



(43) International Publication Date
15 December 2016 (15.12.2016)

(10) International Publication Number
WO 2016/198567 A1

(51) International Patent Classification:

A23L 2/52 (2006.01) *A23L 29/212* (2016.01)
A23P 10/30 (2016.01) *A23L 5/44* (2016.01)

(21) International Application Number:

PCT/EP2016/063247

(22) International Filing Date:

10 June 2016 (10.06.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

15171900.2 12 June 2015 (12.06.2015) EP

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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))

(54) Title: ACID STABLE BEVERAGES COMPRISING BIXIN

(57) Abstract: The present invention is directed to an acid-stable bixin form, wherein the bixin is microencapsulated in a matrix of a hydrocolloid, preferably in a matrix of modified food starch. This bixin form can be in the form of an emulsion, a suspension or in form of a powder. The present invention is further directed to a process for the manufacture of such forms, as well as to beverages containing them. These yellow-orange to red-orange beverages are physically stable and color stable.



WO 2016/198567 A1

5 Acid stable beverages comprising bixin

Traditionally, annatto is widely used as a colorant for dairy, cheese, frozen food, snacks, cereals, savory and oil based products.

Until now there are no viable formulations of bixin available in the market
10 place providing reddish-orange color shades with high tinctorial strength, high coloration efficiency and low taste impact, and at the same time providing long term physical and appropriate light stability at low pH. These product properties are, however, necessarily required in the RTD (ready-to-drink) beverage segment.

15 What is promoted and commercially available are formulations of norbixin (which is the chemically de-esterified fraction of annatto) stabilized by polysorbate providing a bright yellow color. Polysorbates are, however, known to cause foaming issues in beverage manufacturing processes and to impact the
20 sensory profile of the final consumer product in terms of a soapy off-taste. Furthermore, polysorbate based emulsifiers are not associated with naturalness and do not really fit the natural trend for colors used in the food and beverage industry. Polysorbate free norbixin forms are not physically stable at neutral to acid pH and, at alkaline pH provide a bright yellow color. What is also offered
25 are microencapsulated bixin forms such as the CapColor range of Chr. Hansen. The latter, however, only show low color strength, as proven by the comparison example on page 29, and are not physically stable in low pH beverages over time.

30 One of the CapColors of Christian Hansen A/S based on curcumin is e.g. described in WO 2014/191556. A further example (example 3) is given for β -carotene. No concrete examples for bixin are given in WO 2014/191556. Main

5 final application of the formulations according to WO 2014/191556 are bouillon cubes (example 4) which are not an application field of the bixin formulations of the present invention. Further important application fields mentioned in WO 2014/191556 are soup powder, infant formula powder and sports drink powder and others (see page 6, line 19-25), i.e. instant powders which are dissolved
10 rapidly and consumed directly after dissolution. Thus, a long-term stability in liquids (such as e.g. beverages) is not needed for formulations for instant powders.

The annatto based formulations in the preferred embodiment of the current
15 invention are forms of the natural bixin fraction of annatto.

They impart a natural orange to red-orange and, at the same time, show very high coloration efficiency and physical stability over a wide pH range. Therefore, they are especially suitable for ready-to-drink beverages where
20 their long term stability is also advantageous. The bixin formulations of the present invention do not contain low molecular weight emulsifiers such as polysorbates and the like and are based on modified food starch.

Therefore, these forms give a blend a neutral taste and can be added even at
25 high concentrations without negative impact on the taste profile of the final consumer product. Due to that they can also be used to replace paprika based colors which are often associated with a characteristic off-taste. Furthermore, the bixin formulations in the preferred embodiment of the current invention are fully plant based, vegetarian products that offer a lot of advantages in that
30 respect vs. animal based non-kosher carmine/cochineal based forms that are also used to give orange-reddish shades in beverages. They may also be used in place of nature-identical carotenoids such as apocarotenal or canthaxanthin of which both are also associated to orange-reddish color shades as well.

5 The present invention is directed to a beverage comprising a bixin form wherein the beverage is physically stable at a pH in the range of from 2 to 5, preferably in the range of from 2.5 to 4, even more preferably in the range of from 2.8 to 3.6, for a period of time of at least 3 months, especially for a period of time of at least 6 months. Preferably the beverage is also color
10 stable. Further advantages are that (almost) no ringing and (almost) no precipitation/sedimentation of the bixin in the beverage occurs.

The present invention is further directed to the bixin form itself as well as to its manufacturing process and to the use of such forms for coloring beverages.

15

There is increasing interest in the food industry to replace artificial materials for coloring foods such as azo dyes and the like with natural or nature identical colorants. Especially wanted are colors that are also animal-free, allergene-free, GMO-free and kosher/halal.

20

A challenge in replacing artificial colorants with natural colorants in beverages has been in obtaining the stability of color characteristics provided by artificial colorants and to match the color of the product the consumer is already used to. Thus, it is important that a consistent visual quality of the product is
25 guaranteed.

Bixin can be used to impart a yellow-orange to red-orange color shade to beverages. Beverages usually have a pH in the range of from 2 to 5. Surprisingly the color provided by bixin is stable in this pH range meaning that for the first
30 time a stable bixin form has been provided by the present invention which allows a stability over this broad range of pH. Furthermore the bixin form according to the present invention shows high color strength and color saturation. It provides upon re-dispersion in water an E1/1 value of at least 400, preferably an E1/1 value in the range of from 500 to 1800, and thus a

5 much higher E1/1 as the one of the emulsions according to EP-A 2 687 103
(E1/1 = 140-280 - see page 3, paragraph [0025] and claim 4).

Until now bixin has been described as unstable compared to its derivative
norbixin, which can be obtained from bixin by demethylation (see e.g. GB
10 1,049,539: page 2, left column, line 40-43) or via a different extraction route
of annatto seeds using alkaline pH conditions which causes the deesterification
of the naturally occurring bixin. A change in color in a consumer's end-product
is, however, irritating for the consumer since it is linked in the personal
subjective perception as a sign of bad quality. A further challenge is that bixin
15 - in contrast to norbixin - is not water-soluble as such.

Bixin is especially valuable since it is considered as "natural colorant"
according to the NATCOL classification of food colorants. Norbixin, however, is
considered only as "nature derived colorant" according to the NATCOL
20 classification of food colorants.

Whereas norbixin gives a bright yellow color shade to beverages the bixin forms
of the present invention impart strong and bright yellow-orange to red-orange
color shades.

25 Thus, the present invention is directed to beverages comprising a bixin form,
wherein the bixin is microencapsulated, and whereby preferably the average
particle size of the inner phase measured by Photon Correlation
Spectroscopy (Beckman Coulter N4 Plus Submicron Particle Sizer) is in the
30 range of from 100 to 400 nm. In such beverages the color shade h is preferably
in the range of from 40 to 70 (more preferably from 45 to 70) at the CIELAB
Color scale. Furthermore, the color value C* is preferably in the range of from
20 to 110 at the CIELAB Color scale.

5 Beverages comprising a bixin form, wherein the bixin is microencapsulated, and whereby preferably the average particle size of the inner phase when measured in water by Photon Correlation Spectroscopy (Beckman Coulter N4 Plus Submicron Particle Sizer) is in the range of from 100 to 300 nm, show a yellow-orange color shade. The color shade h of such beverage is preferably in the
10 range of from 60 to 70 at the CIELAB Color scale and preferably the color value C* is preferably in the range of from 25 to 110 (more preferably from 40 to 110) at the CIELAB Color scale.

Beverages comprising a bixin form, wherein the bixin is microencapsulated, and
15 whereby preferably the average particle size of the inner phase when measured in water by Photon Correlation Spectroscopy (Beckman Coulter N4 Plus Submicron Particle Sizer) is in the range of from 200 to 400 nm, show a red-orange color shade. The color shade h of such beverage is preferably in the range of from 40 to 60 (preferably from 45 to 60) at the CIELAB Color scale and
20 preferably the color value C* is preferably in the range of from 20 to 70 at the CIELAB Color scale.

