

A PROCESS FOR THE PRODUCTION OF A FLAVOURING AGENT

1 This invention relates to a process for the production
of a flavouring agent having a meat-like taste, in which a
paste-like mixture containing at least one source of free
amino acids and additives comprising at least one reducing
5 sugar is reacted by heating.

 In the production of flavouring agents intended to
taste like cooked or roasted meat, where a source of free
amino acid, such as a protein hydrolyzate, is reacted with
a reducing sugar, it has hitherto been customary to select
10 and prepare the most suitable starting materials for ob-
taining flavours characteristic of various types of meat
without any aftertaste. The reaction itself, known as the
Maillard reaction, is generally carried out by heating a
liquid or paste-like mixture of the appropriate ingredients
15 to a temperature approaching the boiling temperature of water
or of the mixture for a period of time ranging from several
tens of minutes to several hours in standard reactors, such
as a double-jacketed, stirred tank reactor. The liquid or
paste-like reaction product is then generally dried under
20 mild conditions, i.e. reduced pressure and moderate temper-
ature, so that the reaction is unable to continue for hours.
This conventional process is carried out in relatively large
installations over relatively long periods of time.

 The object of the present invention is to provide a new
25 process which can be carried out more quickly using a more
compact installation and also an apparatus for carrying out
this process.

 To this end, the process according to the present
invention for the production of a flavouring agent is
30 characterized in that 70 to 95% by weight of a source of
free amino acids having a water content of 1 to 3%, 1 to 25%
by weight of said additives and water are mixed to form a

paste-like mixture containing 5 to 12% water, the paste-like mixture is plasticized by kneading and heating, the plasticized mixture is reacted for 30 s to 30 mins at a temperature of 80 to 140°C under a pressure of 1 to 100 bar and the reaction product is dried and cooled by extrusion and expansion in a chamber, wherein the pressure in the chamber is maintained at a reduced pressure of 5 to 50 mbar.

It has thus surprisingly been found that the conventional process may be completely replaced by a new process which considerably reduces the time, energy and space required to produce flavouring agents by Maillard reaction of a paste-like mixture based on a source of free amino acids, such as a protein hydrolyzate. It has also been found that this saving of time, energy and space is accompanied equally surprisingly by a radical improvement in the possibilities for controlling the process parameters and the characteristics of the product obtained.

The apparatus for carrying out the process according to the invention is characterized in that it comprises a continuous mixing unit, a continuous kneading and heating unit and an extrusion unit opening into a chamber connected to a pump.

In a first preferred embodiment of this apparatus, the continuous mixing unit comprises an Archimedian screw conveyor surmounted by a feed hopper for powder-form ingredients and a feed pipe for a liquid ingredient, the continuous kneading and heating unit comprises a double-jacketed Archimedian screw conveyor and the extrusion unit comprises a pump and an extrusion die.

In a second preferred embodiment of the apparatus according to the invention, the continuous mixing unit comprises a first charging zone for dry ingredients and a second charging zone for liquid ingredients of a single-screw or twin-screw extruder while the continuous kneading and heating unit comprises at least a third kneading and

1 heating zone of said extruder, each zone being provided with
a separate double jacket.

Accordingly, the process according to the invention
may be carried out in a simple and compact apparatus in
5 which the operation of each element may readily be directly
controlled in contrast to the inertia of, for example, a
conventional mixing and heating tank.

To carry out the process according to the invention,
the amino acid source may be selected from the starting
10 materials most commonly used for this purpose in the industry
in question, particularly acidic or enzymatic hydrolyzates
of materials rich in vegetable or animal proteins, such as
oilseed cakes, sugar extraction residues, cereal germs,
blood or offal for example, and the extracts or autolyzates
15 of microorganisms rich in proteins, such as brewer's or
baker's yeasts or certain bacteria grown on hydrocarbon-
based substrates for example.

One preferred embodiment of the process according to
the invention is characterized by the use of an amino acid
20 source containing, in percent by weight of said mixture,
40 to 95% of a protein hydrolyzate and 0 to 30% of a yeast
extract. In this embodiment, it is possible for example to
use a vegetable protein hydrolyzate obtained by cooking oil-
seed cakes with hydrochloric acid, neutralization and fil-
25 tration either on its own or in combination with a yeast
extract or autolyzate obtained by hydrolysis with natural
yeast enzymes and separation of the insolubles.

