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Oat extract and process for producing it

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COMPLETE SPECIFICATION

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INVENTION TITLE:

Oat extract and process for producing it

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

The present invention relates to oat extract and a process for producing it.

Extracts from various grains and cereals are presently commercially available. In particular, there is a considerable market for malt and barley extracts, which both provide a valuable source of sugars, natural colouring and flavouring.

It would be desirable to produce extracts from other grains and cereals which are readily available. In this respect, the present invention aims to provide a process for producing oat extract.

A previous attempt to produce oat extract, via a process analogous to that for producing malt and barley extract, met without success. This was because the resultant oat extract product was too susceptible to rancidity for the process to be commercially viable.

We have since discovered that the cause of rancidity in the oat extract is lipase enzymes. In this respect, oats have a very high lipid content, as compared to malt and barley, which in turn gives rise to a high lipase activity in the subsequent oat extract.

Accordingly, the present invention seeks to provide a solution to the above problem and to provide a process for preparing a storage stable oat extract.

With the above aim in mind, the present invention provides a process for producing oat extract, the process comprising treating crushed oat substrate with a combination of enzyme and heat pre-treatment steps to produce wort, the process including a heat treatment step for producing a wort which is substantially lipase-free. The process optionally involves concentrating the wort to produce oat extract having a predetermined solids level.

In this context, it is straightforward to test for the presence of lipase in the wort (and indeed in the final extract product). The established test involves detection of a blue colour change in a certain reaction. In more detail this generally involves detection of a blue colour in the form of a ring when a spot of the product is mixed with indoxyl acetate, shielded from light and left for 20 minutes at room temperature. If no blue colour is detected, the test is considered to be lipase-negative i.e. the level of lipase is below that detectable by the test conditions.

In the present invention, the crushed oat substrate typically includes what is known as tightly crushed oats. This is produced by crushing whole oats between rollers to such an extent that the oat husks are in a cupped state. In some embodiments, the tightly crushed oats may be mixed with oat flour. In this context, the oat flour is typically produced by stripping the oat of its husks and subsequently passing the stripped product through rollers to provide a flour which is of a much smaller particle size than the tightly crushed oats.

In such embodiments, a mixture of tightly crushed oats and oat flour preferably comprises a minor proportion of oat flour. There will be a practical upper limit to the flour content. This is because a high proportion of fine particles can cause difficulties in subsequent separation and processing stages, to be discussed in more detail below. In preferred embodiments, the crushed oat substrate will comprise a mixture of tightly crushed oats and oat flour, in which the oat flour comprises preferably no more than about 15% of the mixture. Most preferably, the oat flour comprises up to about 10% of the mixture.

Typically, the treatment stage for the crushed oat substrate will involve a combination of enzyme and heat treatment stages. Typically, the treatment is applied to a mixture of the oat substrate and water. Typically, the water and oat mixture will contain from about 25 to about 30% grain on a dry weight basis. Whilst it may be possible to operate outside this range, less water can produce a mash which is very concentrated which may result in inhibition of enzymes in the subsequent processing steps. Also, an excess of water may reduce the likelihood of the enzyme and appropriate substrate being brought into contact for the appropriate conversion.

Oat cereal comprises starch in a matrix of protein which is in turn encased within a matrix of betaglucan. Bearing this in mind, typically the present process will involve a first treatment step to degrade at least the betaglucan (and preferably also the matrix of protein) and a second step to degrade the starch. It will be appreciated that different conditions of e.g. temperature and pH will be appropriate for the respective treatment steps.

Suitably the present invention involves use of a mixture of proteolytic, amylolytic and bioglucanase enzymes to effect appropriate degradation of the crushed oat substrate. In this respect, the bioglucanase enzymes will effect degradation of the outer matrix of betaglucan, the proteolytic enzymes will effect degradation of the protein matrix, and the amylolytic enzymes will digest the starch. The enzyme cocktail may further include diastatic enzymes.

Typically, the treatment of the crushed oat substrate will be performed at two different temperatures. Suitably, a first temperature will be selected at which the proteolytic and bioglucanse enzymes are effective, and a second higher temperature will be selected for activation of the amylolytic enzymes. In this respect, suitably the process involves a treatment stage at a temperature in the region of from about 45° to about 55°C. Within this temperature range the proteolytic and bioglucanase enzymes are effective. Most preferably, this stage of the process is carried out in the region of about 50°C, and most preferably at 50° ± 1°C.

