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(71) Applicant: ARCHER DANIELS MIDLAND COMPANY [US/US]; 4666 Faries Parkway, Decatur, Illinois 62526 (US).

(72) Inventors: BASEETH, Shireen; 636 Waterford Lane, Decatur, Illinois 62526 (US). DAVIS, Alyssa; 40 Corman Ct, Decatur, Illinois 62521 (US). RHODE, Olivia; 163 Bristol Dr., Decatur, Illinois 62521 (US). HALALIPOUR, Ali; 777 W. Prairie Ave, Apartment 401, Decatur, Illinois 62522 (US).

(74) Agent: NILLES, Andrew, F.; Archer Daniels Midland Company, 4666 Faries Parkway, Decatur, Illinois 62526 (US).

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(54) Title: STARCH BASED WHITENING AND OPACIFYING AGENTS AND USES THEREOF

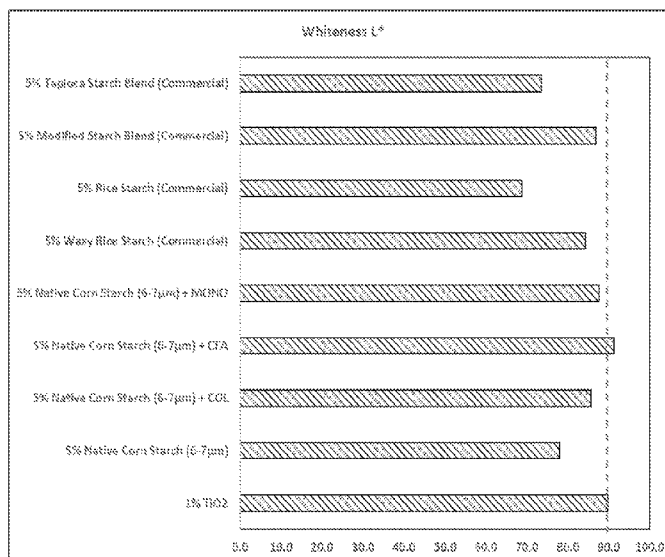


FIGURE 1

(57) Abstract: Starch based whitening and opacifying starch products and uses thereof in food products are disclosed. The starch-based whitening and opacifying starch products may be used to coat food products or be mixed with food products to whiten and opacify such food products.



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))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

STARCH BASED WHITENING AND OPACIFYING AGENTS AND USES THEREOF

FIELD OF THE INVENTION

5 The present invention relates generally to opacifying or whitening agents. More particularly, the present invention relates to processes for using starch based opacifying or whitening agents, such as in confectionary compositions.

BACKGROUND OF THE INVENTION

10 Titanium dioxide is a common food additive used for its whitening effects in processed foods such as baked goods, confectionaries, chewing gum, soups, and creamers. Titanium dioxide is also used for its whitening and opacifying effects in personal care products, cosmetics, and paints and coatings.

 Titanium dioxide has recently been declared by the European Food Safety
15 Authority to no longer be safe as a food additive. Accordingly, needs exist for safer whitening and opacifying agents for use in foods.

SUMMARY OF THE INVENTION

 In each of various embodiments, the present invention solves these needs and
20 discloses starch-based whitening and opacifying agents.

 In one embodiment, a process of coating a food product comprises dispersing a starch-based whitening or opacifying agent in a liquid, thus producing a coating composition, coating the food product with the coating composition, and allowing the coating composition to dry.

25 In another embodiment, a process of coating a food product comprises dispersing a starch particle coated with an emulsifier or a lipid in a liquid, thus producing a coating composition and coating the food product with at least one layer of the coating composition.

 In a further embodiment, a process of opacifying a food product comprises
30 mixing an effective amount of a starch-based whitening or opacifying agent with the product in an amount to provide opacity to the food product.

 In an additional embodiment, a process of opacifying a food product comprises mixing an effective amount of a starch particle coated with an emulsifier or a lipid with the product in an amount to provide opacity to the food product.