In addition to the reducing sugar, the additives
mentioned may comprise a substance containing sulfur and
30 flavourings or flavour enhancers, such as spices or spice
extracts, particularly extract of onion or garlic powder,
and also nucleotides, particularly inosine monophosphate, or
even glutamate or citric acid for example, or, finally, food-
quality acids or bases intended for possible adjustment of
35 the pH of the paste-like mixture in case it should deviate

1 significantly from a preferred range of approximately 4 - 8.

One preferred embodiment of the process according to the invention is characterized by the use of additives comprising, in % by weight of the mixture, from 0.5 to 10% of a
5 reducing sugar, from 0.5 to 10% of a sulfur-containing substance, from 0 to 20% of monosodium glutamate and from 0 to 5% of inosine monophosphate. The reducing sugar may be, for example, a pentose or a hexose, particularly xylose, arabinose, fructose or glucose or a mixture thereof, or even a
10 uronic acid, particularly galacturonic acid. The sulfur-containing substance may be selected from the group comprising, for example, cysteine, cystine, methionine, thiamine and mixtures thereof.

In addition, maltodextrin and fats may be incorporated
15 in the mixture in quantities of, respectively, 0 to 40% by weight and 0 to 15% by weight, based on the mixture. The incorporation of more than 15% of fats in the mixture on the one hand places a premix of the dry ingredients in danger of losing its free-flow properties and, on the other hand,
20 involves the risk of the fats separating from the reaction product on issuing from the extruder. Accordingly, since the source of free amino acids used in the process according to the invention has a water content of about 1 to 3% and since the additives mentioned are also dry, the quantity of
25 water or of an aqueous solution of certain additives to be added to obtain a paste-like mixture containing 5 to 12% water is small and may be of the order of 5 to 10%.

The operations of mixing the dry ingredients and a little water, plasticizing the paste-like mixture by
30 kneading and heating, reaction and extrusion into a chamber under reduced pressure may advantageously be carried out continuously and are coordinated in such a way that their total duration is of the order of a few minutes to around 10 minutes. During its plasticization, the paste-like mixture
35 changes into a smooth and homogeneous paste which is malle-

1 able when hot and which may have a viscosity of approximately
14,000 mPs at 100°C or 3,400 mPs at 120°C for example. By
contrast, this paste is solid when cold.

5 The reaction itself is carried out for 30 s to 30 mins
at a temperature of 80 to 140°C under a pressure of 1 to
100 bar. At a temperature below 80°C, the reaction does not
take place quickly enough to be completed in the required
time. At a temperature above 140°C, the reaction may be
10 accompanied by degradation of the components and may give a
product which has a taste like that of over-roasted meat.
In a first preferred embodiment of the process according to
the invention, the plasticized mixture is reacted at a tem-
perature of 80 to 125°C and its temperature is adjusted to
125 to 140°C just before extrusion. In this way, the re-
15 action may largely take place at a relatively moderate
temperature and additional heat is only applied at the last
moment to enhance the effect of drying and cooling by ex-
trusion and expansion into a chamber under reduced pressure.
It is also possible in this way precisely to adjust the
20 residual moisture content of the extruded reaction product
without affecting the reaction process itself. For example,
an increase in the temperature of the paste just before
extrusion of 10°C causes the vaporization of approximately
0.8% additional water during extrusion into the chamber
25 under reduced pressure.

30 If the reaction takes place at a pressure towards the
lower end of the indicated range of 1 to 100 bar, it is pre-
ferred to apply an increase in pressure on completion of the
actual reaction in order again to enhance the drying and
cooling effect by extrusion and expansion into a chamber
under reduced pressure. By contrast, if the reaction takes
place at a pressure situated in the middle or at the upper end
of the indicated range, this will also be sufficient to
obtain an adequate drying and cooling effect. Finally, if
35 the reaction takes place at a pressure above 100 bar, this

1 may mean that the plasticized paste-like mixture might not
move sufficiently quickly and is in danger of burning.