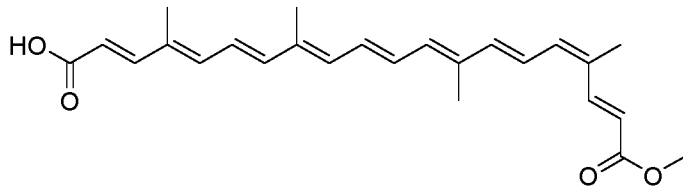
Thus, it is possible to obtain a broad color range from yellow-orange via orange to red-orange by using bixin in beverages.

25

Bixin

cis-Bixin (compound of formula below; 9-*cis*-6,6'-diapo- ψ,ψ -carotenedioic acid, 6-methyl ester; 6-methyl hydrogen (9'*Z*)-6,6'-diapocarotene-6,6'-dioate) can be obtained from a natural source, by fermentation or by chemical synthesis. A
30 natural source might be the seeds of *Bixa orellana* L. Such Annatto Seed Extract is commercially available as "cake" and contains at least 50 weight-%, preferably at least 70 weight-%, more preferably at least 85 weight-% of bixin. Chemical syntheses of bixin or its pre-cursors and derivatives are e.g. described in GB 768,172, GB 756,896, GB 751,573 and GB 744,890.

5



The term “bixin” used herein encompasses the (all-E)-isomer as well as mono-, oligo- or poly-(Z)-isomers. A preferred isomer mixture consists especially
10 essentially of cis-bixin.

Amount of bixin in the beverage

Preferably the amount of bixin in the beverage is in the range of from 1 ppm to 50 ppm, more preferably it is in the range of from 2 ppm to 30 ppm, most preferably it is in the range of from 5 ppm to 25 ppm, based on the total weight of the beverage.

Bixin form

The bixin form may be liquid (a dispersion) or solid (a powder). Its manufacturing process is described in more detail below.

“Bixin form” or “bixin formulation” are synonyms for each other and mean that the bixin is encapsulated, especially microencapsulated, i.e. embedded, in a matrix of a hydrocolloid which protects it against degradation and oxidation.

25

The dispersion can be an emulsion or a suspension. When the bixin form is a dispersion (preferably an emulsion), its water content is preferably in the range of from 45 to 65 weight-%. When the bixin form is a powder, its water content is preferably in the range of from 3 to 7 weight-%.

30

- 5 The powder may be manufactured by drying the dispersion (preferably the emulsion) by any method known to the person skilled in the art, e.g. by spray-drying, spray-drying in combination with fluidised bed granulation or by a powder-catch technique, whereby the sprayed dispersion droplets are caught in a bed of an absorbent, such as starch (especially corn starch), and subsequently
- 10 dried. When the powder-catch technique is applied and corn starch is used as absorbent, its amount in the bixin form is preferably in the range of from 10 to 40 weight-%, more preferably in the range of from 25 to 35 weight-%, based on the total weight of the bixin form.
- 15 The amount of the bixin in the bixin form is usually in the range of from 1 to 20 weight-%, preferably in the range of from 2.5 to 15 weight-%, more preferably in the range of from 5 to 10 weight-%, based on the total weight of the bixin form.
- 20 When the color of such bixin form is measured at the CIELAB color scale at a concentration of 5 ppm of bixin in water, the color value a^* is preferably in the range of from 10 to 25 (more preferably from 15 to 25), and the color value b^* is preferably in the range of from 10 to 50. The color is then yellow-orange to orange to red-orange. Hereby the average particle size of the inner phase of
- 25 the bixin form measured by Photon Correlation Spectroscopy (Beckman Coulter N4 Plus Submicron Particle Sizer) is preferably in the range of from 100 to 400 nm.

When the average particle size of the inner phase of the bixin form measured

30 by Photon Correlation Spectroscopy (Beckman Coulter N4 Plus Submicron Particle Sizer) is in the range of from 100 to 300 nm, the resulting color is yellow-orange. When the bixin form is dissolved in water, so that the amount of bixin is 5 ppm, the resulting colored water has a color value a^* in the range

- 5 of from 20 to 25, and preferably the color value b^* is preferably in the range of from 25 to 50.

When the average particle size of the inner phase of the bixin form measured by Photon Correlation Spectroscopy (Beckman Coulter N4 Plus Submicron
10 Particle Sizer) is in the range of from 200 to 400 nm, the color is red-orange. When the bixin form is dissolved in water, so that the amount of bixin is 5 ppm, the resulting colored water has preferably a color value a^* in the range of from 10 to 25 (preferably from 15 to 25). The color value b^* of such bixin form is preferably in the range of from 10 to 20.

15

In a preferred embodiment of the present invention the bixin is preferably encapsulated, especially microencapsulated, i.e. embedded, in a matrix of at least one modified food starch. The modified food starch (esp. OSA starch) and mixtures thereof are described in more detail below.

20

The amount of the modified food starch in the form is usually in the range of from 35 to 55 weight-%, preferably in the range of from 40 to 50 weight-%, more preferably of around 45 weight-%, based on the total weight of the form.

- 25 Additionally one or more water- and/or fat-soluble antioxidants may be present, preferably in an amount of from 0.5 to 5 weight-% in total, based on the total amount of the bixin form.

A preferred example of such water-soluble antioxidants is sodium ascorbate.

- 30 When sodium ascorbate is used, its amount is preferably chosen in such a way so that its final amount in the bixin form is in the range of from 0 to 2 weight-%, based on the total weight of the bixin form.

5 A preferred example of such fat-soluble antioxidants is dl-alpha-tocopherol. When dl-alpha-tocopherol is used, its amount is preferably chosen in such a way so that its final amount in the bixin form is in the range of from 0 to 3 weight-% (preferably 0 to 2 weight-%), based on the total weight of the bixin form. Alternatively natural (R,R,R)-alpha-tocopherol may also be used.

10

Especially preferred is a bixin form, wherein the matrix further comprises at least one saccharide. The saccharides are disclosed in more detail below.

When a saccharide is present, the amount of the saccharide is preferably in the
15 range of from 0.1 to 10 weight-%, more preferably in the range of from 2 to 8 weight-%, even more preferably in the range of from 3 to 7 weight-%, most preferably of around 5 weight-%, based on the total weight of the bixin form.

An additional ingredient that may also be present in the bixin form are middle-
20 chain triglycerides as e.g. commercially available as "Bergabest 60/40" (a mixture of 60% octanoic acid and 40% decanoic acid) (commercially available from Berg + Schmidt, Hamburg, Germany). The term "middle-chain triglycerides" encompasses saturated C₆₋₁₂ fatty acids and their mixtures such as fractionated coconut oil.

25

When middle-chain triglycerides are present, their amount is preferably in the range of from 0.1 to 10 weight-%, more preferably in the range of from 2 to 8 weight-%, even more preferably in the range of from 3 to 7 weight-%, most preferably of around 5 weight-%, based on the total weight of the bixin form.

30

The amounts of all ingredients of the bixin form sum up to 100 weight-%.

Preferably no other compounds are present in the bixin form. Such not-being-present compounds are preferably the following ones:

- 5 - Gum Acacia; Gum Arabic; also modified as disclosed in WO 2008/110225;
- Fenugreek gum;
- Gelatin;
- Plant proteins such as e.g. soy protein, potato protein;
- Pectins such as e.g. beet pectin, chicory pectin, Jerusalem artichoke
- 10 pectin or other pectin types having a high degree of acetylation,
 especially those as disclosed in US 6,500,473;
- Milk proteins such as e.g. whey protein, whey protein isolate and sodium
 caseinate;
- Ligninsulfonate;
- 15 - Conjugates of plant gums and modified food starch, especially those as
 disclosed in WO 2011/039336;
- Octenyl-succinic anhydride-modified gum Acacia, especially one as
 disclosed in WO 2012/059286;
- Sodium lauryl sulfate and other sodium alkyl sulfates.