In yet a further embodiment, the use of a starch particle coated with an emulsifier, a lipid, or a combination thereof in a liquid as an opacifying or whitening agent in a food product is disclosed.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the whiteness (L^*) for panning with various embodiments of the starch-based whitening or opacifying agents of the present invention compared to different commercially available products.

FIG. 2 shows the whiteness (L^*) for panning with various embodiments of the starch-based whitening or opacifying agents of the present invention at different amounts (5 or 10%).

DETAILED DESCRIPTION OF THE INVENTION

In one embodiment, a process of coating a food product comprises dispersing a starch-based whitening or opacifying agent in a liquid, thus producing a coating composition, coating the food product with the coating composition, and allowing the coating composition to dry. The food product may be a confection or a food particle. The confection may be a panned confection, a gum, or a pressed tablet.

The starch-based whitening or opacifying agent may be a micronized starch having a particle size range of d_{50} of 6-7 μm or a d_{90} of less than 10 μm .

The starch based whitening or opacifying agent may be produced by (a) heating a mixture of water and native or modified starch or flour to a temperature in the range of 25° Celsius to less than 200° Celsius, extruding the mixture with a screw configuration comprising in series at least one low-shear forward conveying screw and at least one high-shear mixing screw to produce an extrudate; or (b) forming a mixture of water, a lipid, and native or modified starch or flour, and drying the mixture of water, lipid, and native or modified starch or flour to produce a dried lipid starch intermediate or dried lipid flour intermediate.

In the process of coating the food product, the liquid may include a sweetener that may be a sugar-based sweetener or a sugar-free sweetener. The process may further include sealing the food product before coating the food product with the coating composition.

The process may include repeating coating the food producing with the coating composition and allowing the coating composition to dry.

In an additional embodiment, a process of coating a food product comprises dispersing a starch particle coated with an emulsifier, a lipid, or a combination thereof in a liquid, thus producing a coating composition and coating the food product with at least one layer of the coating composition.

5 The food product may be a confection or a food particle. The confection may be a panned confection, a gum, or a pressed tablet.

The starch particle may be a micronized starch having a particle size range of d50 of 6-7 μm or a d90 of less than 10 μm .

10 The liquid in the process may comprise a sweetener that may be a sugar-based sweetener or a sugar-free sweetener.

The process may further comprise sealing the food product before coating the food product with the coating composition. The process may also include repeating coating the food producing with the coating composition and allowing the coating composition to dry.

15 In a further embodiment, a process of opacifying a food product includes mixing an effective amount of a starch-based whitening or opacifying agent with the product in an amount to provide opacity to the food product. The food product may be selected from the group consisting of a beverage, powdered drink, a powdered mix, a baked good, a fondant, an icing, a compound coating, a topping, a dairy product, a dairy
20 alternative product, a soup, a sauce, a dressing, a meal alternative, a ped food, a creamer, or a pet treat.

The starch-based whitening or opacifying agent may be a micronized starch having a particle size range of d50 of 6-7 μm or a d90 of less than 10 μm .

25 The starch based whitening or opacifying agent may also be produced by (a) heating a mixture of water and native or modified starch or flour to a temperature in the range of 25° Celsius to less than 200° Celsius, extruding the mixture with a screw configuration comprising in series at least one low- shear forward conveying screw and at least one high- shear mixing screw to produce an extrudate or (b) forming a mixture of water, a lipid, and native or modified starch or flour, and drying the mixture of water,
30 lipid, and native or modified starch or flour to produce a dried lipid starch intermediate or dried lipid flour intermediate.

In another embodiment, a process of opacifying a food product includes mixing an effective amount of a starch particle coated with an emulsifier or a lipid with the product in an amount to provide opacity to the food product. The food product may be
35 selected from the group consisting of a beverage, powdered drink, a powdered mix, a

baked good, a fondant, an icing, a compound coating, a topping, a dairy product, a dairy alternative product, a soup, a sauce, a dressing, a meal alternative, a pet food, a creamer, or a pet treat.