During the drying and cooling operation, it is possible
on the one hand to eliminate all the water added to the
5 paste, namely around 5 to 10% water, and on the other hand
to cool the reaction product to a sufficiently low temper-
ature for the reaction to stop. During extrusion, the
strand of paste entering the chamber under reduced pressure
swells or expands considerably under the effect of the
10 vaporization of the added water which it contains and the
expansion of that water vapour. By escaping from the paste
which it has caused to expand, this water vapour removes the
latent heat of vaporization which is reflected in a sudden
cooling of the expanded strand. The temperature thus falls
15 from 125 - 140°C to 50 - 60°C for example.

A reduced pressure of 5 to 50 mbar is thus maintained
in the chamber into which the paste is extruded. Maintaining
a pressure below 5 mbar involves an unnecessarily high energy
consumption and involves the risk of blockage of the extru-
20 sion process by excessive expansion of the paste commencing
prematurely in the extrusion die. Maintaining a pressure
above 50 mbar, such as 60 - 80 mbar for example, may give
rise to problems due to the fact that the strand does not
cool sufficiently, remains thermoplastic, does not expand
25 sufficiently and dries less effectively. The process
according to the invention in effect enables an expanded,
extruded reaction product having a residual moisture content
of 1 to 3% to be obtained. An increase in the pressure
prevailing in the chamber of 10 mbar beyond the range indi-
30 cated may produce an increase of around 0.3% in this residual
moisture content.

The expanded, extruded reaction product may have an
apparent density of approximately 100 to 200 g/l. However,
the product is preferably ground into a powder or granulate
35 having an apparent density of approximately 450 to 750 g/l.

1 This apparent density may be adjusted not only by the fine-
ness of grinding, particularly through the mesh width of the
grid of a hammer mill for example, but also by the pressure
maintained in the chamber. Thus, where grinding is carried
5 out in a hammer mill having a 2 mm mesh grid, the apparent
density of the powder may be varied from 460 to 600 g/l by
varying the pressure in the chamber from 15 to 50 mbar for
example.

The apparatus for carrying out the process according to
10 the invention thus comprises a continuous mixing unit, a
continuous kneading and heating unit and an extrusion unit
opening into a chamber connected to a pump. As mentioned
above, this apparatus may be constructed in different ways
which may be grouped into two principal preferred embodiments
15 distinguished primarily by the fact that the continuous
kneading and heating unit is or is not itself capable of
providing the pressure required at least for the extrusion
step.

In the first preferred embodiment presented above,
20 therefore, the apparatus comprises two Archimedian screw
conveyors followed by a pump preceding the extrusion die
while, in the second preferred embodiment presented above,
the apparatus comprises a single-screw or twin-screw ex-
truder comprising several successive zones each provided
25 with a separate double jacket.

In this second preferred embodiment, the extrusion unit
may be formed by the front part of the extruder itself, i.e.
may comprise at least a last independent double-jacketed
zone and an extrusion die of the extruder. However, it may
30 also comprise additional elements enabling the reaction
temperature to be dissociated from the extrusion temperature.

The extrusion unit may thus comprise at least a last
zone of the extruder surrounded by a separate double jacket,
at least one heating tube connected to the extruder and
35 surrounded by a double jacket and an extrusion die connected

1 to the heating tube. The heating tube is preferably filled
with geometric static mixing elements intended to mix the
flux of paste to improve the speed and uniformity of heat
transfer and to prevent the paste from stopping at dead
5 points of the tube.

In this embodiment of the apparatus, where the extrusion
unit is extended beyond the extruder, the continuous
kneading and heating unit may additionally comprise a
double-jacketed dwell tube between the extruder and the
10 heating tube. This dwell tube is also preferably filled
with geometric static mixing elements. Its diameter is
preferably large enough for the mean axial speed of the
paste therein to be similar to the mean axial speed of the
paste in the extruder.

15 The introduction of geometric static mixing elements
into the dwell tube and the heating tube and even into the
extrusion die itself is undoubtedly capable of producing
significant pressure losses, i.e. of absorbing a large
proportion of the pressure generated by the pump or by the
20 extruder. This effect may be particularly marked in the
heating tube of which the diameter is preferably fairly
small to ensure rapid heat transfer. In order at least
partly to counteract this effect, the heating tube may with
advantage be divided into several parts and these parts
25 connected in parallel.