20

This preference applies for all bixin formulations of the present invention.

In an especially preferred embodiment of the present invention the bixin
formulation does not comprise conjugates of plant gums and modified food
25 starch, especially it does not comprise those conjugates as disclosed in WO
2011/039336.

In another preferred embodiment of the present invention the bixin
formulation does not comprise octenyl-succinic anhydride-modified gum
30 Acacia, especially it does not comprise one as disclosed in WO 2012/059286.

In another preferred embodiment of the present invention the bixin
formulation does not comprise pectins such as e.g. beet pectin, chicory pectin,

- 5 Jerusalem artichoke pectin or other pectin types having a high degree of acetylation, especially it does not comprise those as disclosed in US 6,500,473.

“Saccharide”

The term “a saccharide” encompasses one saccharide or more.

10

The term „saccharide“ in the context of the present invention encompasses mono-, di-, oligo- and polysaccharides, as well as any mixtures thereof.

Examples of monosaccharides are fructose, glucose (= dextrose), mannose,
15 galactose, sorbose, as well as any mixtures thereof.

Preferred monosaccharides are glucose and fructose, as well as any mixture thereof.

- 20 The term “glucose” in the context of the present invention does not only mean the pure substance, but also a glucose syrup with a $DE \geq 90$. This also applies for the other monosaccharides.

The term “dextrose equivalent” (DE) denotes the degree of hydrolysis and is a
25 measure of the amount of reducing sugar calculated as D-glucose based on dry weight; the scale is based on native starch having a DE close to 0 and glucose having a DE of 100.

Examples of disaccharides are saccharose (= sucrose), isomaltose, lactose,
30 maltose and nigerose, as well as any mixture thereof.

An example of an oligosaccharide is maltodextrin.

An example of a polysaccharide is dextrin.

5

An example of a mixture of mono- and disaccharides is invert sugar (glucose + fructose + saccharose).

10

Mixtures of mono- and polysaccharides are e.g. commercially available under the tradenames Glucidex IT 47 (from Roquette Frères), Dextrose Monohydrate ST (from Roquette Frères), Sirodex 331 (from Tate & Lyle), Glucamyl F 452 (from Tate & Lyle) and Raftisweet I 50/75/35 (from Lebbe Sugar Specialties).

15

The most preferred saccharides are glucose (e.g. “dextrose monohydrate 0.5%”), maltodextrin (e.g. “maltodextrin DE 2023 2%”) and sucrose.

20

When glucose such as “dextrose monohydrate 0.5%” is present in the matrix, its amount is preferably chosen in such a way so that its final amount in the bixin form is in the range of from 0 to 1 weight-%, based on the total weight of the bixin form.

25

When maltodextrin such as “maltodextrin DE 2023 2%” is present in the matrix, its amount is preferably chosen in such a way so that its final amount in the bixin form is in the range of from 0 to 3 weight-%, based on the total weight of the bixin form.

30

When sucrose is present in the matrix, its amount is preferably chosen in such a way so that its final amount in the bixin form is in the range of from 0 to 4 weight-%, based on the total weight of the bixin form.

“Modified food starch”

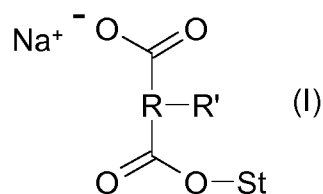
A modified food starch is a food starch that has been chemically modified by known methods to have a chemical structure which provides it with a

- 5 hydrophilic and a lipophilic portion. Preferably the modified food starch has a long hydrocarbon chain as part of its structure (preferably C5-C18).

At least one modified food starch is preferably used to make a liquid formulation of this invention, but it is possible to use a mixture of two or more
 10 different modified food starches in one liquid formulation.

Starches are hydrophilic and therefore do not have emulsifying capacities. However, modified food starches are made from starches substituted by known chemical methods with hydrophobic moieties. For example starch may be
 15 treated with cyclic dicarboxylic acid anhydrides such as succinic anhydrides, substituted with a hydrocarbon chain (see O. B. Wurzburg (editor), "Modified Starches: Properties and Uses, CRC Press, Inc. Boca Raton, Florida, 1986, and subsequent editions). A particularly preferred modified food starch of this invention has the following formula (I)

20



wherein St is a starch, R is an alkylene radical and R' is a hydrophobic group. Preferably R is a lower alkylene radical such as dimethylene or trimethylene.
 25 R' may be an alkyl or alkenyl group, preferably having 5 to 18 carbon atoms. A preferred compound of formula (I) is an "OSA-starch" (starch sodium octenyl succinate). The degree of substitution, i.e. the number of esterified hydroxyl groups to the number of free non-esterified hydroxyl groups usually varies in a range of from 0.1% to 10%, preferably in a range of from 0.5% to 4%, more
 30 preferably in a range of from 3% to 4%.

5

The term “OSA-starch“ denotes any starch (from any natural source such as corn, waxy maize, waxy corn, wheat, tapioca and potato or synthesized) that was treated with octenyl succinic anhydride (OSA). The degree of substitution, i.e. the number of hydroxyl groups esterified with OSA to the number of free non-esterified hydroxyl groups usually varies in a range of from 0.1% to 10%, preferably in a range of from 0.5% to 4%, more preferably in a range of from 3% to 4%. OSA-starches are also known under the expression “modified food starch”.

10

15 The term “OSA-starches” encompasses also such starches that are commercially available e.g. from National Starch under the tradenames HiCap 100, Capsul (octenylbutanedioate amyloextrin), Capsul HS, Purity Gum 2000, Clear Gum Co03, UNI-PURE, HYLON VII; from National Starch and Roquette Frères, respectively; from CereStar under the tradename C*EmCap or from Tate & Lyle.

20

In an embodiment of the present invention a commercially available modified food starch such as e.g. HiCap 100 (from National Starch) and ClearGum Co03 (from Roquette Frères) is used.

25

Processes of the present invention

The present invention is also directed to a process for the manufacture of a bixin form as described above comprising the following steps:

30

- a) forming a solution of the bixin in an organic solvent, optionally adding a fat-soluble antioxidant and/or optionally adding an oil and/or optionally adding middle-chain triglycerides (“MCT”);

- 5 b) providing a matrix of modified food starch and optionally a saccharide and/or a water-soluble antioxidant in water;
- c) emulsifying the solution obtained in step a) into the matrix obtained in step b) to obtain a dispersion, preferably an emulsion;
- d) removing the organic solvent from the dispersion (preferably the emulsion) obtained in step c) to obtain a bixin dispersion (preferably a bixin emulsion);
- 10 e) optionally drying the bixin dispersion (preferably the bixin emulsion) obtained in step d) to obtain a bixin powder.
- 15 When steps a), b), c) and d) are performed, the bixin form obtained is a bixin dispersion (preferably a bixin emulsion). When steps a), b), c), d) and e) are performed, the bixin form obtained is a bixin powder.

The steps are now described in detail below.

20

Step a)

The amounts of the bixin, the fat-soluble antioxidant and the oil and/or MCT are chosen so that the final amounts of these compounds in the resulting form after having performed all steps is as described above.

25

The term “oil” in the context of the present invention encompasses glycerol and any triglyceride such as vegetable oils or fats like corn oil, sunflower oil, soybean oil, safflower oil, rapeseed oil, peanut oil, palm oil, palm kernel oil, cotton seed oil, olive oil or coconut oil.

30

The oils can be from any origin. They can be natural, modified or synthetic. If the oils are natural they can be plant or animal oils. The term “oil” in the context of the present invention thus also encompasses canola oil, sesame oil, hazelnut oil, almond oil, cashew oil, macadamia oil, mongongo nut oil, pracaxi

5 oil, pecan oil, pine nut oil, pistachio oil, sachalini (Plukenetia volubilis) oil, walnut oil or polyunsaturated fatty acids (= "PUFAs") (for example arachidonic acid, eicosapentaenoic acid, docosahexaenoic acid and γ -linolenic acid) as well as the triglycerides of PUFAs and the esters of PUFAs, e.g. the ethyl esters of PUFAs.