The starch particle may be a micronized starch having a particle size range of d50 of 6-7 μm or a d90 of less than 10 μm . The starch particle may be coated with the lipid and the emulsifier.

In another embodiment, use of a starch particle coated with an emulsifier, a lipid, or a combination thereof in a liquid as an opacifying or whitening agent in a food product.

In one embodiment, a starch-based whitening or opacifying agent may be a milled corn starch. The milled corn starch may be a PEARLEDGE brand corn starch, such as PEARLEDGE SILK, PEARLEDGE SATIN, or PEARLEDGE SHINE, each available from Archer-Daniels-Midland Company of Decatur, Illinois. The milled corn starch may be micronized to a particle size of a d50 of 6-7 μm and/or a d90 of less than 10 μm .

In a further embodiment, the starch-based whitening or opacifying agent may be the ultra-fine starch/flour product described in International Publication No. WO 2021/119532 assigned to Archer-Daniels-Midland Company of Decatur, Illinois. Such ultra-fine starch/flour product may be produced by: heating a mixture of water and native or modified starch or flour to a temperature in the range of 25° Celsius to less than 200° Celsius, extruding the mixture with a screw configuration comprising in series at least one low- shear forward conveying screw and at least one high- shear mixing screw to produce an extrudate or forming a mixture of water, a lipid, and native or modified starch or flour, and drying the mixture of water, lipid, and native or modified starch or flour to produce a dried lipid starch intermediate or dried lipid flour intermediate.

In a further embodiment, the starch-based whitening or opacifying agent may be a milled corn starch described herein coated with a fat and/or an emulsifier.

Non-limiting examples of fats that may be used include, but are not limited to, coconut oil, coconut fatty acids, palmitic acid, vegetable oils, vegetable fatty acids, and combinations of any thereof.

Non-limiting examples of emulsifiers that may be used include, but are not limited to, monoglycerides, monodiglycerides, lecithin, and combinations of any thereof.

The invention is further described in the following non-limiting Examples.

Example 1.

Preparation of starch-based whitening or opacifying agent.

A native corn starch was milled to a particle size range of d50 of 6-7 μm and a d90 of less than 10 μm as measured with a Malvern Mastersizer 3000 dry module. A fluidized bed jet mill (Netzsch condux CGS 10) was used to make the micronized starch. The starch was introduced into the mill by a volumetric feeder and milled by compressed gas supplied at 6 bars to three grinding nozzles. The particle size may be tuned as desired by adjusting the rotational speed of an internal classifier in the jet mill.

Example 2.

The micronized starch of Example 1 was further processed by spray drying with a lipid and an emulsifier. The spray drying was done in two stages. In the first stage, the fat was melted to a temperature of at least 10°C above the melting point of the fat, and the melted fat was blended with the emulsifier to form a homogenous mixture. The fat/emulsifier blend (at a ratio of 1:1 fat to emulsifier) was homogenized at 4000 rpm using a Silverson homogenizer for 10 minutes to form a uniform dispersion. In this Example, the emulsifier was a C8/C10 monodiglyceride (Drewmulse GMC 9-10 available from Stepan, USA). The fats used were coconut oil, coconut fatty acid and palmitic acid. The lipid/emulsifier dispersion was added to water and slurried with the micronized starch at low shear. The resulting lipid/emulsifier/starch dispersion was spray dried with an inlet temperature of 370°F (plus/minus 5°F), and an outlet temperature of 175°F (plus/minus 5°F) and sieved through a 20-mesh screen.

Example 3.

Hard sucrose panning application.

A number of different starch-based whitening or opacifying agents were used in a panning application at a 5% or 10% inclusion. The starch-based agents shown in Table 1 were used.

Table 1.

