Fig. 2 and Fig. 3.

10 In Fig. 5a, the volume 208 is illustrated as an increased pathway for the oat derived material 204 and enzymes 206 to travel through the enzymation section 202, 212. In other words, the length of the processing pipes in the enzymation section 202, 212 may be set such that the time it takes for the oat derived material 204 to travel through the enzymation
15 section 202, 212 allows for the satisfactory enzymation.

In Fig. 5b, the volume 208 is illustrates as a section of the processing pipe having an increased cross-sectional area. This may cause the flow rate of the oat derived material 204 to decrease through the volume 208 of the enzymation section 202, 212. Thus, allowing the oat derived material 204 to
20 be in the enzymation section 202, 212 a sufficient amount of time for reaching the satisfactory enzymation level.

Reference is hereby made to a number of related applications with the same applicant and filing date as the present application. A related application titled A TWO-STEP PROCESS AND SYSTEM FOR PREPARING
25 A LIQUID OAT BASE OR DRINK FROM AN OAT DERIVED MATERIAL discloses a process and system for preparing a liquid oat base or drink from an oat derived material in a two-step enzymation process for an more even quality. Another related application titled A BATCH PROCESS AND SYSTEM FOR PREPARING A LIQUID OAT BASE OR DRINK FROM AN OAT
30 DERIVED MATERIAL discloses a process and system for preparing a liquid oat base or drink from an oat derived material where the first and second enzymation sections comprises two or more enzymation tanks respectively for a higher output. Another related application titled A MIXED PROCESS

AND SYSTEM FOR PREPARING A LIQUID OAT BASE OR DRINK FROM AN OAT DERIVED MATERIAL discloses a process and system for preparing a liquid oat base or drink from an oat derived material where one of the first and second enzymation sections comprises two or more enzymation tanks
5 and the other of the first and second enzymation section comprises a volume with continuous inlet and outlet for a higher output.

It is understood that other variations in the present invention are contemplated and, in some instances, some features of the invention can be employed without a corresponding use of other features. Accordingly, it is
10 appropriate that the appended claims be construed broadly in a manner consistent with the scope of the invention.

CLAIMS

1. A process (100) for preparing a liquid oat base or drink from an oat derived material (204), comprising, simultaneously:
5 feeding (S102) a first enzymation section (202) with the oat derived material (204) and an enzyme (206),
 enzymating (S104) the oat derived material (104) in the first enzymation section (202), and
 outputting (S106) a flow of enzymated oat derived material (210) from
10 the first enzymation section (202).
2. The process (100) according to claim 1, further comprising,
 heating (S108), by a first heating device (400a) fluidly connected to and arranged downstream of the first enzymation section (202), the flow of
15 enzymised oat derived material (210) to terminate the enzymation thereof.
3. The process (100) according to claim 2, further comprising,
 cooling (S112) the enzymised oat derived material (210) after heating (S108) the flow of enzymised oat derived material (210).
20
4. The process (100) according to claim 3, further comprising the step of steaming (S110) enzymised oat derived material (210) after the step of heating (S108) the enzymised oat derived material (210) to terminate the enzymation and before the step of cooling (S112) the enzymised oat derived
25 material (210).
5. The process (100) according to any of the preceding claims, further comprising, simultaneously:
 feeding (S114) a second enzymation section (212) with the enzymated
30 oat derived material (210) and enzymes (206),
 enzymating (S116) the enzymised oat derived material (210) in the second enzymation section (212), and

outputting (S118) a flow of enzymated oat derived material (210) from the second enzymation section (212).

6. The process (100) according to claim 5, further comprising, heating (S120), by a second heating device (400b) fluidly connected to
5 and arranged downstream of the second enzymation section (212), the flow of enzymised oat derived material (210) to terminate the enzymation thereof.

7. The process (100) according to claim 6, further comprising, cooling (S124) the enzymised oat derived material (210) after heating
10 (S120) the flow of enzymised oat derived material (210).

