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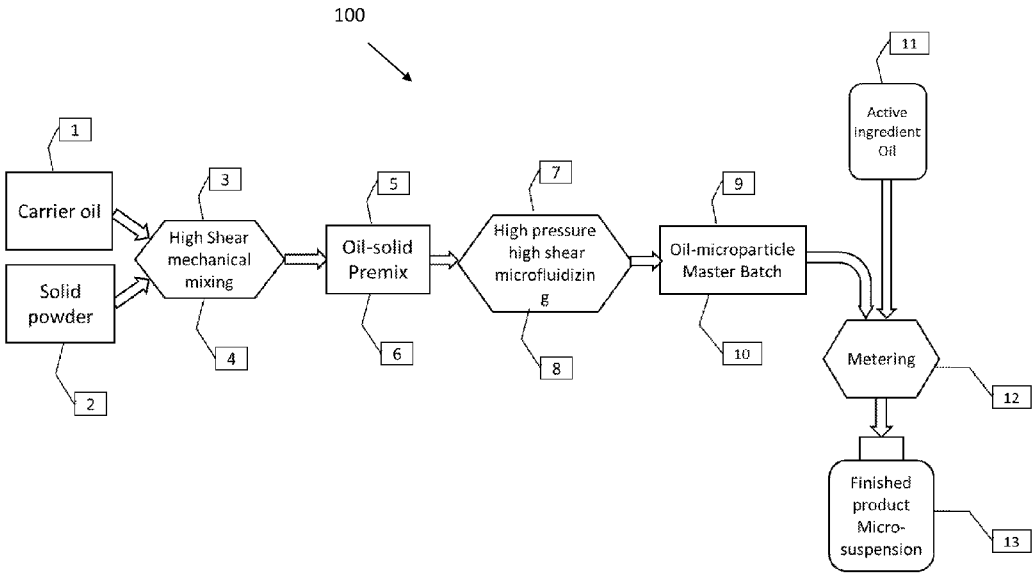

Fig. 5

(57) Abstract: An oil-based suspension may include a carrier oil and edible solid particles having an average diameter of less than about 50 pm.

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OIL- SUSPENSION OF EDIBLE SOLIDS AND METHODS OF PREPARING THE SAME

FIELD OF THE INVENTION

[0001] The invention is directed to an oil suspension comprising micro and nanoparticles of edible solids. The invention is further directed to a method for preparing such an oil suspension.

BACKGROUND OF THE INVENTION

[0002] The sweetening or other flavoring of oils, as well as products having a high oil content may be necessary for example, in the food industry, such as in producing chocolate, sweetened peanut butter, etc. However, since the sugar molecule or other polar molecule (e.g., salt) does not readily dissolve in oil, or in products having a high oil content, this poses a real challenge in the production of oil-based sweetened products.

[0003] For example, sugars may be premixed with water, wherein the formed solution is mixed with an oil component thereby forming an emulsion. The emulsions formed may require the addition of emulsifiers in order to provide a stable product. Further, while powdered sugar may be more readily mixed into oil substances, it is considered to be dust when the particles are under 500 μm (micron). Sugar dust is known to be highly explosive in free air, and therefore, safety regulations require that powdered sugar be mixed with additional components, such as starch, to reduce conflagration risk. Another known solution is the use of artificial sweeteners in order to replace sugar. However, such sweeteners are not necessarily agreeable with various bodily functions, and further, the flavor they provide to the food products is generally different than that of natural sugars, and therefore, the end-products tend to be less satisfying to the consumers.

[0004] While, as detailed above, water, or additional ingredients, such as starch, may be used in various products, there are products in which the addition of water or other ingredients is not possible or undesired. For example, certain products are required to be prepared without water. Certain products, for instance omega-3 fatty acids, olive oil, plant oils, omega 6s oils and the like, are highly sensitive to oxidation and therefore, must be prepared in an inert and dry environment. As used herein, a dry environment is an environment that is practically free from H_2O molecules or water. Certain powder and solid products, for instance spices should be dried to protect against

microbial activity and to preserve its organoleptic properties and therefore, should be preserved in a dry environment during the shelf life. The addition of water to such products may therefore not be possible.

[0005] Another possible consideration when preparing sweetened products relates to the sugar content of those products. Other than the complications detailed above regarding the inclusion of sugar in oil-based products, the amounts of sugar necessary for providing an end-product that is sweet enough for consumers, may be very high. Chocolate, for instance, may comprise about 50% w/w of sugar. Since the disadvantages and complications of high sugar (or salt) consumption, such as diabetes, high blood pressure and obesity, are well known, it would be highly advantageous to provide means by which the sugar (or salt) content of food products may be reduced, without decreasing consumer satisfaction and likings of such products.

[0006] Therefore, there seems to be a need in the art for oil based formulations comprising edible solids, such as, sugars, salts and spices, that do not require additional ingredients, such as water or a stabilizer (for example, starch), and further, which provide a desirable organoleptic sensation of enhanced flavoring, even at a reduced edible solids (e.g., sugar) content.

SUMMARY OF THE INVENTION

[0007] Some aspects of the invention may be directed to an oil-based suspension comprising a carrier oil and edible solid particles having an average diameter of less than about 50 μm. In some embodiments, the edible solid particles have an average diameter of less than about 15μm. In some embodiments, the suspension has an edible solid content of between about 1% to 30% w/w. In some embodiments, the edible solid is selected from: sugar, salt and spices. In some embodiments, the oil is selected from medium chain triglyceride (MCT) oil, canola oil, coconut oil, peanut butter oil, palm oil, olive oil, fish oil, sunflower seed oil, soy oil, or any combination thereof.

[0008] Some embodiments of the invention may be directed to a consumable product comprising the oil-based suspension disclosed herein. In some embodiments, the consumable product may be a sweetened fish oil. In some embodiments, the consumable product may include about 1-50% w/w of the oil-based suspension.

[0009] Some aspects of the invention may be directed to a method for preparing an oil-based suspension. The method may include: mixing edible solid raw-particles with a carrier oil, thereby

obtaining an oil- edible solid raw-particles mixture; and reducing the particle size of the edible solid raw particles in the oil-sugar mixture, thereby obtaining an oil-based suspension, wherein the oil-based suspension comprises edible solid particles having an average particle size of between about 5-50 μm. In some embodiments, reducing the particle size may be performed in 1, 2, 3, 4 or 5 steps, wherein the particle size of the edible solid in each consecutive step is reduced in comparison to any previous step.