Samples	Description
Native Corn Starch (6-7 μm)	Micronized Starch
Native Corn Starch (6-7 μm) + MONO	Micronized Starch + Monoglyceride
Native Corn Starch (6-7 μm) + COL	Micronized Starch + Coconut Oil + Monoglyceride
Native Corn Starch (6-7 μm) + CFA	Micronized Starch + Coconut Fatty Acid + Monoglyceride
Native Corn Starch (3-4 μm) + PFA	Micronized Starch + Palmitic Acid + Monoglyceride
Rice Starch + MONO	Rice Starch + Monoglycerides

Dark chocolate coated soybeans were used as a starting medium for hard panning. An engrossing syrup was made with granulated sucrose (66%) and water (33%). The starch-based whitening or opacifying agents were added to the engrossing

syrups at inclusion levels of 5 or 10%. Air was used as a drying medium in this engrossing step, and no air was applied during the finishing step.

A Latini Enterprises coating pan was used for the panning process with a 16-inch stainless steel smooth pan attachment. The air and speed were adjusted as needed. The conditions of the engrossing process were about 50-60% relative humidity and a
5 temperature of about 60-70°F. The engrossing syrups were drizzled on the chocolate-covered soybeans using a 10 mL syringe.

The chocolate-covered soybeans were pre-sealed with a gum Arabic (40%) and water (60%) solution. The pre-sealing provided a good base for the engrossing syrup to
10 adhere. The gum Arabic solution was added to the chocolate-covered soybeans in 3 coats, at 20 mL each coat, with a dry charge of powdered sucrose added in between each coat. The pre-sealed chocolate-covered soybeans were allowed to dry overnight at room conditions.

The engrossing syrup was made by bringing granulated sucrose and water to a
15 boil and cooking until 70% solids were achieved with a refractometer. The engrossing syrup was weighed into containers and allowed to sit overnight to completely cool. The percent of starch-based whitening or opacifying agents needed was calculated based on the amount of engrossing syrup. The starch-based whitening or opacifying agents were added and dispersed in the engrossing syrup using high shear at 2700 RPM for 2 minutes
20 with a Silverson mixer. The engrossing syrups were allowed to completely cool, and the solids were tested and adjusted back to 70% as needed. The white syrups (containing the starch-based whitening or opacifying agents) were run on a Minolta colorimeter.

The engrossing step of the chocolate-covered soybeans with the white syrups was done in about 20 total coats (10 mL of white syrup each coat). For each coat, the
25 chocolate covered soybeans were tumbled for about 1-2 minutes with the white syrup without air to coat the chocolate covered soybeans, then air was applied for about 1 minute to dry the white syrup and prepare for the next coating. The engrossing step was used to apply about 20 coats.

A finishing step was performed next, which was similar to the engrossing step,
30 and was used to establish a nice, smooth finish on the chocolate covered soybeans. The finishing step was done with the white engrossing syrup diluted with water to 67% solids and added in 10 coats of 10 mL each. The finishing step was tumbled dry for about 10 minutes with no air. After finishing, the coated soybeans were allowed to dry overnight.

Figure 1 shows the whiteness (L^*) for panning with the different starch-based whitening or opacifying agents of the present invention compared to different commercially available products.

Figure 2 shows the whiteness (L^*) for panning for the different starch-based whitening or opacifying agents of the present invention at different amounts (5 or 10%). 5% is the darker bar and 10% is the lighter bar.

This disclosure has been described with reference to certain exemplary embodiments, compositions, and uses thereof. However, it will be recognized by those of ordinary skill in the art that various substitutions, modifications, or combinations of any of the exemplary embodiments may be made without departing from the spirit and scope of the disclosure. Thus, the disclosure is not limited by the description of the exemplary embodiments, but rather by the appended claims as originally filed.