10

The oil does not work as solvent as it does in the process of EP-A 2 687 103 (see page 3, paragraph [0027]), but it prevents the re-crystallization of bixin later in the process. Furthermore bixin cannot be solved in oil without heating, whereby bixin degrades.

15

The amount of the solvent and the dissolution temperature are chosen so as to dissolve the bixin, the fat-soluble antioxidant, if present, and the MCT, if present, completely. Usually it is necessary to heat up the suspension obtained when mixing all compounds present in this step to get a solution. Preferably
20 the temperature to which the suspension is heated up is in the range of from 100 to 120°C. After having obtained the solution it is usually kept at the temperature it was before heated up to or at a slightly higher temperature (+ 5 Kelvin).

25 Step b)

Preferably this step is performed at a temperature in the range of from 50 to 70°C, more preferably at a temperature in the range of from 64°C to 67°C. Preferably the temperature is lower if a saccharide is present compared to the temperature that is used when no saccharide is present.

30

Step c)

Preferably this step is performed at a mixing temperature in the range of from 60 to 90°C, more preferably at a mixing temperature in the range of from 65 to 80°C, to obtain a dispersion (preferably an emulsion).

5

The emulsification can be achieved by using a rotor-stator device or a high pressure homogenizer or both. Other devices known to the person skilled in the art may also be used.

- 10 If rotor-stator device and/or a high pressure homogenizer is used, a pressure drop in the range of 100 to 1000 bar, more preferably in the range of 150 to 300 bar, is preferably applied.

Step d)

- 15 The organic solvent may e.g. be removed by using a thin film evaporator cascade (preferred). Other methods known to the person skilled in the art are also applicable.

Step e)

- 20 The resulting dispersions (preferably the resulting bixin emulsions) after having performed steps a) to d) can be used as such. "Dispersions" hereby encompass suspensions as well as emulsions, whereby emulsions are preferred.

- The resulting dispersions can, however, also be dried by any method known to the person skilled in the art, e.g. by spray-drying, spray-drying in combination with fluidised bed granulation or by a powder-catch technique, whereby the sprayed dispersion droplets (preferably the sprayed emulsion droplets) are caught in a bed of an absorbent, such as starch (e.g. corn starch), and subsequently dried.

30

Beverages according to the present invention

In a preferred embodiment of the present invention the bixin form according to the present invention is used in beverages, especially in soft drinks, which

5 generally have a pH in the range of from 2 to 5, preferably a pH in the range of from 2.5 to 4, more preferably a pH in the range of from 2.8 to 3.6.

Surprisingly it was found that the bixin form is acid stable in such beverages. The period of time for which the bixin form is acid stable is at least 3 months, preferably at least 6 months. Therefore, the beverages themselves are acid
10 stable, especially for these period of times, and preferably also color stable.

“Color-stable” in the context of the present invention means that the color difference DE^* between the initial color and the color after a storage time of 3 months should be lower than 10 ($DE^* < 10$). DE^* is the distance in a metric color
15 scale (CIE) of two measuring points (colors) where delta is a Greek letter often used to denote difference, and “E” stands for “Empfindung” (German for “sensation”). A $DE^* < 10$ means that the color difference is acceptable and at $DE^* < 3$ cannot be seen by naked eyes, i.e. without the use of an apparatus such as a colorimeter.

20

Beverages wherein the liquid formulations of the present invention can be used as a colorant or a functional ingredient can be carbonated beverages e.g., flavoured seltzer waters, soft drinks or mineral drinks, as well as non-carbonated beverages e.g. flavoured waters, fruit juices, fruit punches and
25 concentrated forms of these beverages. They may be based on natural fruit or vegetable juices or on artificial flavours. Also included are alcoholic beverages. Besides, sugar containing beverages diet beverages with non-caloric and artificial sweeteners are also included. Especially preferred are soft drinks, preferably with a pH in the range of from 2 to 5, preferably with a pH in the
30 range of from 2.5 to 4, more preferably with a pH in the range of 2.8 to 3.6.

The final concentration of the bixin, which is added via the bixin form of the present invention to beverages may be from 1 to 50 ppm, particularly from 2 to 30 ppm, more preferably from 5 to 25 ppm, based on the total weight of the

- 5 beverage and depending on the particular beverage to be colored or fortified and the intended grade of coloration or fortification.

For coloration or fortification of a beverage a bixin form of this invention can be used according to methods per se known for the application of emulsions,
10 dispersions, suspensions or powders.

Further embodiments of the present invention

The present invention is also directed to the use of a bixin form, wherein the bixin is microencapsulated, and whereby preferably the average particle size of
15 the inner phase of the bixin form measured by Photon Correlation Spectroscopy (Beckman Coulter N4 Plus Submicron Particle Sizer) is in the range of from 100 to 400 nm, for coloring beverages. As disclosed above, the bixin in the bixin form is preferably microencapsulated in a matrix of modified food starch, wherein the matrix optionally further comprises a saccharide.

20

A further embodiment of the present invention is a method for coloring a beverage, wherein a bixin form, wherein the bixin is microencapsulated, and whereby preferably the average particle size of the inner phase of the bixin form measured by Photon Correlation Spectroscopy (Beckman Coulter N4 Plus
25 Submicron Particle Sizer) is in the range of from 100 to 400 nm, is added to the beverage to provide a yellow-orange to red-orange color to the beverage.

The following non limiting examples illustrate the invention further.

30 Examples

Examples 1-7: Manufacture of powders according to the present invention

The examples were carried out according to the following general procedure with the amounts of compounds (bixin, middle-chain triglycerides, modified

5 food starch, saccharide, antioxidants, water) and the process parameters as
given in detail in Table 1. As solvent an organic solvent selected from the group
consisting of dimethyl carbonate, ethyl formate, ethyl acetate, isopropyl
acetate, methyl tert-butyl ether and methylene chloride was used. The amount
of the solvent and the dissolution temperature were chosen so as to dissolve
10 the bixin and the fat-soluble antioxidant and the MCT, if present, completely.

The bixin used was the commercially available AlcabixP (from AICA-Color,
Peru).

15

General procedure

Bixin, the fat-soluble antioxidant and the middle-chain triglycerides (MCTs)
(amounts as given in Table 1) are dispersed in an organic solvent as mentioned
above. The resulting suspension is then heated up to a temperature as given in
20 Table 1 to dissolve the whole amount of bixin. The resulting solution is then
held at the temperature as given in Table 1 in a holding vessel.

The matrix phase consisting of the modified food starch (= OSA starch), the
saccharide and the water-soluble antioxidant as given in Table 1 is dissolved in
25 the amount of water as given in Table 1 at the temperature as given in Table 1.

The emulsification process consists of two steps and is carried out under
pressure.

Both phases are continuously fed to a rotor stator device where the solution is
30 emulsified into the matrix phase. The rotation speed is 5000 rpm (revolutions
per minute) and the mixing temperature is as given in Table 1. The next step
entails a second micronisation step and consists of a sapphire orifice. The
orifice diameter is as given in Table 1 and the applied pressure drop over the
orifice is as given in Table 1 at the temperature as given in Table 1.

5

Then the organic solvent is removed from the emulsion by using a thin film evaporator cascade. After that the solvent-free emulsion is sprayed into a fluidized corn starch bed where the particles are dried.

- 10 The results of the examples are summarized below. The average particle size of the inner phase was measured by Photon Correlation Spectroscopy (Beckman Coulter N4 Plus Submicron Particle Sizer).

- 15 The color intensity E1/1 is the absorbance of a 1% solution and a thickness of 1 cm and is calculated as follows: $E1/1 = (A_{max} - A_{650}) \times \text{dilution factor} / (\text{weight of sample} \times \text{content of product form in } \%)$.

