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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
1 September 2016 (01.09.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/135292 A1

(51) International Patent Classification:
A23L 7/13 (2016.01) *A23L 7/165* (2016.01)

(21) International Application Number:
PCT/EP2016/054085

(22) International Filing Date:
26 February 2016 (26.02.2016)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
1503244.4 26 February 2015 (26.02.2015) GB

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

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

Published:

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

WO 2016/135292 A1

(54) Title: EXPANDED SNACK FOOD

(57) Abstract: A snack food pellet comprising a continuous starch-based matrix and a plurality of starch-based micropellets dispersed as inclusions in the continuous matrix. Also disclosed are a method of manufacturing such a snack food pellet, a method of producing an expanded snack food piece from such a snack food pellet, and an expanded snack food piece.

EXPANDED SNACK FOOD

The present invention relates to snack food pellets and to a method of manufacturing snack food pellets. The present invention also relates to a snack food produced from the snack food pellets.

The manufacture of snack food pellets is well known. Dried pellets are produced by an extrusion process with a subsequent drying step. The pellets are then cooked, for example by frying in oil, which causes expansion the pellets to form an expanded snack food of a desired shape and configuration. Various compositions of snack food pellets are known.

The product design of snack food pellets made by conventional means is constrained by the correlation of certain product attributes which are affected by changes in composition or process variables. For example, increased starch gelatinization can deliver a more aerated structure through increased pellet expansion and a softer, more melting texture; there can be limitations should the snack food pellet be intended to produce a more expanded product with a harder, crunchy texture.

Furthermore, pellets expanded by means other than frying in oil commonly have a smooth, shiny surface appearance, which is typically regarded as unattractive or artificial by consumers. The shiny surface can also lead to difficulties in applying controlled quantities of topical oil and seasoning powder to the expanded product.

In addition, the conventional pellet production process, incorporating extrusion of a homogeneous mass, yields highly homogeneous products.

The present invention aims at least partially to solve these problems of known snack food pellets and their manufacture.

The present invention accordingly provides a snack food pellet comprising a continuous starch-based matrix and a plurality of starch-based micropellets dispersed as inclusions in the continuous matrix.

The pellet has a shape and composition for subsequent expansion in hot oil, hot air or microwave to form an expanded snack food product.

The present invention further provides a method of manufacturing a snack food pellet, the method comprising the steps of:

i. providing a starch-based mixture;
ii. providing a plurality of starch-based micropellets;
iii. forming a dough comprising the micropellets dispersed as inclusions in the starch-based mixture; and
iv. extruding the dough to form pellets comprising a continuous starch-based matrix formed from the starch-based mixture with the starch-based micropellets dispersed therein.

The present invention further provides a method of producing a snack food, the method comprising the steps of:

i. providing a plurality of pellets according to the present invention or manufactured according to the method of the present invention; and
ii. expanding the pellets during a cooking step to produce a plurality of snack food pieces.

The present invention further provides an expanded snack food piece comprising a continuous starch-based expanded matrix and a plurality of starch-based expanded inclusions dispersed in the continuous expanded matrix.

Preferred features of all of these aspects of the present invention are defined in the dependent claims.

The preferred embodiments of the present invention can provide a modified pellet design which can be expanded to form a snack food, for example a chip, exhibiting localised variations in texture and/or colour and/or flavour across the product surface or internally, which can offer to the consumer a more natural, 'home baked' character to the expanded product as compared to currently available expanded snack chips produced from pellets.

In preferred embodiments of the present invention there is provided a modified pellet design in which smaller fragments of pre-processed pellets, referred to herein as micropellets, are incorporated into the pellet structure in a way that delivers localised property variations that are discrete from the continuous phase of the pellet. Such a heterogeneous pellet structure employs a two-step process, a first step to produce the micropellets and a second step to produce pellets incorporating the micropellets. These two steps may be entirely independent from the other, for example the two micropellet- and pellet-forming steps may be executed at completely separate locations and/or at different times.

The micropellets to form inclusions may be manufactured using standard pellet production technology to manufacture micropellets from a range of potential raw materials, typically including a high starch component (e.g. cereals, potato, etc.). Typically, the micropellet is extruded, and optionally the end faces of the extrusion are cut. The micro pellets typically have a size which is less than 5mm in diameter. The micropellets are then dried under controlled temperature and humidity to achieve a moisture content of from 8 to 14 wt% based on the weight of the micropellet. The resulting micropellets are stable in ambient storage conditions for several months.