In preferred embodiments, the process will involve a second treatment step, at a temperature which is higher than that for the first treatment step. Suitably, the second step is performed within a temperature range of from about 60°C to about 70°C, and most preferably at about 65°C. Within this temperature range the amylolytic enzymes are effective.

The appropriate timescale for each of the above treatment steps may vary in dependence upon the selected temperature, for example. However, appropriate timescales are within the order of several hours.

As noted above, the present invention is characterised by a step for removal of lipase enzymes. In this respect, oats are distinguished from other grains and cereals in that they have a high lipid content, which will give rise to high lipase activity, resulting in a tendency for the extract to go rancid. The present invention aims to solve this problem by providing a step for removal of lipase enzymes.

In preferred embodiments of the present process, the lipase removal step involves heat treatment to degrade the lipase enzymes. Preferably, the heat treatment is conducted above 70°C and preferably at a temperature of from about 75 to about 79 or 80°C, most preferably at about 78°C. Once the temperature has been raised to this level the presence (or absence) of lipase may be readily detected.

At the higher temperature, the viscosity of the various components in the reaction mixture is reduced, thus facilitating transfer of the reagents for subsequent processing steps. The proteolytic, amylolytic and bioglugonase (and optionally also diastatic) enzymes are also deactivated at this higher temperature so that no further conversion takes place.

The resultant reaction mixture is known as wort (in the same way as a reaction mixture in a malt or barley extract process).

The present process will typically also involve a separation stage, to separate the wort from the oat husks which are no longer required. Thus, the present process typically involves a filtration stage.

Preferably, the filtered husks will be washed to remove entrained wort. The dilute wort produced is suitably combined with the filtrate wort and preferably the combined wort is evaporated to a desired solids level. In preferred embodiments, the desired solids level is from about 79% to about 82%. This is selected because at lower solids levels the wort is susceptible to microbial decomposition. Also, at higher solids levels difficulties can arise in handling the concentrated wort; in particular pumping becomes difficult.

The resultant concentrated product is an oat extract which may be ready for sale.

Other embodiments of the present invention may involve a further drying step to produce a dried oat extract. Preferably, any such drying step is conducted to provide a dry cake having a moisture content of about 4% or less.

Embodiments of the present invention will now be described in more detail, by way of example, with reference to the accompanying drawing in which the sole Figure 1 illustrates the various preferred processing stages for the manufacture of oat extract according to the invention.

An example manufacturing method is as follows: 5T of tightly crushed oats and 0.5T of oat flour are mixed in a mash reactor, indicated as (1) in Fig. 1. 12 T of water is added to the mash reactor to provide a mash having a grain content within the desired range of 25% to 30% on a dry weight basis.

The desired enzymes are also added to the mash reactor (1) at this stage. This is typically a cocktail of proteolytic, amylolytic, bioglucanase and optionally also diastatic enzymes. A suitable enzyme cocktail is available from Novo of Denmark, under the Trade Mark NovozymOS. The temperature of the mash is raised to 50°C ± 1°C, the enzyme cocktail is added to the mash reactor, and the pH of the mash and enzyme mixture is adjusted to be between 5 and 6. The reagents are mixed in reactor (1) and the temperature is maintained within this range for 3 hours.

At this temperature and pH the bioglucanase enzyme and the proteolytic enzyme start to digest the gums and proteins of the oats and flour to expose starch within the endosperm structure.

The temperature of the mash in the mash reactor (1) is then raised to the second, higher process temperature. In this example, the temperature is raised to 65°C and held at that level for about two hours. At this temperature the alpha-amylase from the enzyme mixture and naturally occurring beta-amylase from the crushed oat begin to digest the starch to lower carbohydrates such as glucose, maltose, maltotriose etc. The process will also result in a range of higher sugars and dextrins.

This is then followed by the treatment step to degrade lipase enzymes, to provide a wort which is substantially lipase free. In the present example this is effected by raising the temperature of the mash in the reactor (1) to 75°C. At this high temperature the viscosities of the various components in the reactor are also reduced, which facilitates transfer of the mixture from reactor (1) to lauter (2). It also ensures that the various enzymes in the enzyme mixture are inactivated so that no further conversion of the mash takes place.

The wort is filtered in the lauter (2) to remove the oat husks which are no longer required. The wort is also drained and pumped through a filter (3) to remove any suspended particles. An example process will utilise a 500 micron filter.