[0010] In some embodiments, the method may further include obtaining the edible solid raw-particles at particle size lower than 250 μm, therefore, reducing the particle size of the edible solid raw particles may include: reducing the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture to between about 100 to 0.1 μm, thereby providing the oil-based suspension. In some embodiments, the reduction step may be performed in a microfluidizer. In some embodiments, the method may further include obtaining the edible solid raw-particles at particle size of equal to or higher than 250 μm therefore, reducing the particle size of the edible solid may include a first step and a second step, wherein the first step may include reducing the average particle size of the edible solid in the oil-sugar mixture to between about 500 to 50 μm, thereby providing an intermediate reduced-size oil- edible solid mixture; and the second step may include reducing the average particle size of the edible solid in the intermediate reduced-size oil-sugar mixture to between about 100 to 0.1 μm, thereby providing the oil-based suspension. In some embodiments, the first step may be performed in a food processor.

[0011] In some embodiments, the second step may be performed in a microfluidizer. In some embodiments, the microfluidizer is used at a pressure of between about 5,000-40,000 psi. In some embodiments, the microfluidizer has channels sizes between 75 μm to 1100 μm, for example, 87 μm and 200 μm.

[0012] In some embodiments, the oil-based suspension may include between about 1-30 %w/w edible solid. In some embodiments, the method may further include mixing the oil-based suspension with an additional oil or product with a high-oil content, thereby providing a final sweetened product. In some embodiments, the oil-based suspension may be mixed with an additional oil or product with a high-oil content, under inert conditions. In some embodiments, the additional oil is fish oil, such that the final sweetened product is a sweetened fish oil.

[0013] In some embodiments, a consumable product may be prepared according to the method disclosed herein above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanied drawings. Embodiments of the invention are illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like reference numerals indicate corresponding, analogous or similar elements, and in which:

[0015] Fig. 1, is a flowchart of a method of preparing an oil-based suspension according to some embodiments of the invention;

[0016] Fig. 2 is microscope photograph showing the original size of natural sugar particles (prior art);

[0017] Fig. 3A and 3B are microscope photographs showing the size of the sugar particles in an oil-based sugar suspension following two reduction steps according to some embodiments of the invention;

[0018] Fig. 4A is a graph showing the volume weighted distribution % vs particle size of the sugar particles at several stages during the preparation of an embodiment of the oil-based sugar suspension of the invention;

[0019] Fig. 4B is a graph showing the volume weighted cumulative distribution *vs.* the particle size which presents the particle size distribution of the sugar particles at several stages during the preparation of an embodiment of the oil-based sugar suspension of the invention;

[0020] Fig. 5 is a block diagram describing an embodiment of the system of the invention.

[0021] It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn accurately or to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity, or several physical components may be included in one functional block or element. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Throughout this application, unless specifically mentioned otherwise or unless a person skilled in the art would have understood otherwise, the term "about" is considered to cover a range of ±10% of the listed value(s).

[0023] Some embodiments of the invention are directed to an oil-based suspension comprising a carrier oil and edible solid particles (e.g., sugar particles, salt particles, spices, and the like) having an average diameter of less than about 60 μm. Some embodiments of the invention are directed to an oil-based suspension comprising a carrier oil and edible solid particles having an average diameter of less than about 50μm. Some embodiments of the invention are directed to an oil-based suspension comprising a carrier oil and edible solid particles having an average diameter of less than about 40μm. Some embodiments of the invention are directed to an oil-based suspension comprising a carrier oil and edible solid particles having an average diameter of less than about 30μm. Some embodiments of the invention are directed to an oil-based suspension comprising a carrier oil and edible solid particles having an average diameter of less than about 20μm. Some embodiments of the invention are directed to an oil-based suspension comprising a carrier oil and edible solid particles having an average diameter of less than about 15μm.

[0024] In some embodiments, the oil-based suspension may include only the carrier oil and the edible solid particles. In some embodiments, oil-based suspension is free from any stabilizer.

[0025] Some embodiments of the invention are directed to an oil-based suspension comprising a carrier oil and edible solid particles having an average diameter of between about, 100-0.1 μm, for example, between about 60-5μm. According to some embodiments, the edible solid particles have an average diameter of about 1μm, for example, 800 nm, 700 nm, 600 nm, 500 nm or less. According to some embodiments, the edible solid particles have an average diameter of about 5μm. According to some embodiments, the edible solid particles have an average diameter of about 7.5μm. According to some embodiments, the edible solid particles have an average diameter of about 10μm. According to some embodiments, the edible solid particles have an average diameter of about 12.5μm. According to some embodiments, the edible solid particles have an average diameter of about 15μm.

[0026] According to some embodiments, the oil-based suspension remains stable as a suspension for between about 5-60 minutes. As used herein, a stable suspension is a suspension having the

majority the mixed solid particles not settled in the oil, for example, more than 70%, 80%, 90% or more of the mixed solid particles are not settled in the oil (e.g., less than 30, 20, 10 or less volume % phase separation). The parameters defining the settling time to phase seperation are mainly the particel size and oil viscositiy. The larger the particle size the lower is the settling time. According to some embodiments, the oil-based suspension remains stable as a suspension for about 5,10, 15, 20, 25, 30, 35, 40, 45, 50, 55 or 60 minutes. It is noted that a stable suspension is considered to be a suspension in which there is no visible phase separation, or that the phase separation involves an insignificant number of particles thereof. It is further noted that the oil-based suspension and/or products comprising the same, may be provided in vials or containers of any sort that may be mixed by manual agitation before use, or by any other appropriate means, such that, even if partial or full phase separation has occurred, the suspension may be reinstated by agitation, or other mixing means, and thereafter, will remain stable, as detailed herein.

[0027] According to some embodiments, the size distribution of the edible solid (e.g., sugar) micro and/or nano particles in the oil-based sugar suspension may be less than 30 μm.

[0028] According to some embodiments, the edible solid content in the oil-based suspension is between about 1% to 30% w/w . According to some embodiments, the edible solid content in the oil-based suspension is about 1% w/w. According to some embodiments, the edible solid content in the oil-based sugar suspension is about 10% w/w. According to some embodiments, the edible solid content in the oil-based suspension is about 15% w/w. According to some embodiments, the edible solid content in the oil-based suspension is about 20% w/w. According to some embodiments, the edible solid content in the oil-based suspension is about 30% w/w.

[0029] According to some embodiments, the amount of the carrier oil in the oil-based sugar suspension is between about 50% to 99% w/w. According to some embodiments, the amount of the carrier oil in the oil-based suspension is about 99% w/w. According to some embodiments, the amount of the carrier oil in the oil-based suspension is about 90% w/w. According to some embodiments, the amount of the carrier oil in the oil-based suspension is about 85% w/w. According to some embodiments, the amount of the carrier oil in the oil-based suspension is about 80% w/w. According to some embodiments, the amount of the carrier oil in the oil-based suspension is about 50% w/w.