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CLAIMS

What is claimed is:

1. A process of coating a food product comprising:
5 dispersing a starch-based whitening or opacifying agent in a liquid, thus producing a coating composition;
coating the food product with the coating composition; and
allowing the coating composition to dry.
- 10 2. The process of claim 1, wherein the food product is a confection or a food particle.
3. The process of claim 2, wherein the confection is a panned confection, a gum, or a pressed tablet.
- 15 4. The process of any one of claims 1-3, wherein the starch-based whitening or opacifying agent is a micronized starch.
5. The process of claim 4, wherein the micronized starch has particle size
20 range of d50 of 6-7 μm or a d90 of less than 10 μm .
6. The process of any one of claims 1-3, wherein the starch-based whitening or opacifying agent is produced by:
 - 25 (a) heating a mixture of water and native or modified starch or flour to a temperature in the range of 25° Celsius to less than 200° Celsius, extruding the mixture with a screw configuration comprising in series at least one low-shear forward conveying screw and at least one high-shear mixing screw to produce an extrudate; or
 - 30 (b) forming a mixture of water, a lipid, and native or modified starch or flour, and drying the mixture of water, lipid, and native or modified starch or flour to produce a dried lipid starch intermediate or dried lipid flour intermediate.
7. The process of any one of claims 1-6, wherein the liquid comprises a
35 sweetener.

8. The process of claim 7, wherein the sweetener is a sugar-based sweetener or a sugar-free sweetener.

9. The process of any one of claims 1-8, further comprising sealing the food
5 product before coating the food product with the coating composition.

10. The process of any one of claims 1-9, further comprising repeating coating the food producing with the coating composition and allowing the coating composition to dry.

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11. A process of coating a food product comprising:
dispersing a starch particle coated with an emulsifier, a lipid, or a combination thereof in a liquid, thus producing a coating composition; and
coating the food product with at least one layer of the coating composition.

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12. The process of claim 11, wherein the food product is a confection or a food particle.

13. The process of claim 12, wherein the confection is a panned confection, a
20 gum, or a pressed tablet.

14. The process of any one of claims 11-13, wherein the starch particle is a micronized starch.

25 15. The process of claim 14, wherein the micronized starch has particle size range of d50 of 6-7 μm or a d90 of less than 10 μm .

16. The process of any one of claims 11-15, wherein the liquid comprises a sweetener.

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17. The process of claim 16, wherein the sweetener is a sugar-based sweetener or a sugar-free sweetener.

18. The process of any one of claims 11-17, further comprising sealing the
35 food product before coating the food product with the coating composition.

19. The process of any one of claims 11-18, further comprising repeating coating the food producing with the coating composition and allowing the coating composition to dry.

5 20. A process of opacifying a food product, comprising:
 mixing an effective amount of a starch-based whitening or opacifying agent with the product in an amount to provide opacity to the food product.

10 21. The process of claim 20, wherein the food product is selected from the group consisting of a beverage, powdered drink, a powdered mix, a baked good, a fondant, an icing, a compound coating, a topping, a dairy product, a dairy alternative product, a soup, a sauce, a dressing, a meal alternative, a pet food, a creamer, or a pet treat.

15 22. The process of claim 20 or claim 21, wherein the starch-based whitening or opacifying agent is a micronized starch.

 23. The process of claim 22, wherein the micronized starch has particle size range of d50 of 6-7 μm or a d90 of less than 10 μm .

20 24. The process of claim 20 or claim 21, wherein the starch-based whitening or opacifying agent is produced by:

 (a) heating a mixture of water and native or modified starch or flour to a temperature in the range of 25° Celsius to less than 200° Celsius, extruding the mixture with a screw configuration comprising in series at least one low-shear forward conveying screw and at least one high-shear mixing screw to produce an extrudate; or

25 (b) forming a mixture of water, a lipid, and native or modified starch or flour, and drying the mixture of water, lipid, and native or modified starch or flour to produce a dried lipid starch intermediate or dried lipid flour intermediate.