The final pellet is manufactured by combining micropellets from the first production step into a mix of dry materials to be used to produce the continuous phase of the final pellet. The pellet dough is formed using a low-shear, low-temperature extrusion press for producing pellets. Such apparatus is generally known in the art of manufacturing snack foods. The extrusion press has a relatively open slot die at the product exit, and the opening aperture of slot die is greater than the diameter of the inclusion micropellets. A high open area of the die aperture prevents pressure build-up within the extrusion barrel, which could otherwise cause breakdown of the micropellet structure. The thickness of the extruded pellet may be adjusted, as appropriate, through the use of various post-extrusion methods, for example stretching of the pellet, compression of the pellet using compression rollers and/or embossing of the pellet using embossing rollers. The pellets are finally dried under controlled temperature and humidity to a moisture content of from 8 to 14 wt% based on the weight of the pellet.

The resultant product is a pellet containing inclusions of a different pellet, in the form of micropellets. This provides a wide variety of possibilities to optimise the snack food product design by affecting, for example, one or more of: the ingredient composition of the inclusion micropellet; the size and size distribution of the inclusion micropellets; the use of mixtures of different micropellets; the incorporation of colour and/or flavour components in micropellets; the use of varied dosages of inclusion micropellets; the ingredient composition of the continuous pellet phase.

The pellet may include discrete regions within the pellet comprising different starch components. Pellets are conventionally formulated to include starch-containing ingredients, such as potato and cereals, for example wheat, maize, rice, oats, barley, etc. Other cereal crops could be used, as well as starch from pulses, legumes, cassava, etc. The starch-containing ingredients may be added as whole foods (e.g. potato flakes/granules; wheat flour) or as

refined/isolated constituents (e.g. potato starch). The ingredients may be used individually or in combination with other starch-containing ingredients. The functionality of these ingredients in the manufacture of snack food products may be further manipulated by control over the manufacturing process (e.g. by controlling the degree of starch gelatinization) either as individual ingredients before pellet manufacture or during the pellet manufacturing process. The structure and texture of the snack food product after expansion is strongly influenced by the nature and composition of the starch-containing ingredients.

Using this invention, the nature and composition of the starch-containing ingredients can be independently controlled in the inclusion micropellets and the continuous phase of the final pellet in order to produce final pellets in which the inclusion micropellets and final pellet continuous phase are comprised of different starch-containing ingredients or different combinations of starch-containing ingredients, and/or the inclusion micropellets and final pellet continuous phase contain starches that have been processed to a different degree or extent (e.g. different degrees of gelatinization).

The size of the inclusion micropellets is dependent on the selected apparatus and process used to manufacture the micropellets. The properties of the final pellet continuous phase would affect the capacity to contain micropellets during pellet manufacture and subsequent use. Typically, the inclusion micropellets may have a size range of diameter 0.5mm to 10mm.

The percentage of inclusion micropellets by weight that can be used is likely to be dependent on the properties of the final pellet continuous phase and the capacity of the continuous phase to contain micropellets during pellet manufacture and subsequent expansion. Typically, the inclusion micropellets may be incorporated into the final pellet at any loading level up to 70 wt% based on the total weight of the final pellets.

The pellet may include discrete regions within the pellet, with the regions having different moisture contents. Standard snack pellets typically contain moisture at a level of from 8 to 14 wt% based on the weight of the pellet. Typically, the moisture content of both the inclusion micropellets and the final pellet continuous phase fall within the range of standard snack pellets, i.e. at a level of from 8 to 14 wt% based on the weight of the respective micropellet and the continuous phase. In some embodiments, however, the moisture contents, either within the inclusion micropellets, or the final pellet continuous phase, or both, may be outside the standard range. For example the extended moisture range may encompass moisture contents as low as

1 wt% or as high as 25 wt% based on the weight of the respective component or the entire final pellet.

The pellet may include discrete regions within the pellet, with the regions having different colour and/or flavor. In addition to the major starch-containing components included in the pellet and micropellet composition, minor ingredients can be used to impart colour and/or flavour to the finished product. Examples of such ingredients include, but are not limited to, flavouring/seasoning preparations, spices, natural and artificial colourings, herbs, and reaction flavour precursors, or any combination thereof. There may be provided a distinction between the inclusion micropellets and final pellet continuous phase which may be based on the presence or absence of colouring and/or flavouring components, or their inclusion at contrasting levels.