- 20 “(A_{max}-A₆₅₀)” means the value you get when you subtract the Adsorption value measured at 650 nm (“A₆₅₀”) wavelength from the value (“A_{max}”) that was measured at the maximum Adsorption in the UV-Spectrophotometer.

“*” means “multiplied with”.

“dilution factor” = the factor by which the solution has been diluted.

“weight of sample” = the amount/weight of the formulation that was used in [g]

- 25 “content of product form in %” = “the amount of bixin in the powder in %” (detected via UV spectrophotometer) which is in the range of from 4.5 to 9.7% in the following examples.

Example 1

- 30 The final product has a bixin content of 4.5%, E1/1 = 1355 and a particle size of the inner phase of 226 nm.

Example 2

- 5 The final product has a bixin content of 9.0%, $E1/1 = 710$ and a particle size of the inner phase of 306 nm.

Example 3

- 10 The final product has a bixin content of 7.1%, $E1/1 = 992$ and a particle size of the inner phase of 282 nm.

Example 4

- 15 The final product has a bixin content of 9.7%, $E1/1 = 621$, a particle size of the inner phase of 352 nm and a turbidity of 196 NTU (measured in a pasteurized soft drink (6 ppm) as prepared according to the instruction below). Such turbidity adds to the “juicy” appearance of a fruit juice when added to it and is in this application advantageous.

Example 5

- 20 The final product has a bixin content of 5.1%, $E1/1 = 1057$, a particle size of the inner phase of 307 nm and a turbidity of 160 NTU (measured in a pasteurized soft drink (6 ppm) as prepared according to the instruction below).

Example 6

- 25 The final product has a bixin content of 4.8%, $E1/1 = 1035$, a particle size of the inner phase of 378 nm and a turbidity of 157 NTU (measured in a pasteurized soft drink (6 ppm) as prepared according to the instruction below).

Example 7

- 30 The final product has a bixin content of 5.6%, $E1/1 = 834$, a particle size of the inner phase of 331 nm and a turbidity of 209 NTU (measured in a pasteurized soft drink (6 ppm) as prepared according to the instruction below).

5 Application trials with the powders according to examples 1-7

The powders according to examples 1-7 have been applied in soft drinks with a concentration of the bixin of 6 ppm. The objective of these trials was to evaluate the performance of these samples for their application in beverages.

- 10 The powders have to provide a good color stability, good chemical stability and a good performance of appearance (no or less ringing, absence of or only few particles on the surface and (almost) no sedimentation).

Preparation of the soft drinks

- 15 The soft drinks had the following composition:

	Ingredient	Amount of ingredient
1	Potassium sorbate	0.2 g
2	Sugar syrup (64° Brix)	156.2 g
	Ascorbic acid	0.2 g
	Aqueous 50-weight-% citric acid	5.0 g
	Apricot flavor (water-soluble, Givaudan 78848-56)	0.2 g
	Pectin solution 2-weight-%	10 g
	Stock solution *	6 g (i.e. 6 ppm)
3	Water	Filled up so that a total amount of the soft drink of 1000 ml results
	Total amount	1000 ml

- 5 * From each powder according to examples 1 to 7 a stock solution was prepared, whereby the powder was diluted with water so that the stock solution had a concentration of the bixin of 0.1 weight-% (= 1000 ppm).

The soft drinks were prepared as follows:

- 10 Potassium sorbate 1) was dissolved in water, the other ingredients 2) were added one after the other while the mixture was gently stirred. Then the resulting soft drink syrup was diluted with drink water in such an amount to result in 1000 ml of the soft drink. The pH of the soft drinks was in the range of from 2.8 to 3.6.

15

The soft drinks were then filled in glass bottles and the bottles sealed with a metallic cap. Some of these bottles were pasteurized and some not. A tunnel pasteurizer from Miele was used for pasteurization with a holding temperature of 80°C for 1 minute at a core of the bottle.

20

The bottles were stored at room temperature (temperature in the range of 18 to 27°C) and under light exposure 12 hours per day with 800 Lux. Color measurements were performed directly after beverage preparation (time = 0), as well as after a storage time of 2 weeks, 30 days, 60 days and 90 days.

25

Color measurements

- Color measurements for the application in food are performed with a colorimeter (Hunter Lab Ultra Scan Pro) which can other than a spectrophotometer express color values according to the psychophysical perception of color by human eye.
- 30

Color measurements are carried out after CIE guidelines (Commission International d'Eclairage). Values can be expressed either as planar coordinates

- 5 L*a*b* with L* being the measuring value for lightness, with a* being the value on the red-green-axis and with b* being the value on the yellow-blue-axis.

Instrument settings:

- Color scale : CIE L*a*b* / L*C*h*
- 10 • Light source definition: D65 daylight equivalent
- Geometry : Diffuse / 8°
- Wavelengths: scan 350 to 1050 nm in 5 nm optical resolution
- Sample measurement area diameter: 19 mm (large)
- Calibration mode: Transmission/ white tile

15

The Chroma (C*) sometimes called saturation describes the vividness or dullness of a color which can be calculated as followed:

$$C^* = \sqrt{a^{*2} + b^{*2}}$$

20

The angle called hue (h) describes how we perceive an object's color and can be calculated as followed:

$$h = \tan(b/a)^{(-1)}$$

25

The color difference DE* is calculated using the following equation:

$$DE^* = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$$

whereby L = lightness, a = red value, and b = yellow value

30 $\Delta L^* = L_x^* - L_0^*$; 0 = initial value; x = time of measuring

$\Delta a^* = a_x^* - a_0^*$; 0 = initial value; x = time of measuring

$\Delta b^* = b_x^* - b_0^*$; 0 = initial value; x = time of measuring

- 5 For a good color stability, DE^* should be lower than 10 ($DE^* < 10$); this means that the color difference is acceptable and at $DE^* < 3$ cannot be seen by naked eyes, i.e. without the use of an apparatus such as a colorimeter.

Physical stability is measured by human eye according to an evaluation matrix.

- 10 Parameter recorded for soft drink beverages are:

- Ring formation / Neck ring in bottles in score 6 to 1 with “6” representing “no ring”, and “1” representing “very strong ring”.
- Surface particles in score 6 to 1 with “6” representing “no particles / no covering” and “1” representing “more than half of surface covered with
- 15 particles / more than two third of surface covered with film other than particles”.
- Sediment on the bottom of packaging as fine film, individual particles or ring-formation in score 6 to 1 with “6” representing “either no particles, no film or no ring” and “1” representing “either more than half of bottom covered
- 20 with particles, bottom covered with strong film or very strong ring visible”.

Turbidity measurements

- Suspended solids (or particles) are responsible for the turbid appearance of beverages containing juice. This turbid appearance can be evaluated by
- 25 turbidity measurements. Turbidity depends on the light-scattering properties of such particles: their size, their shape and their refractive index.

- In this work turbidity measurements were conducted using a Turbidimeter (Hach 2100N IS®, USA) and turbidity values were given in NTU (nephelometric turbidity units). Nephelometer measures the light scattered by a sample in
- 30 90° from the incident light path (s. Fig. 1).

Fig. 1 illustrates the principle of the nephelometric turbidity measurement

Instrument settings: Light source: 860 ± 10 nm LED

5 Results concerning the soft drinks containing bixin (powders according to
examples 1-7)

a) Color difference

10 The results concerning the measurement of the color difference during storage
are shown in Fig. 2 and 3.

Fig. 2 shows the color difference (DE^*) in non-pasteurized soft drinks during a storage time of up to 3 months.

x-axis: Storage time in days; y-axis: Color difference (DE^*) (dimensionless);

15 □ = soft drink containing a powder according to example 4;

x = soft drink containing a powder according to example 6;

● = soft drink containing a powder according to example 7.

All samples showed acceptable ($DE^* \sim 10$) and similar color stability.