30 25. A process of opacifying a food product, comprising:
 mixing an effective amount of a starch particle coated with an emulsifier or a lipid with the product in an amount to provide opacity to the food product.

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26. The process of claim 25, wherein the food product is selected from the group consisting of a beverage, powdered drink, a powdered mix, a baked good, a fondant, an icing, a compound coating, a topping, a dairy product, a dairy alternative product, a soup, a sauce, a dressing, a meal alternative, a pet food, a creamer, or a pet treat.
27. The process of claim 25 or claim 26, wherein the starch particle is a micronized starch.
28. The process of claim 27, wherein the micronized starch has particle size range of d50 of 6-7 μm or a d90 of less than 10 μm .
29. The process of any one of claims 25-28, wherein the starch particle is coated with the lipid and the emulsifier.
30. Use of a starch particle coated with an emulsifier, a lipid, or a combination thereof in a liquid as an opacifying or whitening agent in a food product.

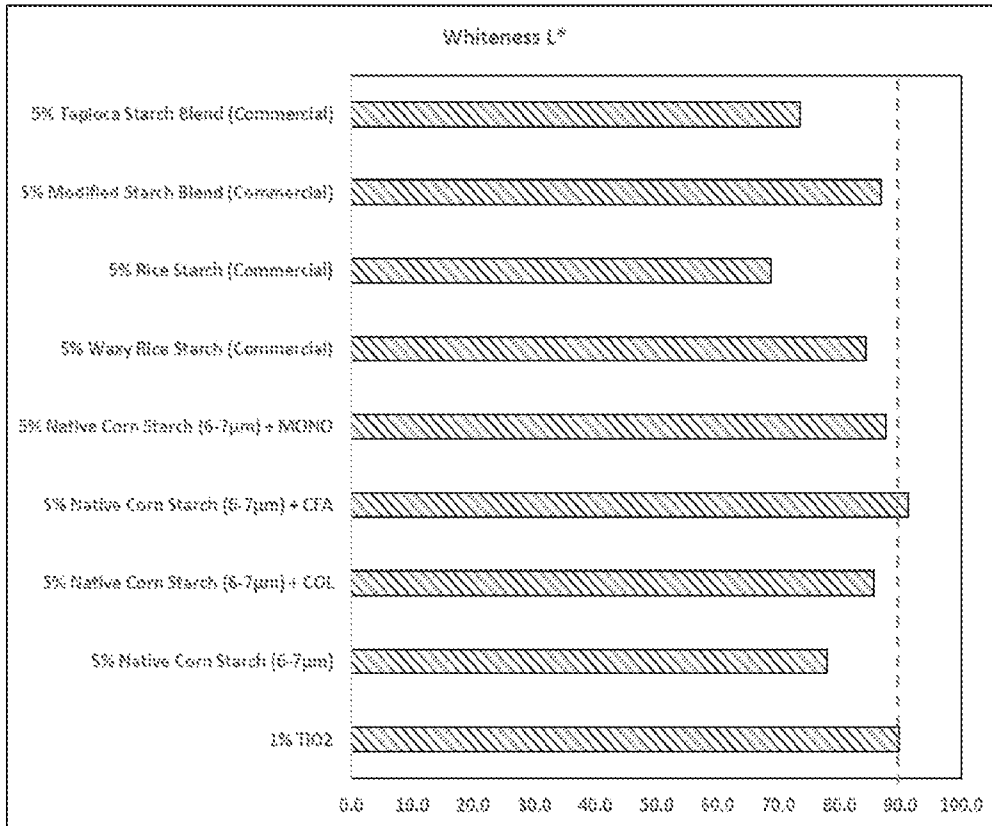


FIGURE 1

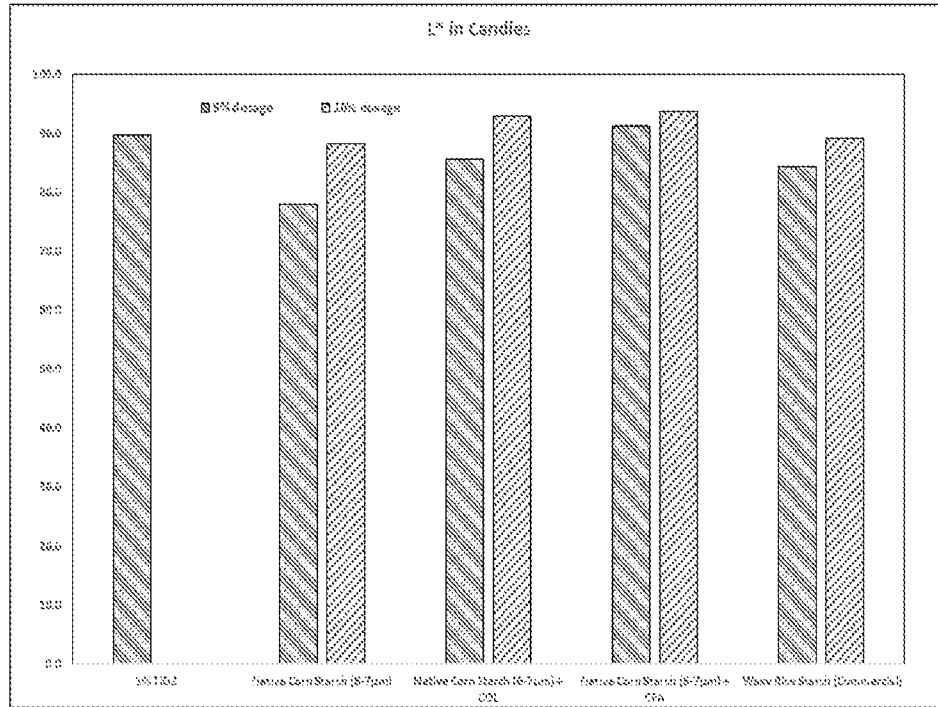


FIGURE 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 23/63480

A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. A23L 29/212, A23L 29/00, A23L 29/219 (2023.01)
 - ADD. A23L 29/262 (2023.01)

CPC - INV. A23L 29/212, A23L 29/015, A23L 29/219
 - ADD. A23L 29/262

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)
 See Search History document

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/0093476 A1 (TIENSE SUIKKERAFFINADERIJ N.V.) 2 April 2015 (02.04.2015)- entire document especially Table 1, Table 2, and para [0059], [0048]-[0049], [0044]-[0045], [0029], [0033]	1-6, 11-15, 20-28, 30