[0030] According to some embodiments, the edible solid may be salt (e.g., sea salt), various spices (e.g., pepper, paprika, cardamom, nutmeg, oregano, turmeric, cumin, sage and the like) According to some embodiments, the edible solid in the oil-based suspension is sugar, which may be one of: sucrose, fructose, glucose, galactose, lactose, maltose, xylose, glycerol, sorbitol, corn syrup solids, maltodextrin, aspartame, sucralose, acesulfame, xylitol or any combination thereof. According to some embodiments, the edible solid may be any kind of herbal medicine, medicine, minerals, lipophilic amino acids or vitamins (e.g., vitamin C powder) and thereof. It is noted that the embodiments of the invention are not limited to any particular source or type of edible solid. Any type or combination of edible solid, that may provide desirable organoleptic sensation, including of the required flavoring, and that may be reduced in particle size to the sizes according to the embodiments of the invention, may be included in the oil-based suspension of the invention. It is further noted that the reduced edible solid particle size implemented according to embodiments of the invention may enhance the organoleptic sensation, such that the flavoring of the oil-based suspension may be enhanced in comparison to corresponding formulations, having similar edible solid contents. Therefore, even edible solids that are generally not used in the food industry as, for example, sweeteners, since they do not provide the required sweetness, may be used according to the invention. Thus, according to some embodiments, a sugar in the oil-based sugar suspension may be galactose.

[0031] According to some embodiments, the carrier oil in the oil-based suspension may be selected from any edible oil, such as medium chain triglyceride (MCT) oil, canola oil, coconut oil, peanut butter oil, palm oil, olive oil, fish oil, sunflower seed oil, soy oil, or any combination thereof. According to some embodiments, the carrier oil in the oil-based suspension may be selected from any melted butter like Cocoa butter, Peanut butter or any combination thereof. According to some embodiments, the carrier oil is a saturated oil, an unsaturated oil, or any combination thereof. According to some embodiments, the carrier oil is resistant to oxidation. According to some embodiments, the carrier oil is inert. According to some embodiments, the carrier oil is tasteless, odorless, or both. In some embodiments, the oil-based suspension may include only the carrier oil and the edible solid particles, with no addition of stabilizer and/or water.

[0032] Reference is now made to Fig. 1 which is a flowchart of a method for preparing an oil-based suspension according to some embodiments of the invention. In step 110 embodiments may include mixing an edible solid particles with a carrier oil thereby obtaining an oil- edible solid

mixture. In some embodiments, the mixture may include only the carrier oil and the edible solid particles with no addition of stabilizers and/or water. In some embodiments, the mixture may be stabilizer-free mixture, accordingly no stabilizer may be added to the oil or the mixture. The mixing may be performed according to any known method using any known mixer or stirrer, for example, using the high shear mechanical mixing illustrated and disclosed with respect to the system of Fig. 5. In some embodiments, the raw edible solid may include any commercial edible solid, for example, sugars, salts and spices as being provided (e.g., off the shelf products). The particle size of the raw edible solid may be at least 0.5 mm.

[0033] In step 120, embodiments may include reducing the particle size of the edible solid in the oil- edible solid mixture, thereby obtaining an oil-based suspension, wherein the oil-based suspension comprises edible solid particles having an average particle size of less than about 0.1-100 μm. According to some embodiments, the particle size reduction of the edible solid is performed in a single step. In some embodiments, the method may further include obtaining the edible solid raw-particles at particle size lower than 250 μm, therefore, reducing the particle size of the edible solid raw particles may be conducted in a single step and may include: reducing the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture to between about 100 to 0.1 μm, thereby providing the oil-based suspension. In some embodiments, the reduction step may be performed in a microfluidizer, as discloses herein below.

[0034] In some embodiments, the method may further include obtaining the edible solid raw-particles at particle size of equal to or higher than 250 μm therefore, the particle size reduction of the edible solid particles may be performed in more than one step. According to some embodiments, the particle size reduction of the edible solid particles is performed in 1, 2, 3, 4, 5 or more steps. According to some embodiments, the particle size reduction of the edible solid particles is performed in two steps. According to some embodiments, in each consecutive step the average particle size of the edible solid in the oil- edible solid mixture is further reduced in comparison to the previous step(s).

[0035] According to some embodiments, the particle size reduction of the edible solid includes a first and a second step, wherein the first step comprises reducing the average particle size of the edible solid particles in the oil- edible solid mixture to between about 50 to 500 μm, thereby providing an intermediate reduced-size oil- edible solid mixture. Further, the second step may comprise reducing the average particle size of the edible solid particles in the intermediate reduced-

size oil- edible solid mixture to less than about 100 μm, thereby providing an oil-based sugar suspension. According to some embodiments, the second step may include reducing the average particle size of the edible solid particles in the intermediate reduced-size oil- edible solid mixture to less than about 50 μm, thereby providing an oil-based sugar suspension.

[0036] In some embodiments, the mixing and size reduction may allow the use of stabilizer-free mixture. The final size of the edible solid particles may be determined such that the particles may remain stable in the suspension for between about 5-60 minutes, such that no additional stabilizer is required.

[0037] Thus, certain embodiments of the invention are directed to a method for preparing an oil-based suspension. In some embodiments, the method may include:

mixing a raw edible solid with a carrier oil thereby obtaining an oil- edible solid mixture;

reducing the average particle size of the edible solid in the oil- edible solid mixture to between about 50 to 500 μm thereby providing an intermediate reduced-size oil- edible solid mixture;

further reducing the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture to less than about 100 μm or to less than about 50 μm, thereby providing an oil-based suspension.

[0038] According to some embodiments, the oil- edible solid mixture prepared according to the method of the invention may include between about 1% to 30% %w/w edible solid. According to some embodiments, the oil- edible solid mixture prepared according to the method of the invention may include about 1%w/w edible solid. According to some embodiments, the oil - edible solid mixture prepared according to the method of the invention may include about 10%w/w edible solid. According to some embodiments, the oil- edible solid prepared according to the method of the invention may include about 15%w/w edible solid. According to some embodiments, the oil-edible solid mixture prepared according to the method of the invention may include about 20%w/w edible solid. According to some embodiments, the oil- edible solid mixture prepared according to the method of the invention may include about 30%w/w edible solid.

[0039] According to some embodiments, the oil- edible solid mixture prepared according to the method of the invention may include between about 50% to 99% w/w carrier oil. According to some embodiments, the oil- edible solid mixture prepared according to the method of the invention may include about 99%w/w carrier oil. According to some embodiments, the oil- edible solid mixture prepared according to the method of the invention may include about 90%w/w carrier oil. According to some embodiments, the oil- edible solid mixture prepared according to the method of the invention may include about 85%w/w carrier oil. According to some embodiments, the oil-edible solid mixture prepared according to the method of the invention comprises about 80%w/w carrier oil. According to some embodiments, the oil- edible solid mixture prepared according to the method of the invention comprises about 50%w/w carrier oil.