20

Fig. 3 shows the color difference (DE^*) in pasteurized soft drinks during a storage time of up to 3 months.

x-axis: Storage time in days; y-axis: Color difference (DE^*) (dimensionless);

□ = soft drink containing a powder according to example 4;

25 x = soft drink containing a powder according to example 6;

● = soft drink containing a powder according to example 7.

All samples showed very good ($DE^* < 10$) and similar color stability.

30 Fig. 4 shows the chemical stability (% recovery) in pasteurized soft drinks
during a storage time of up to 3 months.

x-axis: Storage time in days; y-axis: Chemical stability (% recovery)

“CS”(dimensionless);

□ = soft drink containing a powder according to example 4;

- 5 x = soft drink containing a powder according to example 6;
 • = soft drink containing a powder according to example 7.

All samples showed good chemical stability (% recovery <15).

10 c) Physical appearance

After 3 months of storage the non-pasteurized and pasteurized soft drinks were evaluated visually concerning their physical appearance. Hereby the samples were examined visually whether they show a ring in the bottle neck, whether they show particles on the surface and whether they show white sediments.

- 15 The following schedule of notes was applied:

Ring in bottle neck:

6 = no ring

5 = hardly noticeable ring

- 20 4 = recognizable ring

3 = clear fine ring recognizable

2 = strong ring recognizable

1 = broad ring recognizable

25 Particles on surface:

6 = no particles

5 = 1 to 10 particles

4 = more than 10 particles

3 = not countable anymore

- 30 2 = half of the surface covered

1 = more than half of the surface covered

Sediment:

6 = no sediment

- 5 5 = slight matt glimmer
 4 = fine matt sediment
 3 = matt sediment
 2 = strong matt sediment
 1 = very strong matt sediment

10

For a good performance, scores should be ≥ 3 .

Tab. 2 shows the results obtained for the appearance evaluation of a non-pasteurized soft drink.

15

5

Soft drink containing a powder according to example	Ring in bottle neck	Particles on the surface	White sediment
4	4	6	4

The sample showed a very good performance with respect to its appearance attributes.

- 10 Tab. 3 shows the results obtained for the appearance evaluation of a pasteurized soft drink.

Soft drink containing a powder according to example	Ring in bottle neck	Particles on the surface	White sediment
4	4	6	5

- 15 Also in pasteurized drinks, the sample showed a very good performance with respect to its appearance attributes.

Comparison example

- 20 The commercial available product CapColor A-8-WSS-145 from Christian Hansen, Denmark, was further analyzed. It is a dark reddish brown liquid or gel, produced by extraction of annatto pigments from the seeds of the annatto tree (*Bixa Orellana* L.). The pigments are dispersed in an aqueous solution of vegetable hydrocolloid (Gum Arabic). CapColor A-8-WSS-145 comprises 7.5 to 8.5% of bixin as major coloring principle.

- 25 The E1/1 corrected in water is only 226 (430 nm) and therefore, much lower than the E1/1 of the bixin forms according to the present invention.

5 **Table 1:** In this table D = dl- α -tocopherol; H = HiCap 100; Q = Q-Naturale 200 (Quillaja - a mixture of triterpenic saponins, commercially e.g. provided by Desert King International, San Diego, US); C = ClearGum Co03 (an OSA starch); P = Purity Gum Ultra (an OSA starch); MCT = middle chain triglycerides (commercially available as Bergabest 60/40); S = Sodium ascorbate.

Example	1	2	3	4	5	6	7
Amount of bixin [g]	62	60	60	62	48	56	54
Fat-soluble Antioxidant	D	D	D	D	D	D	D
Amount of fat-soluble antioxidant [g]	9	8	9	9	2.6	3	4.3
Amount of MCT [g]	28	—	27	4.5	12.8	15	21.4
Modified food starch	H	H	H	H	H/Q	C/P	C/P
Amount of modified food starch [g]	218	231	211	218	189/11.3	113/110	127/56.3

Saccharide and amount	21 g of malto-dextrin (DE2023)	—	21 g of malto-dextrin (DE2023)	—	5.3 g of dextrose monohydrate + 24.7 g of malto-dextrin (DE2023)	4 g of dextrose monohydrate + 8 g of maltodextrin (DE2023)	32.8 g of sucrose + 23.4 g of maltodextrin (DE2023)
Water-soluble antioxidant	none	none	none	none	S	S	none
Amount of water-soluble antioxidant [g]	—	—	—	—	5.3	3	—
Amount of water [g]	720	693	696	720	946	913	718
Temperature at which the hydrocolloid matrix is prepared	65 °C	65 °C	67 °C	64 °C	50 °C	50 °C	50 °C
Temperature to which the suspension is	105 °C	112 °C	116 °C	113 °C	106 °C	104 °C	106 °C

heated up									
Temperature at which the solution is held	120 °C	117 °C	116 °C	120 °C	110 °C	108 °C	114 °C		
Mixing temperature	68 °C	66 °C	77 °C	66 °C	71 °C	71 °C	90 °C		
Orifice diameter [µm]	170	230	230	230	170	170	200		
Applied pressure drop at temperature given	215 bar at 68 °C	56 bar at 66 °C	64 bar at 69 °C	48 bar at 66 °C	188 bar at 66 °C	180 bar at 70 °C	175 bar at 75 °C		

5

Claims

1. A beverage comprising a bixin form, wherein the bixin in the bixin form is microencapsulated in a matrix of a hydrocolloid, characterized in that the beverage is physically stable at a pH in the range of from 2 to 5,
10 preferably at a pH in the range of from 2.5 to 4, more preferably at a pH in the range of from 2.8 to 3.6, for a period of time of at least 3 months, preferably for a period of time of at least 6 months.
2. The beverage according to claim 1, wherein the beverage is color stable.
15
3. The beverage according to claim 1 and/or 2, wherein the hydrocolloid is at least one modified food starch so that the bixin in the bixin form is microencapsulated in a matrix of at least one modified food starch.
- 20 4. The beverage according to any one or more of claims 1 to 3, wherein the matrix further comprises a saccharide.
5. The beverage according to any one or more of claims 1 to 4, wherein the bixin form upon re-dispersion in water provides a yellow-orange to red-orange color hue at high color strength characterized by an E1/1 value of
25 at least 400, preferably an E1/1 value in the range of from 500 to 1800.
6. The beverage according to any one or more of the preceding claims, wherein the amount of bixin in the beverage is in the range of from 1 ppm
30 to 50 ppm, preferably in the range of from 2 to 30 ppm, more preferably in the range of from 3 to 25 ppm, based on the total weight of the beverage.

- 5 7. The beverage according to any one or more of the preceding claims,
 wherein the beverage is selected from the group consisting of soft drinks,
 flavored waters, fortified waters, sports drinks, mineral drinks,
 carbonated beverages, fruit juices, fruit-juice containing soft drinks, fruit
10 punches, alcoholic beverages, sugar-containing beverages and diet
 beverages.
8. A bixin form, wherein the bixin is microencapsulated in a matrix of a
 hydrocolloid.
- 15 9. The bixin form according to claim 8, wherein the bixin form upon re-
 dispersion in water provides a yellow-orange to red-orange color hue at
 high color strength characterized by an E1/1 value of at least 400,
 preferably an E1/1 value in the range of from 500 to 1800.
- 20 10. The bixin form according to claim 8 and/or 9, wherein the average
 particle size of the inner phase of the bixin form measured by Photon
 Correlation Spectroscopy (Beckman Coulter N4 Plus Submicron Particle
 Sizer) is in the range of from 100 to 400 nm.
- 25 11. The bixin form according to any one or more of claims 8 to 10 being a
 powder or a dispersion.
12. The bixin form according to any one or more of claims 8 to 11, wherein
 the bixin is microencapsulated in a matrix of at least one modified food
30 starch.
13. The bixin form according to any one or more of claims 8 to 12, wherein
 the matrix further comprises a saccharide.