8. The process (100) according to claim 7, further comprising the step of steaming (S122) the enzymised oat derived material (210) after the step of heating (S120) the enzymised oat derived material (210) to terminate the
15 enzymation and before the step of cooling (S124) the enzymised oat derived material (210).

9. The process (100) according to any one of the preceding claims, wherein the oat derived material (204) comprises micronized oats or
20 micronized oat-kernels, or oat-flour, or fractions of oat.

10. The process (100) according to any one of the preceding claims, wherein the oat derived material (204) is provided as an aqueous or water suspension or slurry.
25

11. The process (100) according to any one of the preceding claims, wherein the step of enzymating (S104, S116) comprises contacting the oat derived material with starch degrading enzymes, preferably amylase.

30 12. The process (100) according to any one of the preceding claims, wherein the step of enzymating (S104, S116) comprises contacting the oat derived material with protein solubilizing enzyme, preferably protein deamidase or protein glutaminase.

13. The process (100) according to any one of the claims 5 to 12,
wherein the step of enzymating (S104, S116) in the first enzymation section
(202) comprises contacting the oat derived material with starch degrading
5 enzymes, preferably amylase, and

wherein the step of enzymating (S104, S116) in the second
enzymation section (212) comprises contacting the oat derived material with
protein solubilizing enzyme, preferably protein deamidase or protein
glutaminase.

10

14. A system (200) for preparing a liquid oat base or drink from an oat
derived material (204), comprising:

a first enzymation section (202) adapted for a first enzymation of the
oat derived material (204) flowing therethrough, the first enzymation section
15 (202) having a continuous infeed and outfeed, and

a first heating device(400a) fluidly connected to and arranged
downstream of the first enzymation section (202) and adapted to heat the oat
derived material (210) from the first enzymation,

wherein the first enzymation section (202) comprises a first volume
20 (208a), the first volume (208a) being selected such that the oat derived
material (204) is enzymised during a predetermined time-period.

15. The system (200) according to claim 14, wherein the first volume
(208a) and a first flow rate of the oat derived material (204) flowing through
25 the first volume (208a) are selected such that the time-period in which the oat
derived material (204) is enzymised in the first volume (208a) yields a
satisfactory enzymation.

16. The system (200) according to claim 14 or 15, wherein the first
30 heating device (400a) is adapted to both heat the enzymised oat derived
material (210) in a first step and thereafter cool the enzymised oat derived
material (210) in a second step.

17. The system (200) according to any one of claims 14 or 16, wherein the first heating device (400a) comprises a heat exchanger (402) and/or a steam injector (406).

- 5 18. The system (200) according to any one of claims 14 to 17, further comprising,
 a second enzymation section (212) fluidly connected downstream to the first heating device (400a) and adapted for a second enzymation of the oat derived material (210) flowing therethrough, the second enzymation
10 section (212) having a continuous infeed and outfeed, and
 a second heating device (400b) fluidly connected to and arranged downstream of the second enzymation section (212) and adapted to heat the oat derived material (210) from the second enzymation,
 wherein the second enzymation section (212) comprises a second
15 volume (208b), the second volume (208b) being selected such that the oat derived material (210) is enzymised during a predetermined time-period.

19. The system (200) according to claim 18, wherein the second volume (208b) and a second flow rate of the oat derived material (210)
20 flowing through the second volume (208b) are selected such that the time-period in which the oat derived material (210) is enzymised in the second volume yields a satisfactory enzymation.

20. The system (200) according to any one of the claims 18 to 19,
25 wherein the second heating device (400b) is adapted to both heat the enzymised oat derived material (210) in a first step and thereafter cool the enzymised oat derived material (210) in a second step.

21. The system (200) according to any one of the claims 18 to 20,
30 wherein the second heating device (400b) comprises a heat exchanger (402) and/or a second steam injector (406).

22. The system (200) according to any one of the claims 18 to 21, wherein the first enzymation section (202) and the second enzymation section (212) comprises a conduit or a reservoir, such as a tank, respectively.