[0040] According to some embodiments, the intermediate reduced-size oil- edible solid mixture is prepared in a processor, such as a food processor or a high shear rotor stator homogenizer or any other suitable device for reducing size of solid particles in an oil suspension. According to some embodiments, the intermediate reduced-size oil- edible solid mixture is prepared by running a food processor, or any other equivalent device able to provide the required particle size, for any appropriate time intervals, repeating the process any number of times required, until the required particle size is obtained. According to some embodiments, the food processor is run for between about 1-5 minutes. According to some embodiments, the food processor is run for about three minutes. According to some embodiments, the food processor is run at intervals of a predetermined length. According to some embodiments, the intervals are of about 30, 40, 50, 60, 70 or 80 seconds. According to some embodiments, the food processor is run for 1, 2, 3, 4, 5 or 6 time intervals. According to some embodiments, there is an intermission of a pre-determined length of time between each of the intervals. According to some embodiments, the intermission between intervals is of between 1 to 60 seconds.

[0041] According to some embodiments, the further reduction of the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture, thereby obtaining the oil-based suspension, is performed using a microfluidizer. According to some embodiments, the further reduction of the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture, thereby obtaining the oil-based suspension, is performed using a sonicator.

[0042] For example, when using a microfluidizer, the further reduction of the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture, may be performed in a 200 μm channel. As should be understood by one skilled in the art other channels of any known microfluidizer may be used for the further reduction of the average particle size of the edible solid. According to some embodiments, the further reduction of the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture, is performed in a microfluidizer. In some embodiments, the microfluidizer may have any channel size from 75μm to 1100μm, for example, 75 μm , 87μm, 100μm, 125 μm, 150μm, 200μm, 250μm, 300μm, 400μm, 425μm, 550μm and 1100μm .According to some embodiments, the further reduction of the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture, is performed in both the 200μm and the 87μm channels of a microfluidizer. According to some embodiments, the further reduction of the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture, is performed in an 87μm channel of a microfluidizer, while bypassing the 200 μm channel of the microfluidizer or vice versa.

[0043] According to some embodiments, the size reduction in the microfluidizer is performed at a pressure of between about 5,000-40,000psi. According to some embodiments, the size reduction in the microfluidizer is performed at a pressure of about 20,000-23,000psi.

[0044] According to some embodiments, several rounds are performed using the microfluidizer. According so some embodiments, the number of rounds is 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. According to some embodiments, the number of rounds is between 4-7. According to some embodiments, the number of rounds is 5 or 6.

[0045] It is noted that while certain devices, such as food processors and microfluidizers are exemplified herein, any other appropriate devices, that may provide the oil-based edible solid suspension, having edible solid particles in the required size, as detailed herein, may be utilized according to the invention.

[0046] According to some embodiments, the oil-based suspension is mixed with an additional oil, or product with a high oil-content, in order to provide the final product in which the oil-based suspension. In some embodiments, the oil-based suspension may keep its homogeneity for a time sufficient for conducting several industrial uses, for example, at least 5 minutes, 10 minutes, 20 minutes, 30, minutes, 40 minutes, 50 minutes, 60 minutes and more. According to some

embodiments, the oil-based suspension may be mixed with an additional oil, or product with a high oil-content, under inert conditions, e.g., under N_2 or Ar, in order to provide a final product. According to some embodiments, the edible solid particles may remain homogeneously suspended in the final product for a certain length of time, even if that product is liquid. According to some embodiments, the edible solid particles remain homogeneously suspended in the final product for between about 5-60 minutes. According to some embodiments, the edible solid particles remain homogeneously suspended in the final product for about 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55 or 60 minutes. As detailed herein, the final product may be mixed by agitation, or by any other appropriate means, such that, even if phase separation has fully or partially occurred, the homogeneous distribution of the edible solid particles in the final product may be reinstituted. Once reinstituted, the homogeneous distribution will remain stable, as detailed herein, e.g., for between about 5-60 minutes.

[0047] For example, the oil-based sugar suspension may be mixed with fish oil, thereby providing a stable sweetened fish oil suspension. For example, the oil-based sugar suspension may be mixed with cocoa products, such as cocoa butter, thereby providing chocolate products having a reduced sugar load. For example, the oil-based suspension may be mixed with peanut butter, thereby providing sweetened or salted peanut butter. For example, the oil-based suspension may be mixed with dairy butter in order to provide sweetened, salted or spiced dairy butter. For example, the oil-based suspension may be mixed with olive oil, coconut oil, any other vegetable oils or any other edible oil in order to provide sweetened, salted or spiced edible oil. For example, the oil-based sugar suspension may be mixed with one of: any kind of medicine, vitamins, lipophilic amino acids or minerals that cannot be mixed with water, in order to provide a sweetened, orally administered, medicinal product. For example, the oil-based sugar suspension may be mixed with dairy butter, cream, coconut oil, palm oil, animal fat or any other edible fat and oil based products.

[0048] For example, a product may include 76.7 wt.% fish oil, 3.5 wt.% sugar suspended in 19.8 wt.% carrier oil (e.g., MCT).

[0049] Embodiments of the invention are directed to a consumable product that comprises between about 1% to 50% w/w of the oil-based suspension. According to some embodiments, the consumable product comprises about 1%w/w of the oil-based suspension. According to some embodiments, the consumable product comprises about 15%w/w of the oil-based suspension.

According to some embodiments, the consumable product comprises about 20%w/w of the oil-based suspension. According to some embodiments, the consumable product comprises about 25%w/w of the oil-based suspension. According to some embodiments, the consumable product comprises about 30%w/w of the oil-based suspension. According to some embodiments, the consumable product comprises about 35%w/w of the oil-based suspension. According to some embodiments, the consumable product comprises about 50%w/w of the oil-based suspension.

[0050] The products of the invention may be any orally consumable products that require flavoring of any level, including food industry products, pharmaceutical industry products, and the like.

[0051] Further embodiments of the invention are directed to a fish oil product comprising an oil-based edible solid suspension. According to some embodiments, the fish oil product comprises between about 20-30% w/w of the oil-based suspension. According to some embodiments, the fish oil product comprises about 25%w/w of the oil-based suspension. According to some embodiments, the fish oil product comprises an oil-based suspension, wherein the oil-based suspension comprises between about 75-95% w/w of a carrier oil and between about 1-25%w/w of edible solid. According to some embodiments, the fish oil product comprises an oil-based suspension, wherein the oil-based suspension comprises about 85% w/w of a carrier oil and about 15%w/w of edible solid.

[0052] According to some embodiments, the fish oil product comprising the oil based suspension is prepared according to the methods of the invention, described herein.