The apparatus for carrying out the process according to
the invention is described in detail hereinafter with refer-
ence to the accompanying drawings, wherein:

Figure 1 diagrammatically illustrates a first embodiment
30 of the apparatus.

Figure 2 diagrammatically illustrates a second embodi-
ment of the apparatus.

Figure 3 diagrammatically illustrates part of a variant
of the embodiment of the apparatus shown in Figure 2.

35 The apparatus shown in Figure 1 comprises a continuous

1 mixing unit 1-3, a continuous kneading and heating unit 4,5
and an extrusion unit 6-11 opening into a chamber 12 con-
nected to a pump 13.

5 The continuous mixing unit comprises an Archimedian
screw conveyor 1 surmounted by a feed hopper 2 for powder-
form ingredients and a feed pipe 3 for a liquid ingredient.

The continuous kneading and heating unit comprises an
Archimedian screw conveyor 4 surrounded by a double jacket 5
heatable by the circulation of hot oil.

10 The extrusion unit comprises a positive pump 6, a
heating tube 7 surrounded by a double jacket 8 filled with
geometric static mixing elements 9, in the form of metal
spiders overlapping one another, and a die 10 consisting of
a short cylindrical tube segment surrounded by a double
15 jacket 11.

The chamber 12 is connected to a pump in the form of a
vane pump 13. It encloses the downstream end of the die 11,
a conveyor belt 14 and a precrusher 15. It communicates
with the outside through an airlock 16 which opens onto a
20 hammer mill 17.

In the apparatus shown in Figure 2, the continuous
mixing unit comprises a twin-screw extruder having six
zones each provided with a separate double jacket, the
first zone 21 being for charging dry ingredients and
25 the second zone 22 for charging a liquid ingredient.
In these first two zones, the flights of the screws 20
are widely spaced and are merely arranged to compound
the mixture and to advance it through the extruder.

The continuous kneading and heating unit comprises the
30 third, fourth and fifth zones 23, 24 and 25 of the extruder
in which the flights 27 of the screws are closer together
and overlap more closely.

In the last zone 26 of the extruder the flights
28 of the screws are spaced even closer together to
35 apply a thrust or pressure to the paste. The unit also

1 comprises a heating tube 7 connected to the extruder,
which is filled with geometric static mixing elements 9 and
surrounded by a double jacket 8, and an extrusion die formed
5 by a short cylindrical tube section surrounded by a double
jacket 11 filled with geometric static mixing elements 29
and terminating in a removable nozzle 30 inclined towards
a conveyor belt 14 in the chamber 12.

In this second embodiment of the apparatus according to
the invention, the chamber 12 is again connected to a pump
10 in the form of a vane pump 13. It also encloses the down-
stream end of the die 11, the conveyor belt 14 and a pre-
crusher 15. It communicates with the outside through an air-
lock 16 opening onto a hammer mill 17.

In the variant shown in Figure 3, the continuous
15 kneading and heating unit of the embodiment of the apparatus
shown in Figure 2 additionally comprises a dwell tube 31
which is connected between the extruder and the heating tube
and which is filled with geometric static mixing elements 33
in the form of intertwined metal spiders and is
20 surrounded by a double jacket 32.

In this variant, the dwell tube 7 is formed by four
parallel segments each filled with geometric static mixing
elements 9 and surrounded by a common double jacket 8.

The process according to the invention is illustrated
25 by the following Examples in which percentages are by weight.

EXAMPLE 1

A vegetable protein hydrolyzate is prepared by cooking
ground nut cake with hydrochloric acid, neutralization,
30 filtration, partial decoloration and drying to a residual
water content of 2%. Using an apparatus of the type des-
cribed above with reference to Figure 1 of the accompanying
drawings, a dry mixture comprising 82% of this vegetable
protein hydrolyzate, 4.5% chicken fat, 0.5% glucose, 3%
35 cysteine and 5% inosine monophosphate is continuously pre-

1 pared in a first conveyor with twin Archimedian
screws. 5% Water is then added to obtain 100% of a paste-
like mixture.