L	EP 2737805 A1 (LOTTE CO., LTD.) 4 June 2014 (04.06.2014)- entire document especially abstract	3, 13
A	US 2018/0263268 A1 (CORN PRODUCTS DEVELOPMENT, INC.) 20 September 2018 (20.09.2018)- entire document	1-6, 11-15, 20-28, 30
A	WO 2021/119352 A1 (STEPHEN DAVID BRESNICK) 17 June 2021 (17.06.2021)- entire document	1-6, 11-15, 20-28, 30
A	US 2016/0295895 A1 (N.V. NUTRICIA) 13 October 2016 (13.10.2016)- entire document	1-6, 11-15, 20-28, 30
A	US 2014/0030387 A1 (MAP CHILE SPA) 30 January 2014 (30.01.2014)- entire document	1-6, 11-15, 20-28, 30

 Further documents are listed in the continuation of Box C.

 See patent family annex.

* Special categories of cited documents:

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

"D" document cited by the applicant in the international application

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

1 May 2023 (01.05.2023)

Date of mailing of the international search report

JUL 03 2023

Name and mailing address of the ISA/US

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Kari Rodriguez

Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 23/63480

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

- 1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

- 2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

- 3. Claims Nos.: 7-10, 16-19, 29
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

- 1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
- 2. As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
- 3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

- 4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.