[0053] Reference is now made to Fig. 2 (prior art) which is an optical microscope photograph presenting the original size of natural sugar crystals. Natural sugar crystals may vary in size, from several hundred μm to about 2000 μm, e.g., the 545μm, as shown in Fig. 2.

Reference is now made to Figs. 3A and 3B which are optical microscope photographs showing sugar particles after two different reduction steps. After the first reduction, using, e.g., a food processor, the size of the sugar particles was reduced to less than 150 μm, as shown the microscope photographs presented in Fig. 3A. Further reduction (second reduction step), using, e.g., a microfluidizer, the size of the sugar particles was reduced to less than 40 μm, as shown the microscope photographs presented in Fig. 3B.

[0054] Reference is now made to Figs. 4A showing the volume weighted distribution vs particle size and 4B showing the volume weighted cumulative distribution *vs.* the particle size, which presents the particle size distribution of the sugar particles at several stages during the preparation of an embodiment of the oil-based suspension of the invention.

[0055] Reference is now made to Fig. 4A presenting a graph showing volume weighted distribution %, wherein, the Y axis being the percent of the particle population in each particle size in μm and the X axis being the sugar particle size (in μm) of premix (oil based suspension) in comparison to the premix after various number of reduction cycles conducted in a 87 μm microfluidizer: a single cycle (marked as 1x87 μm), 4 cycles (marked as 4x87 μm), and 8 cycles (marked as 8x87 μm). As clearly shown in the graph the premix has a wide particle distribution (between 10-100μm). with large particles (see, Fig. 4B the cumulative graph) with median particle size of about 40μm. The reduction steps, were conducted in the microfluidizer, using a channel of 87μm. A reduction in particle size distribution was observed, even after a single cycle. An additional significant reduction in the particle size distribution was observed after 4 and 8 cycles a in comparison to the first cycle.

[0056] Reference is now made to Figs. 4B presenting a graph showing volume weighted cumulative distribution as function of sugar particle size of premix (oil based suspension) in comparison to the premix after various number of reduction cycles conducted in a 87 μm channel microfluidizer: 3 cycles (marked as 3x87 μm), 4 cycles (marked as 4x87 μm), 5 cycles (marked as 5x87 μm), and 8 cycles (marked as 8x87 μm). The y axis refers to the fraction of the particles from all particles at a specific particle size (where 1.0=100%). Accordingly, half (0.5) indicates the median size of the particles. The premix has a median of about 40μm. Already after 3 milling cycles the median was reduced to about 20μm and after 8 milling cycles to about 12μm.Fig. 5 presents a block diagram describing an embodiment of the system of the invention. A system 100 for producing an oil based suspension according to some embodiments of the invention may include: a carrier oil source 1 (e.g., a tank or a container holding the carrier oil), a raw edible solid particles source 2 (e.g., a container providing, sugar, salts, spices and the like, for example, in powder form) and a mixer 3 for mixing the carrier oil with the solid source. In some embodiments, the mixer may be high sheer mechanical mixer or any other suitable mixer.

[0057] In some embodiments, system 100 may further include a pre-mixer 5 (e.g., a food processor) for conducting the first stage of particle size reduction of the taw edible solid particles. For example, pre-mixer 5 may reduce the particle size from above 0.5 mm to between 50 to 500 μm. In some embodiments, system 100 may further include a finer grinder 7, that may include one or more channels of microfluidizer, as disclosed herein above.

[0058] In some embodiments, system 100 may further include an oil-microparticle masterbatch 9. As used herein masterbatch is a concentrated formulation of active ingredient (e.g., flavorant, colorant, medicaton) which may be diluted later by a carrier matrix of polymer, food, medicine etc. to give the desired end product color, flavor etc.

[0059] In some embodiments, system 100 may further include an additives source 11, for example, an active ingredient oil may include Omega 3s fish oil. Other additives may include a flavoring, starch or other stabilizers. For example, the masterbatch may be mixed with a fish oil.

[0060] In some embodiments, the additives may be dosed or dispensed in a controlled amount (e.g., metering).

[0061] In some embodiments, system 100 may further include a container 13 for collecting the oil based suspension.

[0062] Unless explicitly stated or unless would have been understood by a person skilled in the art, the method embodiments described herein are not constrained to a particular order or sequence. Additionally, some of the described method embodiments or elements thereof can occur or be performed simultaneously, at the same point in time, or concurrently.

[0063] It is appreciated that certain features of the invention may also be provided in combination in a single embodiment. Conversely, various elements of the invention that are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination or as suitable in any other described embodiment of the invention. Further, certain features described in the context of various embodiments are not to be considered essential features of those embodiments, unless the embodiment is inoperative without those elements.

[0064] While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents may occur to those skilled in the art. It is,

therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

CLAIMS

1. An oil-based suspension comprising a carrier oil and edible solid particles having an average diameter of less than about 50 μm.

2. The oil-based suspension according to claim 1, comprising only the carrier oil and the edible solid particles.

3. The oil-based suspension according to claim 1, wherein the oil-based suspension is free from any stabilizer.

4. An oil-based suspension according to any one of claims 1-3, wherein the edible solid particles have an average diameter of less than about 15μm.

5. An oil-based suspension according to any one of claims 1-4, wherein the suspension has an edible solid content of between about 1% to 30% w/w.

6. An oil-based suspension according to any one of claims 1-5, wherein the edible solid is selected from: sugar, salt, spices herbal medicine, medicine, minerals, lipophilic amino acids and vitamins in powder phase.

7. An oil-based suspension according to any one of claims 1-6, wherein the oil is selected from medium chain triglyceride (MCT) oil, canola oil, coconut oil, peanut butter oil, palm oil, olive oil, fish oil, sunflower seed oil, soy oil, or any combination thereof.

8. A method for preparing an oil-based suspension, wherein the method comprises:

mixing edible solid raw-particles with a carrier oil, thereby obtaining an oil- edible solid raw-particles mixture; and

reducing the particle size of the edible solid raw particles in the oil- edible solid mixture, thereby obtaining an oil-based suspension, wherein the oil-based suspension comprises edible solid particles having an average particle size of between about 0.1-50 μm.

9. The method according to claim 8, wherein reducing the particle size is performed in 1, 2, 3, 4 or 5 steps, wherein the particle size of the edible solid in each consecutive step is reduced in comparison to any previous step.

10. The method according to claim 8, further comprising:

obtaining the edible solid raw-particles at particle size lower than 250 μm,

and wherein reducing the particle size of the edible solid raw particles comprises:

reducing the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture to between about 100 to 0.1 μm, thereby providing the oil-based suspension.