The pellet may include discrete regions within the pellet, with the regions having different structural properties. Certain aspects of the pellet performance during the expansion step can be influenced by the internal structure of the pellet, for example the degree of porosity, the density, etc. The distinction between the inclusion micropellets and final pellet continuous phase may be based on differences in pellet structure, such as internal porosity, open volume, density, etc. The pellet may include discrete regions within the pellet with other compositional differences, for example provide advantageous properties and characteristics in the expanded product. Such differences may include the presence/absence, or different application dosages, of constituents such as sugars, raising agents, salts, emulsifiers, fats/oils, humectants, acids, bases, proteins, fibres, dairy ingredients, texture modifiers, acidity regulators or any combination thereof.

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 schematically illustrates a cross-section through a snack food pellet in accordance with an embodiment of the present invention;

Figure 2 schematically illustrates an apparatus for manufacturing a snack food pellet in accordance with another embodiment of the present invention; and

Figure 3 schematically illustrates a perspective cross-section through an expanded snack food piece, in the form of a chip, in accordance with a further embodiment of the present invention.

Referring to Figure 1 of the accompanying drawings, a snack food pellet 2 comprises a continuous starch-based matrix 4 and a plurality of starch-based micropellets 6 dispersed as inclusions in the continuous matrix 4.

The continuous starch-based matrix 4 comprises at least one starch derived from of a cereal or a vegetable, optionally potato. The starch-based micropellets 6 comprise at least one starch derived from of a cereal or a vegetable, optionally potato.

The micropellets 6 have been manufactured using an extruder as generally described below with reference to Figure 3 which discloses a corresponding extrusion for the manufacture of the resultant extruded pellets 2.

The micropellets 6 typically have a maximum dimension of from 0.5 to 10 mm, typically from 1 to 5 mm. The continuous starch-based matrix 4 and the starch-based micropellets 6 have at least one of: a different composition; a different colour; a different flavour; a different starch; at least one different starch-containing ingredient; a different level of starch gelatinization; a different internal porosity; a different open volume; a different density; a different moisture content; and a different shape, or any combination of any two or more thereof.

The snack food pellet 2 typically comprises from 50 to 95 wt% continuous starch-based matrix 4 and from 5 to 50 wt% starch-based micropellets 6, more typically from 70 to 90 wt% continuous starch-based matrix 4 and from 10 to 30 wt% starch-based micropellets 6 each weight being based on the total weight of the continuous starch-based matrix 4 and the starch-based micropellets 6. The continuous starch-based matrix 4 preferably has a moisture content of from 8 to 14 wt% based on the weight of the continuous starch-based matrix 4 and the starch-based micropellets 6 also preferably have a moisture content of from 8 to 14 wt% based on the weight of the starch-based micropellets 6. This provides an overall moisture content in the pellet 2 of from 8 to 14 wt% based on the weight of the pellet 2.

Referring to Figure 2 of the accompanying drawings, in the method of manufacturing the snack food pellet 2, pellets 2 are extruded through an extrusion die 16 of an extruder 8. A starch-based mixture is provided and fed from a matrix mixture supply 12 into a mixer 10 located at the upstream end of the extruder 8. A plurality of starch-based micropellets 6 is fed from a micropellet supply 14 into the mixer 10. A dough is formed in the mixer 10 which comprises the micropellets dispersed as inclusions in the starch-based mixture. The dough is extruded from the extruder 8 to form the pellets 2 comprising the continuous starch-based matrix 4

formed from the starch-based mixture with the starch-based micropellets 6 dispersed therein. The pellets 2 may be collected in a hopper 18.

The thickness of the pellets 2 may additionally be modified after the extrusion step, for example by at least one of stretching, compressing, or embossing the pellets 2. After the extrusion step, and the optional thickness modification, the pellets 2 may be dried, for example to provide that the continuous starch-based matrix 4 has a moisture content of from 8 to 14 wt% based on the weight of the continuous starch-based matrix 6 and that the starch-based micropellets 6 have a moisture content of from 8 to 14 wt% based on the weight of the starch-based micropellets 6.