- 5 14. The bixin form according to any one or more of claims 8 to 13, wherein
the bixin is microencapsulated in a matrix which does not comprise
conjugates of plant gums and modified food starch.
- 10 15. The bixin form according to any one or more of claims 8 to 14, wherein
the bixin is microencapsulated in a matrix which does not comprise
octenyl-succinic anhydride-modified gum Acacia.
- 15 16. The bixin form according to any one or more of claims 8 to 15, wherein
the bixin is microencapsulated in a matrix which does not comprise beet
pectin, chicory pectin, Jerusalem artichoke pectin or other pectin types
having a high degree of acetylation.
- 20 17. A process for the manufacture of a bixin dispersion or a bixin powder
according to any one or more of claims 11 to 16 comprising the following
steps:
- a) forming a solution of the bixin in an organic solvent, optionally
adding a fat-soluble antioxidant and/or optionally adding an oil
and/or optionally adding middle-chain triglycerides;
 - 25 b) providing a matrix of modified food starch and optionally a
saccharide and/or a water-soluble antioxidant in water;
 - c) emulsifying the solution obtained in step a) into the matrix obtained
in step b) to obtain a dispersion;
 - d) removing the organic solvent from the dispersion obtained in step c)
30 to obtain a bixin dispersion;
 - e) optionally drying the bixin dispersion obtained in step d) to obtain a
bixin powder.

5 18. Use of a bixin form, wherein the bixin is microencapsulated in a matrix
of a hydrocolloid, and whereby preferably the average particle size of
the inner phase of the bixin form measured by Photon Correlation
Spectroscopy (Beckman Coulter N4 Plus Submicron Particle Sizer) is in
the range of from 100 to 400 nm, for coloring beverages.

10

19. The use according to claim 18, wherein the bixin in the bixin form is
microencapsulated in a matrix of modified food starch, and wherein the
matrix optionally further comprises a saccharide.