The husks retained in lauter (2) are also washed with a large volume of water to remove entrained wort. This is to reduce wastage of desired end product. In the example, 15,000 litres of water are sprayed at about 78°C over the husks. The temperature of this stage is not critical. It may readily be performed between about 70 and 80°C. The washed wort is collected until the wort solution falls below a desired concentration level. The various worts, weak and strong, are collected and supplied to the wort receiver (4) and mixed together. The mixing is effected because a consistent solids level is required for the evaporator (5) to work efficiently.

The wort from wort receiver (4) is fed to evaporator (5), heated and subjected to vacuum. This is effective to concentrate the wort to a desired solids level. In the example this will result in a solids level of between 79% and 82%. The concentrated wort is collected in a storage tank (6).

The oat extract product may now be tested to determine its content and packaged for sale. Typical desirable criteria for the oat extract are as follows:

Colour - less than 15° EBC on a 10% solution.
Solids - 80% ± 1% for the UK market and 81% ± 1% for export.
pH - 5.2 to 5.8 on a 10% solution.

The oat extract may also be dried on a band dryer (8). Here, the liquid is fed onto a moving band and subjected to further heat and vacuum. Water evaporates to leave a dry cake which may be subsequently granulated, screened and packed. In that case, desirable criteria for dried oat extract are as follows:

Colour - less than 15° EBC on a 10% solution.
Moisture -less than 4%.
pH - 5.0 to 5.8 on a 10% solution.

The resultant oat extract will include various nutrients. For example, the extract may contain vitamins (such as A, B1, B2, B6, B12 and B3) and trace elements including potassium, phosphorus, calcium and sodium, and carbohydrates (including maltose, maltotriose, glucose, fructose and other higher sugars).

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A process for producing oat extract, the process comprising treating crushed oat substrate with a combination of enzyme and heat pre-treatment steps to produce wort, the process including a heat treatment step for producing a wort which is substantially lipase-free.

2. A process according to Claim 1, wherein the heat treatment step which produces a wort which is substantially lipase-free is a heat treatment step at a temperature of above 70°C which degrades lipase enzymes present.

3. A process according to Claim 1 or Claim 2, wherein the crushed oat substrate includes tightly crushed whole oats.

4. A process according to Claim 3, wherein the crushed oat substrate comprises a mixture of tightly crushed oats and oat flour.

5. A process according to Claim 4, wherein the tightly crushed oats/oat flour mixture comprises no more than 15% of the oat flour.

6. A process according to any preceding claim, wherein the treatment of the crushed oat substrate is applied to a mixture of the oat substrate and water, the water and oat mixture containing between 25 and 30% oat grain on a dry weight basis.

7. A process according to any preceding claim, wherein the particles of oat substrate comprise starch in a matrix of protein which is in turn encased within a matrix of betaglucan, the treatment of the crushed oat substrate comprising a first pre-treatment stage to degrade at least the betaglucan and preferably also the matrix of protein, and a second pre-treatment stage to degrade the starch.

8. A process according to any preceding claim, wherein the enzyme pre-treatment stage comprises treatment with a mixture of proteolytic, amylolytic, bioglucanase and optionally diastatic enzymes.

9. A process according to any preceding claim, wherein the heat pre-treatment stage comprises heat treatment at two different temperatures.

10. A process according to Claim 8, wherein the heat pre-treatment stage comprising a first heat treatment stage at a first temperature at which the proteolytic and bioglucanase enzymes are effective, and a second heat treatment stage at a second temperature at which the amylolytic enzyme is effective, the second temperature being higher than the first temperature.

11. A process according to Claim 10, wherein the first temperature of the first heat treatment stage is between 45 and 55°C, and the second temperature of the second heat treatment stage is between 60 and 70°C.

12. A process according to any preceding claim, further including a separation step to separate the wort from the oat husks.

13. A process according to Claim 12, further including an evaporation step to increase the solids level of the resulting wort to between 79 and 82%.

14. A process according to any preceding claim, further including a drying step to produce a dried oat extract preferably having a moisture content of up to 4%.

15. A process for producing oat extract substantially as described herein with reference to the accompanying drawing.

16. Oat extract as produced by the process according to any one of claims 1 to 15.

DATED this 23rd day of July, 1999

International Diamalt Co., Ltd.

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ABSTRACT

Storage stable oat extract is produced by a process which comprises treating crushed oat substrate to produce wort, the process including a heat treatment step to produce a wort which is substantially free of lipase enzyme, to avoid rancidity.