Typically, the dough is formed by mixing the micropellets 6 into the starch-based mixture at a temperature of from 20 to 80 °C and/or at a shear rate of from 1.0 to 2.5 s^{-1}. Typically, the dough comprising micropellets 6 dispersed therein is extruded at a temperature of from 5- to 130 °C and/or at a shear rate of from 0.2 to 1.5 s^{-1}. Typically, the extrusion die 16 has an aperture of which a minimum dimension is greater than a maximum dimension of the micropellets 6.

In the method of producing a snack food, a plurality of the pellets 2 are expanded during a known cooking step to produce a plurality of snack food pieces. The cooking step may comprise frying, baking or microwaving.

Referring to Figure 3 of the accompanying drawings, the resultant expanded snack food piece 20 comprises a continuous starch-based expanded matrix 22 and a plurality of starch-based expanded inclusions 24 dispersed in the continuous expanded matrix 22.

Typically, the expanded inclusions 24 have a maximum dimension of from 1 to 10 mm, for example from 3 to 7 mm. The expanded matrix 22 and the expanded inclusions 24 have at least one of: a different composition; a different colour; a different flavour; a different starch; at least one different starch-containing ingredient; a different level of starch gelatinization; a different internal porosity; a different open volume; a different density; a different moisture content; and a different shape, or any combination of any two or more thereof.

The expanded snack food piece 20 typically comprises from 50 to 95 wt% expanded matrix 22 and from 5 to 50 wt% expanded inclusions 24, for example from 70 to 90 wt% expanded matrix 22 and from 10 to 30 wt% expanded inclusions 24, each weight being based on the total weight of the expanded matrix 22 and the expanded inclusions 24.

The pellet 2 may be shaped and dimensioned to provide any desired shape and dimensions to the resultant expanded snack food piece 20 using shape and dimension selection techniques well known to those skilled in the snack food art.

Various other modifications to the present invention will be readily apparent to those skilled in the art.

Claims

1. A snack food pellet comprising a continuous starch-based matrix and a plurality of starch-based micropellets dispersed as inclusions in the continuous matrix.
2. A snack food pellet according to claim 1 wherein the continuous starch-based matrix comprises at least one starch derived from of a cereal or a vegetable, optionally potato.
3. A snack food pellet according to claim 1 or claim 2 wherein the starch-based micropellets comprise at least one starch derived from of a cereal or a vegetable, optionally potato.
4. A snack food pellet according to any one of claims 1 to 3 wherein the micropellets have a maximum dimension of from 0.5 to 10 mm.
5. A snack food pellet according to claim 4 wherein the micropellets have a maximum dimension of from 1 to 5 mm.
6. A snack food pellet according to any foregoing claim wherein the continuous starch-based matrix and the starch-based micropellets have at least one of: a different composition; a different colour; a different flavour; a different starch; at least one different starch-containing ingredient; a different level of starch gelatinization; a different internal porosity; a different open volume; a different density; a different moisture content; and a different shape, or any combination of any two or more thereof.
7. A snack food pellet according to any foregoing claim which comprises from 50 to 95 wt% continuous starch-based matrix and from 5 to 50 wt% starch-based micropellets, each weight being based on the total weight of the continuous starch-based matrix and the starch-based micropellets.
8. A snack food pellet according to claim 7 which comprises from 70 to 90 wt% continuous starch-based matrix and from 10 to 30 wt% starch-based micropellets, each weight being based on the total weight of the continuous starch-based matrix and the starch-based micropellets.
9. A snack food pellet according to any foregoing claim wherein the continuous starch-based matrix has a moisture content of from 8 to 14 wt% based on the weight of the continuous starch-based matrix.
10. A snack food pellet according to any foregoing claim wherein the starch-based micropellets have a moisture content of from 8 to 14 wt% based on the weight of the starch-based micropellets.
11. A method of manufacturing a snack food pellet, the method comprising the steps of:

i. providing a starch-based mixture;

ii. providing a plurality of starch-based micropellets;

iii. forming a dough comprising the micropellets dispersed as inclusions in the starch-based mixture; and

iv. extruding the dough to form pellets comprising a continuous starch-based matrix formed from the starch-based mixture with the starch-based micropellets dispersed therein.

12. A method according to claim 11 wherein the continuous starch-based matrix comprises at least one starch derived from of a cereal or a vegetable, optionally potato.

13. A method according to claim 11 or claim 12 wherein the starch-based micropellets comprise at least one starch derived from of a cereal or a vegetable, optionally potato.

14. A method according to any one of claims 11 to 13 wherein the micropellets have a maximum dimension of from 0.5 to 10 mm.