11. The method according to claim 10, wherein the reduction step is performed in a microfluidizer.12. The method according to claim 8, further comprising:

obtaining the edible solid raw-particles at particle size of equal to or higher than 250 μm,

and wherein reducing the particle size of the edible solid includes a first step and a second step, wherein

the first step comprises reducing the average particle size of the edible solid in the oil- edible solid mixture to between about 500 to 50 μm, thereby providing an intermediate reduced-size oil- edible solid mixture; and

the second step comprises reducing the average particle size of the edible solid in the intermediate reduced-size oil- edible solid mixture to between about 100 to 0.1 μm, thereby providing the oil-based suspension.

13. The method according to claim 12, wherein the first step is performed in a food processor.

14. The method according to claim 12, wherein the second step is performed in a microfluidizer.

15. The method according to claim 14, wherein the microfluidizer is used at a pressure of between about 5,000-40,000 psi.

16. The method according to claim 14, wherein the microfluidizer has channels sizes between 75 μm to 1100 μm.

17. A method according to any one of claims 8-16, wherein the oil- edible solid mixture is a stabilizer-free oil- edible solid mixture.

18. A method according to any one of claims 8-17, wherein the oil-based suspension comprises between about 1-30 %w/w edible solid.

19. A method according to any one of claims 8-18, further comprising mixing the oil-based suspension with an additional oil or product with a high-oil content, thereby providing a final sweetened product.

20. The method according to claim 19, wherein the oil-based suspension is mixed with an additional oil or product with a high-oil content, under inert conditions.

21. The method according to claim 19, wherein the additional oil is fish oil, such that the final sweetened product is a sweetened fish oil.

22. A consumable product comprising the oil-based suspension according to any one of claims 1-7.

23. The consumable product according to claim 22, wherein the consumable product is a sweetened fish oil.

24. The consumable product according to claim 22, wherein the consumable product comprises about 1-50% w/w of the oil-based suspension.

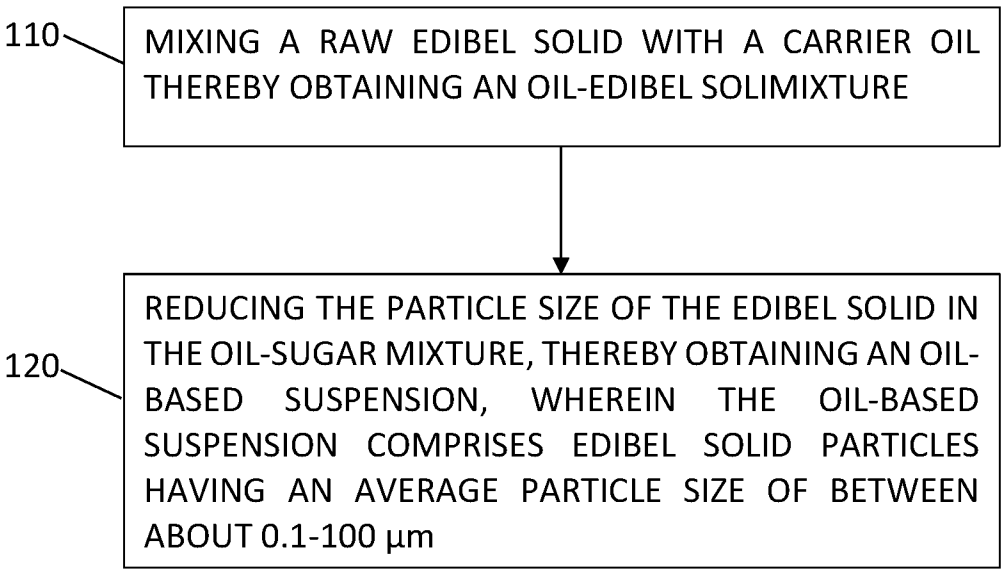

110
MIXING A RAW EDIBEL SOLID WITH A CARRIER OIL THEREBY OBTAINING AN OIL-EDIBEL SOLIMIXTURE
120
REDUCING THE PARTICLE SIZE OF THE EDIBEL SOLID IN THE OIL-SUGAR MIXTURE, THEREBY OBTAINING AN OIL-BASED SUSPENSION, WHEREIN THE OIL-BASED SUSPENSION COMPRISES EDIBEL SOLID PARTICLES HAVING AN AVERAGE PARTICLE SIZE OF BETWEEN ABOUT 0.1-100 µm

Fig. 1

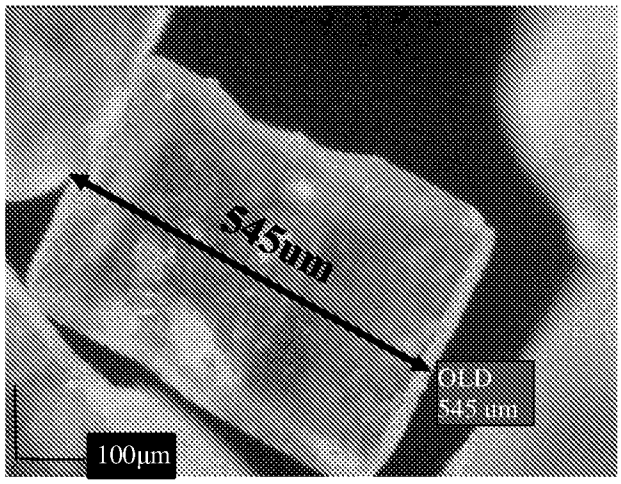


Fig. 2
(PRIOR ART)