5 The paste-like mixture is continuously introduced into
a second conveyor with twin Archimedian screws
surrounded by a double jacket in which hot oil circulates.
In this second conveyor, the mixture is plasticized by
kneading and heating to form a paste which is heated to and
then kept at a temperature of 120°C under 1 bar for 2 mins.

10 By means of a volumetric pump applying a pressure of
10 bar to the paste delivered by the second conveyor, the
paste is propelled through a heating tube surrounded by a
double jacket filled with geometric static mixing elements
in the form of intertwined metal spiders. The
15 temperature of the paste is then increased to 125°C and the
paste is immediately extruded through a die with a cylin-
drical orifice 5 mm in diameter surrounded by a double
jacket and also kept at 125°C. The die opens into a chamber
kept under a pressure of 10 mbar. The strand of extruded
20 paste expands considerably and cools suddenly under the
effect of the vaporization of the added water which it con-
tains and the expansion of that water vapour.

 The extruded paste strand is thus dried to a residual
water content of approximately 2% and is cooled to approxi-
25 mately 50°C, at which temperature the so-called Maillard
reaction is virtually terminated. The expanded strand has a
diameter of approximately 80 mm and an apparent density of
120 g/l. It is collected on a conveyor belt inside the
chamber and carried to a precrusher comprising rotating
30 rakes before leaving the chamber through an airlock. It is
then crushed in a hammer mill equipped with a 2 mm mesh grid.

 A flavouring agent is thus obtained in the form of a
golden, free-flowing powder which has an apparent density of
450 g/l and which is capable of giving a soup or a sauce a
35 roast chicken flavour.

1 EXAMPLE 2

---Using an apparatus of the type described above with reference to Figure 2 of the accompanying drawings, 10 kg/h of a dry mixture comprising 53% of a non-decolored acid
5 hydrolyzate of ground nut cake containing 2% water, 26% of yeast extract containing 2% water, 6% of monosodium glutamate, 1.3% of sodium chloride and 1.2% of thiamine is continuously introduced into a first zone for charging dry ingredients of a twin-screw extruder.

10 The extruder comprises six zones 16 cm in length surrounded by separate double jackets and two screws having an external diameter of 37 mm and an internal diameter of 22 mm. Its free volume is approximately 1 l. The screws are rotated at 40 r.p.m.

15 12.5% Of a glucose syrup containing 20% dry matter are continuously introduced into a second zone of the extruder for charging a liquid ingredient. 100% Of a paste-like mixture as obtained and plasticized by kneading and heating and then reacted in the third, fourth and fifth zones of the
20 extruder. The paste obtained is then kept at a temperature of approximately 100°C for 3 mins under 1.3 bar.

In the sixth zone of the extruder where the flights of the screws are much closer together, a pressure is applied to the paste so that it is able to pass through a
25 heating tube consisting of four parallel cylindrical segments 450 mm in length with an internal diameter of 10 mm filled with geometric static mixing elements and surrounded by a common double jacket while retaining enough energy to lend itself to the subsequent operation of drying and cooling by
30 extrusion.

In this heating tube, the temperature of the paste is rapidly increased to 118°C. This temperature is then increased to 125°C in the extrusion die following the heating tube. The extrusion die itself consists of a cylindrical
35 tube section 500 mm in length with an internal diameter of

- 1 8 mm which is surrounded by a double jacket, filled with
geometric static mixing elements and terminated by a down-
wardly inclined, removable nozzle with an internal diameter of
5 mm.
- 5 The paste is thus extruded towards a conveyor belt
situated below the downstream end of the die in a chamber
kept under a pressure of 15 mbar. The extruded strand under-
goes instantaneous expansion, drying and cooling through
vaporization and expansion of the added water which it
10 contains as it enters the chamber under reduced pressure.
It is thus dried to a residual moisture content of approxi-
mately 2.5% and at the same time cooled to around 50-60°C,
at which temperature the so-called Maillard reaction has
virtually stopped.
- 15 The extruded strand solidifies rapidly during its
transport in the chamber and may be precrushed by means of
rotating rakes before leaving the chamber through an airlock.
The precrushed strand has an apparent density of 150 g/l.
It is then crushed in a hammer mill equipped with a 2 mm
20 mesh grid.
- A flavouring agent is thus obtained in the form of a
free-flowing brown powder which has an apparent density of
500 g/l and which is capable of giving a soup or a sauce a
flavour of cooked beef.