15. A method according to claim 14 wherein the micropellets have a maximum dimension of from 1 to 5 mm.

16. A method according to any one of claims 11 to 15 wherein the continuous starch-based matrix and the starch-based micropellets have at least one of: a different composition; a different colour; a different flavour; a different starch; at least one different starch-containing ingredient; a different level of starch gelatinization; a different internal porosity; a different open volume; a different density; a different moisture content; and a different shape, or any combination of any two or more thereof.

17. A method according to any one of claims 11 to 16 wherein the pellet comprises from 50 to 95 wt% continuous starch-based matrix and from 5 to 50 wt% starch-based micropellets, each weight being based on the total weight of the continuous starch-based matrix and the starch-based micropellets.

18. A method according to claim 17 wherein the pellet comprises from 70 to 90 wt% continuous starch-based matrix and from 10 to 30 wt% starch-based micropellets, each weight being based on the total weight of the continuous starch-based matrix and the starch-based micropellets.

19. A method according to any one of claims 11 to 18 further comprising the step e, after step d, of modifying a thickness of the pellets.

20. A method according to claim 19 wherein step e comprises at least one of stretching, compressing, or embossing the pellets.

21. A method according to any one of claims 11 to 20 further comprising the step f, after step d or e, of drying the pellets.
22. A method according to claim 21 wherein step f provides that the continuous starch-based matrix has a moisture content of from 8 to 14 wt% based on the weight of the continuous starch-based matrix.
23. A method according to claim 21 or claim 22 wherein step f provides that the starch-based micropellets have a moisture content of from 8 to 14 wt% based on the weight of the starch-based micropellets.
24. A method according to any one of claims 11 to 23 wherein in step c the dough is formed by mixing the micropellets into the starch-based mixture at a temperature of from 20 to 80 °C.
25. A method according to any one of claims 11 to 24 wherein in step c the dough is formed by mixing the micropellets into the starch-based mixture at a shear rate of from 1.0 to 2.5 s^{-1}.
26. A method according to any one of claims 11 to 25 wherein in step d the dough comprising micropellets dispersed therein is extruded at a temperature of from 50 to 130 °C.
27. A method according to any one of claims 11 to 26 wherein in step d the dough comprising micropellets dispersed therein is extruded at a shear rate of from 0.2 to 1.5 s^{-1}.
28. A method according to any one of claims 11 to 27 wherein in step d the dough comprising micropellets dispersed therein is extruded through an extrusion die having an aperture, a minimum dimension of the aperture being greater than a maximum dimension of the micropellets.
29. A method of producing a snack food, the method comprising the steps of:
    i. providing a plurality of pellets according to any one of claims 1 to 10 or manufactured according to the method of any one of claims 11 to 28; and
    ii. expanding the pellets during a cooking step to produce a plurality of snack food pieces.
30. A method according to claim 29 wherein the cooking step comprises frying, baking or microwaving.
31. An expanded snack food piece comprising a continuous starch-based expanded matrix and a plurality of starch-based expanded inclusions dispersed in the continuous expanded matrix.

32. An expanded snack food piece according to claim 31 wherein the expanded matrix comprises at least one starch derived from of a cereal or a vegetable, optionally potato.
33. An expanded snack food piece according to claim 31 or claim 32 wherein the expanded inclusions comprise at least one starch derived from of a cereal or a vegetable, optionally potato.
34. An expanded snack food piece according to any one of claims 31 to 33 wherein the expanded inclusions have a maximum dimension of from 1 to 10 mm.
35. An expanded snack food piece according to claim 34 wherein the expanded inclusions have a maximum dimension of from 3 to 7 mm.
36. An expanded snack food piece according to any one of claims 31 to 35 wherein the expanded matrix and the expanded inclusions have at least one of: a different composition; a different colour; a different flavour; a different starch; at least one different starch-containing ingredient; a different level of starch gelatinization; a different internal porosity; a different open volume; a different density; a different moisture content; and a different shape, or any combination of any two or more thereof.
37. An expanded snack food piece according to any one of claims 31 to 36 which comprises from 50 to 95 wt% expanded matrix and from 5 to 50 wt% expanded inclusions, each weight being based on the total weight of the expanded matrix and the expanded inclusions.
38. An expanded snack food piece according to claim 37 which comprises from 70 to 90 wt% expanded matrix and from 10 to 30 wt% expanded inclusions, each weight being based on the total weight of the expanded matrix and the expanded inclusions.