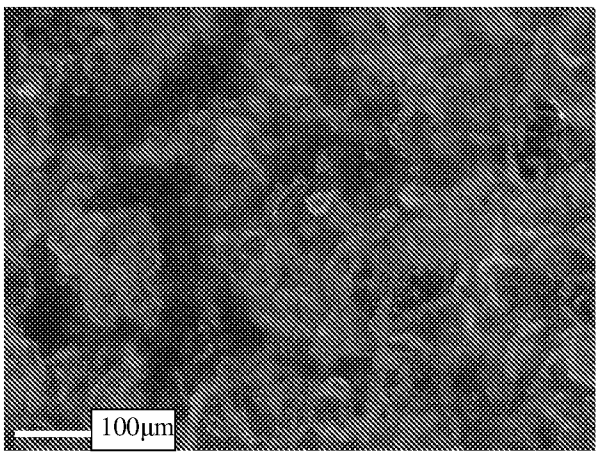


Fig. 3A

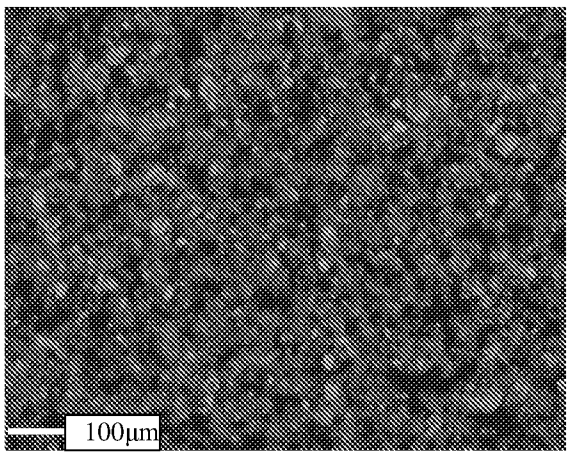
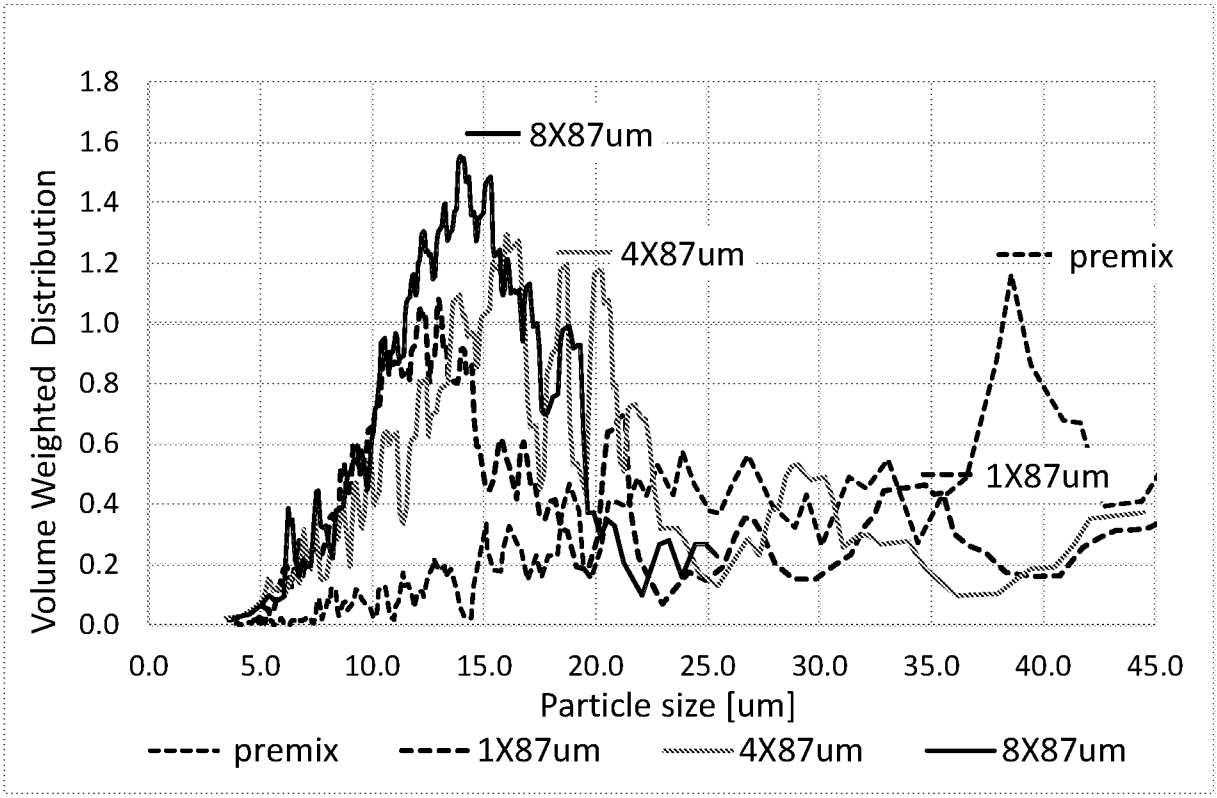


Fig. 3B


Volume Weighted Distribution
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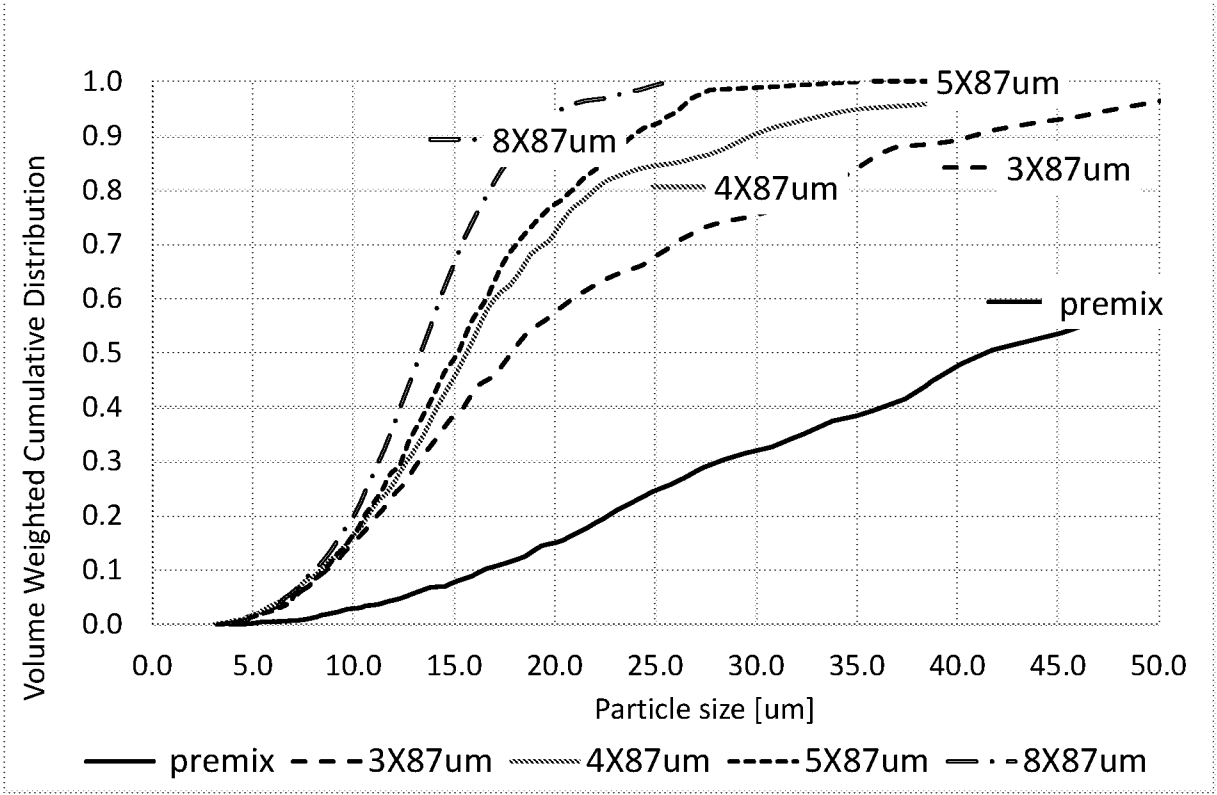
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
8X87um
4X87um
premix
1X87um
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Particle size [um]
premix
1X87um
4X87um
8X87um