1/1

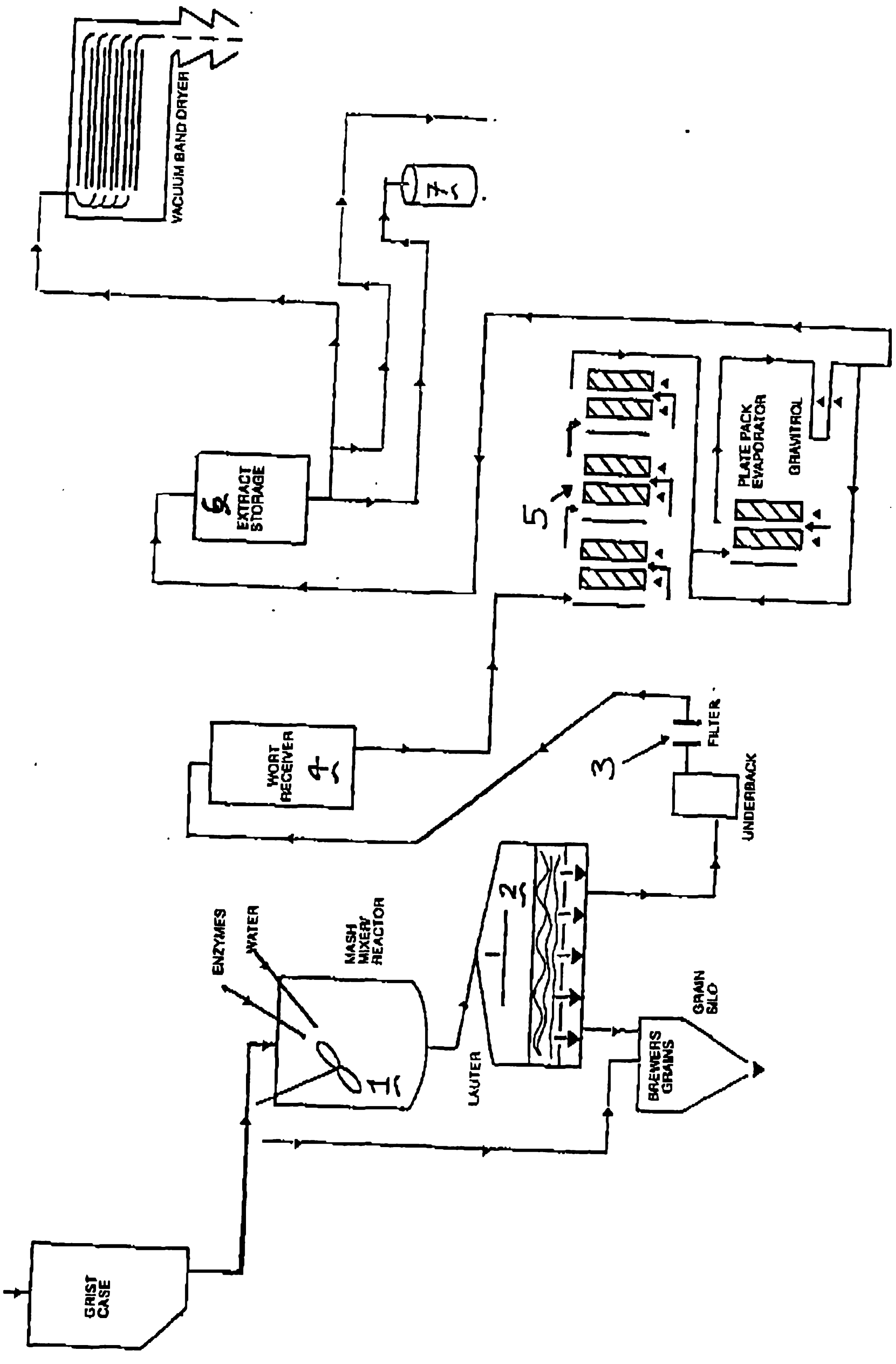
GRIST CASE
ENZYMES
WATER
MASH MIXER/ REACTOR
1
LAUTER
2
BREWERS GRAINS
GRAIN SILO
UNDERBACK
FILTER
3
WORT RECEIVER
4
5
PLATE PACK EVAPORATOR
GRAVITROL
6
EXTRACT STORAGE
7
VACUUM BAND DRYER

Fig. 1