Figure 1

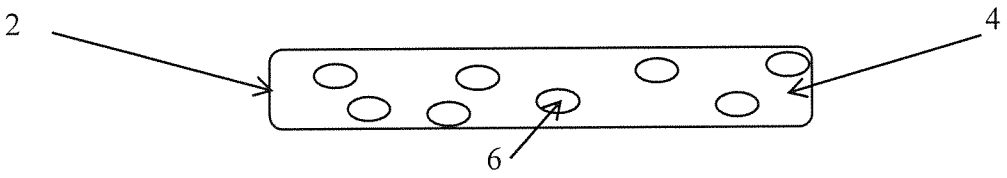


Figure 2

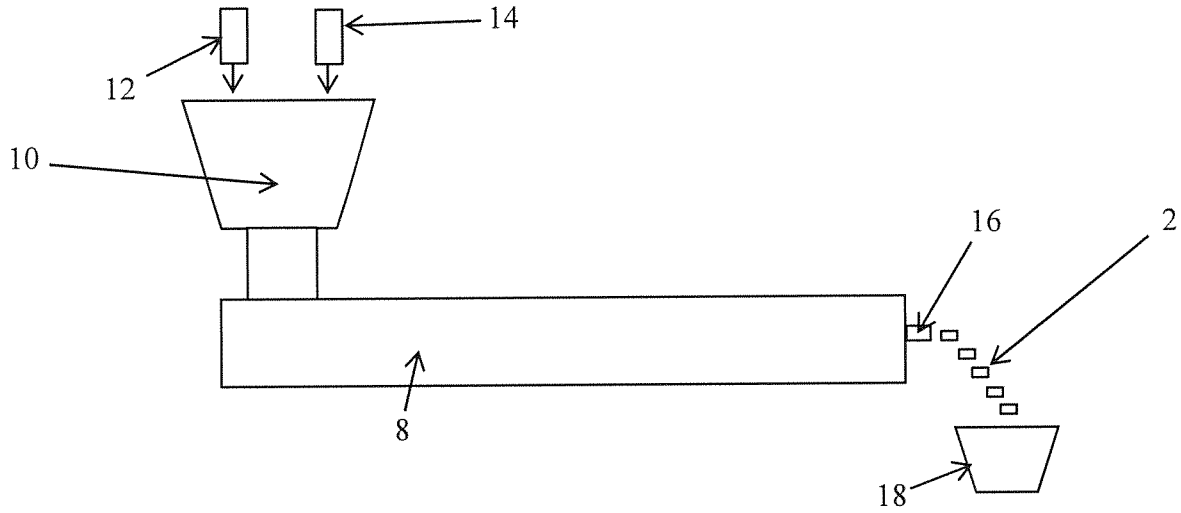
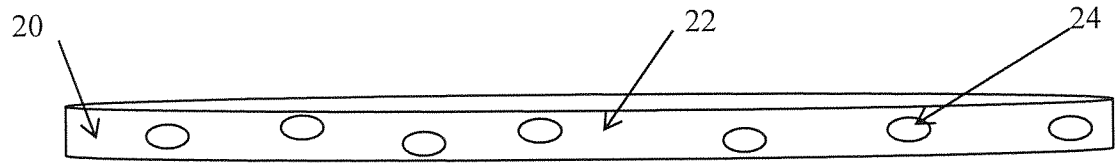


Figure 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/054085

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23L7/13 A23L7/165
ADD.

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

B. FIELDS SEARCHED

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

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/273209 A1 (BAIER STEFAN K [US] ET AL) 17 October 2013 (2013-10-17) figure 5 paragraphs [0025], [0026], [0027], [0049], [0056], [0057], [0058] claims 1,2,3,15,16,17,19,22,31,34,35,36 ----- -/--	1-6, 10-16, 23,25, 27,29-36

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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

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

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 May 2016	25/05/2016

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

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/054085

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/273219 A1 (BAIER STEFAN K [US] ET AL) 17 October 2013 (2013-10-17) figures 1,6,9,10,11A,11C paragraphs [0033], [0034], [0036], [0037], [0038], [0047], [0056], [0061], [0062], [0096], [0097]	1-4,6-8, 11-14, 16-21, 24-29, 31-33, 36-38
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Information on patent family members

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