Fig. 4A


Volume Weighted Cumulative Distribution
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
5X87um
8X87um
3X87um
4X87um
premix
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
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50.0
Particle size [um]
premix
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4X87um
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8X87um

Fig. 4B

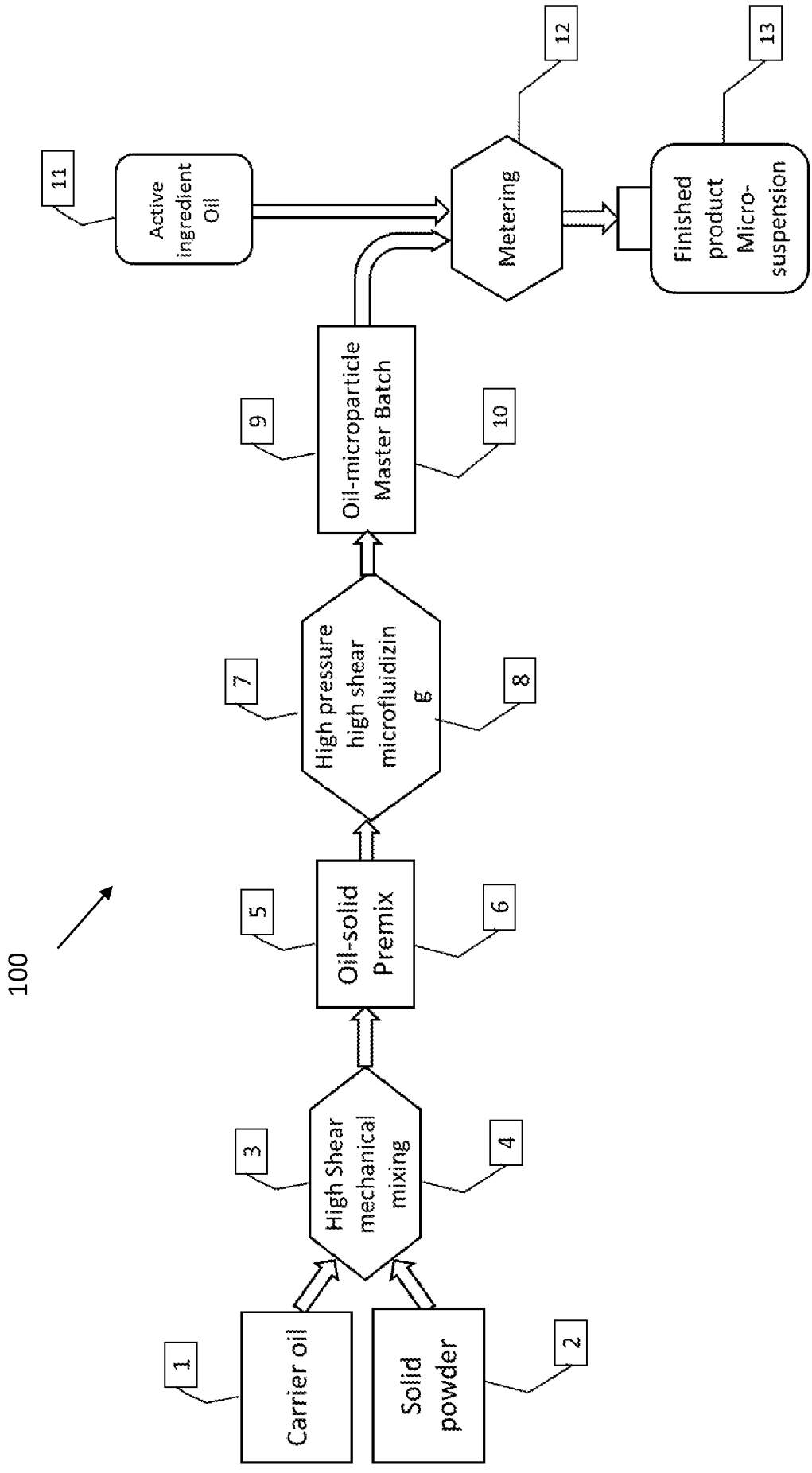
100
1
Carrier oil
2
Solid powder
3
High Shear mechanical mixing
4
5
Oil-solid Premix
6
7
High pressure high shear microfluidizing
8
9
Oil-microparticle Master Batch
10
11
Active ingredient Oil
12
Metering
13
Finished product Micro-suspension

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL2020/050787

A. CLASSIFICATION OF SUBJECT MATTER
IPC (20200101) A61K 9/10, A61K 9/107, A61K 9/14, A61K 31/20, A61K 47/14, A61K 47/44, A61P 3/02, A23D 7/01
CPC (20200101) A61K 9/10, A61K 9/107, A61K 9/14, A61K 31/20, A61K 47/14, A61K 47/44, A61P 3/02, A23D 7/011
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)
IPC (20200101) A61K 9/10, A61K 9/107, A61K 9/14, A61K 31/20, A61K 47/14, A61K 47/44, A61P 3/02, A23D 7/01
CPC (20200101) A61K 9/10, A61K 9/107, A61K 9/14, A61K 31/20, A61K 47/14, A61K 47/44, A61P 3/02, A23D 7/011

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)
Databases consulted: PatBase
Search terms used: oil suspension, particles, edible solid, carrier oil, diameter, size, reducing

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019174792 A1 NESTEC SA [CH] 13 Jun 2019 (2019/06/13) [0070], [0099], [0108], [0194], [0196], [0245], [0250], [0261], [0299], [0372], [0390], [0393]	1-24
X	US 2012207800 A1 ABU-BAKER OMAR ABDELFATTAH [US]; MACKENZIE DONALD [US]; PAN RENNAN [US] 16 Aug 2012 (2012/08/16) [0009], [0076], [0079]	1-7
X	US 2013156892 A1 MUSSAWIR-KEY FREDERICK WADE [GB]; ST GILES FOODS LTD [GB] 20 Jun 2013 (2013/06/20) [0019], [0025], [0031], [0052]	1-7
X	US 6048557 A DSM NV [NL] Apr. 11, 2000 11 Apr 2000 (2000/04/11) examples 1-6, col. 3 line 12, col. 5 line 27, col. 6 lines 19-20, col. 7 39-42, col. 8 lines 1, 28-29, 55, col. 9 2nd par., lines 1-2, 20	1-24

☐ 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
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"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	Date of mailing of the international search report
07 Sep 2020	08 Sep 2020

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Information on patent family members

International application No.
PCT/IL2020/050787

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Information on patent family members

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PCT/IL2020/050787

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