25

EXAMPLE 3

- The procedure is as described in Example 2 except that
50 kg of starting material/h are introduced into the ex-
truder. To ensure that the reaction time stays at around
30 3 minutes in spite of the considerable increase in the
throughput of the extruder, the screws are rotated at
200 r.p.m. and the reaction is extended beyond the extruder
in a double-jacketed dwell tube. This tube, which is con-
nected between the extruder and the heating tube, has a
35 length of 1 m and a diameter of 36 mm. It is filled with

1 geometric static mixing elements in the form of intertwined metal spiders overlapping one another.

A flavouring agent entirely comparable with that of Example 2 is thus obtained.

5



CLAIMS

1. A process for the production of a flavouring agent having a meat-like taste, in which a paste-like mixture containing at least one source of free amino acids and additives comprising at least one reducing sugar is reacted by heating, characterized in that 70 to 95% by weight of a source of free amino acids having a water content 1 to 3%, 1 to 25% by weight of the additives and water are mixed to form a paste-like mixture containing 5 to 12% water, the paste-like mixture is plasticized by kneading and heating, the plasticized mixture is reacted for 30 s to 30 mins at a temperature of 80 to 140°C under a pressure of 1 to 100 bar and the reaction product is dried and cooled by extrusion and expansion in a chamber, wherein the pressure in the chamber is maintained at a reduced pressure of 5 to 50 mbar.
2. A process as claimed in claim 1, characterized in that the source of free amino acids comprises, in % by weight of the mixture, 40 to 95% of a protein hydrolyzate and 0 to 30% of a yeast extract, the additives comprise 0.5 to 10% of a reducing sugar, 0.5 to 10% of a sulfur-containing substance, 0 to 20% of monosodium glutamate and 0 to 5% of inosine monophosphate and 0 to 40% maltodextrin and 0 to 15% fats are additionally incorporated in the mixture.
3. A process as claimed in claim 1 or 2, characterized in that the plasticized mixture is reacted at a temperature of 80 to 125°C and its temperature is adjusted to 125 to 140°C before extrusion.
4. A process as claimed in any of claims 1 to 3, characterized in that an expanded, extruded reaction product having a residual moisture content of 1 to 3% and an apparent density of 100 to 200 g/l is obtained and is ground to form a powder or a granulate having an apparent density of 450 to 750 g/l.
5. An apparatus for carrying out the process claimed in



claim 1, characterized in that it comprises a continuous mixing unit (1-3; 21-22), a continuous kneading and heating unit (4-5; 23-25) and an extrusion unit (6;26; 7-11) opening into a chamber (12) connected to a pump (13).

5 6. An apparatus as claimed in claim 5, characterized in that the continuous mixing unit comprises an Archimedian screw conveyor (1) surmounted by a feed hopper for powder-form ingredients (2) and a feed pipe for a liquid ingredient (3), the continuous kneading and heating unit
10 comprises an Archimedian screw conveyor (4) surrounded by a double jacket (5) and the extrusion unit comprises a pump (6) and an extrusion die (10).

15 7. An apparatus as claimed in claim 5, characterized in that the continuous mixing unit comprises a first zone for charging dry ingredients (21) and a second zone for charging a liquid ingredient (22) of a single-screw or twin-screw extruder (20) and the continuous kneading and heating unit comprises at least a third zone (23-25) of the extruder, each zone being provided with a separate double
20 jacket.

8. An apparatus as claimed in claim 7, characterized in that the extrusion unit comprises at least one last zone (26) of the extruder with a separate double jacket and an extrusion die.

25 9. An apparatus as claimed in claim 7 or 8, characterized in that the extrusion unit comprises at least a last zone (26) of the extruder surrounded by a separate double jacket, at least one heating tube (7) connected to the extruder, filled with geometric static mixing elements (9) and surrounded by a double jacket (8) and also an extrusion
30 die (10) connected to the heating tube (7).

10. An apparatus as claimed in claim 9, characterized in that the continuous kneading and heating unit additionally comprises a dwell tube (31) connected between the extruder
35 (26) and the heating tube (7), filled with geometric static mixing elements (33) and surrounded by a double jacket (32).