15

Fig. 1

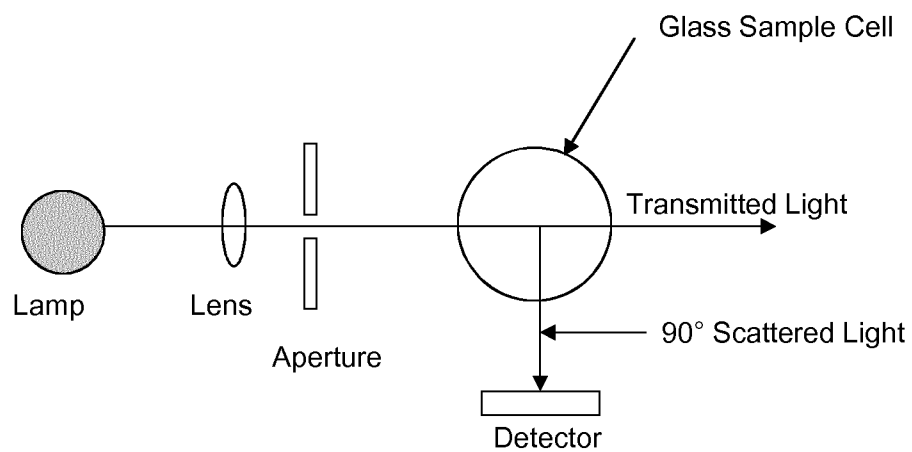


Fig. 2

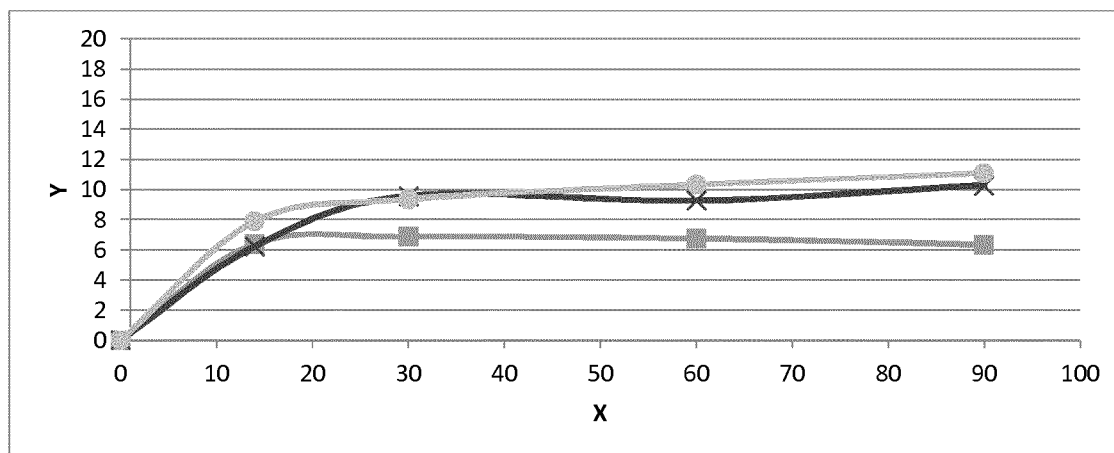


Fig. 3

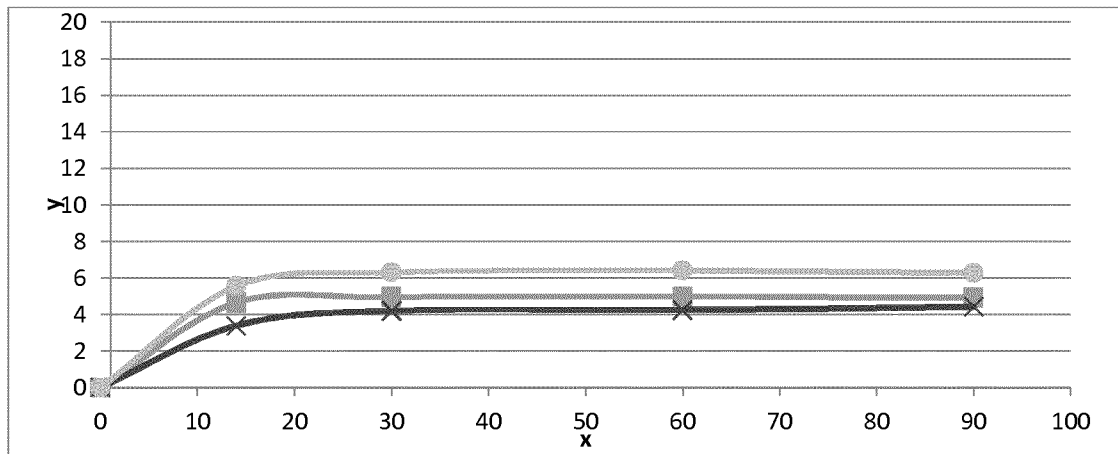


Fig. 4

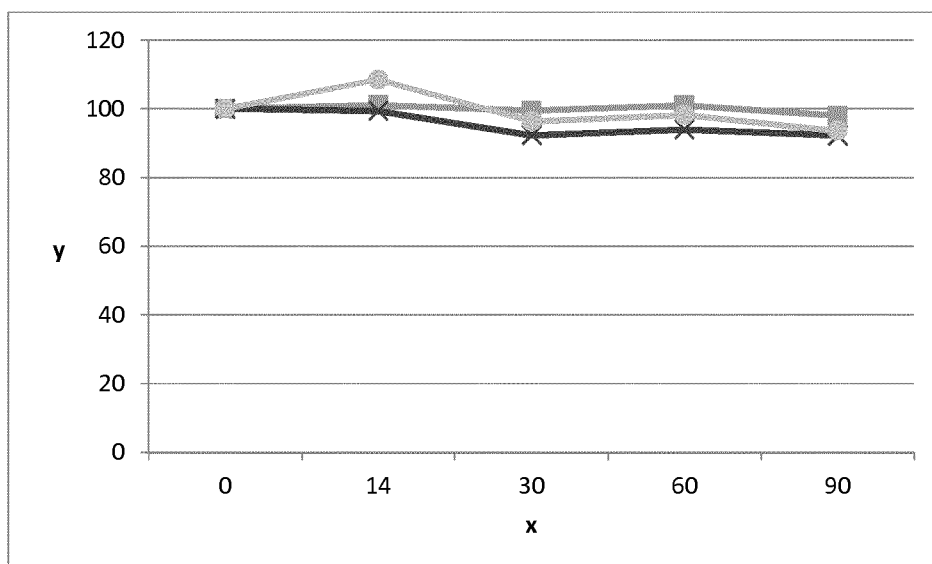


Fig. 5

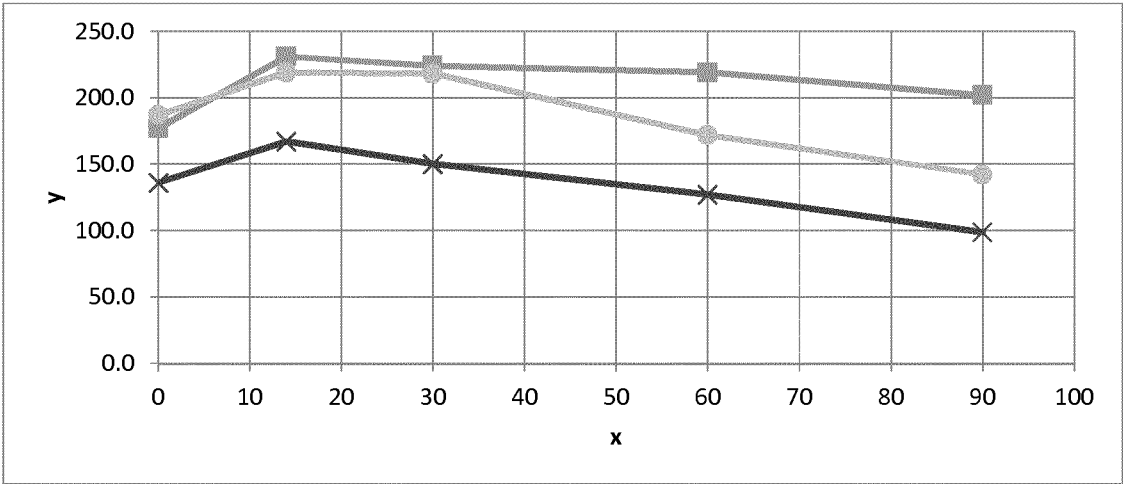
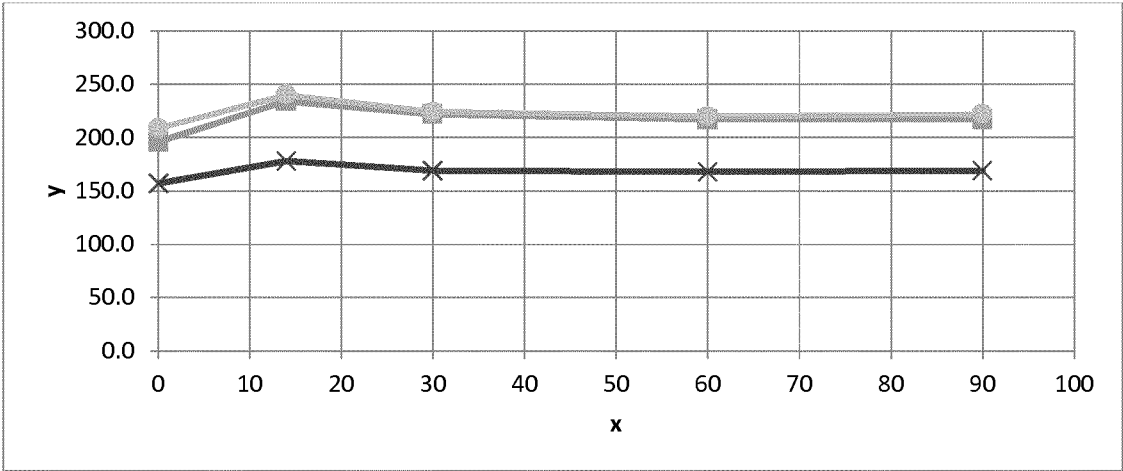


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/063247

A. CLASSIFICATION OF SUBJECT MATTER

INV. A23L2/52 A23P10/30 A23L29/212 A23L5/44
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 A23P

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, FSTA, BIOSIS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/191556 A1 (CHR HANSEN AS [DK]) 4 December 2014 (2014-12-04) claims 1, 4, 8, 9, 10, 12 -----	1-3, 5-12, 14-16, 18,19
X	EP 2 687 103 A1 (BASF SE [DE]) 22 January 2014 (2014-01-22) paragraphs [0056], [0062]; claim 17 -----	1-5,7-19
X	US 2003/148099 A1 (DEFREITAS ZORAIDA [US] ET AL) 7 August 2003 (2003-08-07) claims 1, 3, 5 ----- -/-	8-10



Further documents are listed in the continuation of Box C.



See patent family annex.

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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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Date of the actual completion of the international search

2 September 2016

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/063247

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/039336 A1 (DSM IP ASSETS BV [NL]; VIDONI OLIVIA [FR]; HITZFELD ANDREA [DE]; LEUEN) 7 April 2011 (2011-04-07) cited in the application page 6, line 9 - page 12, line 4; claims 6, 9, 11, 12, 13; example 6 -----	1-13, 15-19
X	WO 2012/059286 A1 (DSM IP ASSETS BV [NL]; HITZFELD ANDREA [CH]; LEUENBERGER BRUNO H [CH];) 10 May 2012 (2012-05-10) page 3, line 26 - page 8, line 37; claims 6, 7, 10, 12; examples 1-5; table 1 -----	1-5, 7-11,14, 16,18
X	US 6 500 473 B1 (KOEHLER KLAUS [DK] ET AL) 31 December 2002 (2002-12-31) column 9, line 24 - column 11, line 16; claims 1, 11, 17, 35; example 1 -----	1-15, 17-19

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/063247

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014191556	A1	04-12-2014	NONE
EP 2687103	A1	22-01-2014	AU 2013292031 A1 29-01-2015 CN 104470373 A 25-03-2015 EP 2687103 A1 22-01-2014 EP 2874507 A1 27-05-2015 JP 2015530076 A 15-10-2015 WO 2014013002 A1 23-01-2014
US 2003148099	A1	07-08-2003	AT 447440 T 15-11-2009 AU 2003207707 A1 02-09-2003 EP 1480736 A2 01-12-2004 ES 2335581 T3 30-03-2010 JP 4989017 B2 01-08-2012 JP 2005517694 A 16-06-2005 JP 2012006943 A 12-01-2012 US 2003148099 A1 07-08-2003 WO 03066205 A2 14-08-2003
WO 2011039336	A1	07-04-2011	CN 102573513 A 11-07-2012 EP 2482672 A1 08-08-2012 US 2012259023 A1 11-10-2012 WO 2011039336 A1 07-04-2011
WO 2012059286	A1	10-05-2012	BR 112013011057 A2 19-07-2016 CN 103188948 A 03-07-2013 EP 2635134 A1 11-09-2013 JP 2013544240 A 12-12-2013 KR 20130125773 A 19-11-2013 US 2013281550 A1 24-10-2013 WO 2012059286 A1 10-05-2012
US 6500473	B1	31-12-2002	AT 238696 T 15-05-2003 AU 772905 B2 13-05-2004 AU 4744200 A 12-12-2000 DE 60002457 D1 05-06-2003 DE 60002457 T2 06-05-2004 DK 1178738 T3 16-06-2003 EP 1178738 A1 13-02-2002 ES 2199165 T3 16-02-2004 JP 2003500035 A 07-01-2003 US 6500473 B1 31-12-2002 WO 0070967 A1 30-11-2000