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(54) Title: FISHY FLAVOR MASKING IN EDIBLE COMPOSITIONS CONTAINING OMEGA-3 OILS

(57) Abstract: This invention embodies a "solid edible ingredient matrix:Omega-3 Oil" composite composition that is free from fishy taste/fishy flavor and process of making the same. The composition is coated with an ingredient to keep the composition free from fishy taste/fishy flavor during storage. Period of freeness from fishy taste/fishy flavor in storage is for at least 6 months. The solid edible ingredient matrix that comprises a macromolecular composition that absorbs Omega-3 oil coming in its contact; and the ingredient for coating the "solid edible ingredient matrix:Omega-3 Oil" composite composition comprises an ingredient which masks the taste and flavor of the Omega-3 oil when coated on the particles of "solid edible ingredient matrix:Omega-3 Oil" composite composition. This invention also discloses a dietary supplement comprising a "solid edible ingredient matrix:Omega-3 Oil" composite composition that is free from fishy taste/fishy flavor as one of the ingredients.



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OILS

FIELD OF INVENTION

This invention pertains to masking of fishy odor/flavor of edible compositions containing Omega-3 oils. In particular, the Omega-3 oils comprise Flax-seed oil, Fish oil and Algal oil.

5 BACKGROUND OF THE INVENTION

The term "Omega-3 oils" used in this application covers within its scope the fats and oils that contain Omega-3 fatty acids, also called ω -3 fatty acids or n-3 fatty acids, also called as polyunsaturated fatty acids (PUFAs), which have a double bond (C=C) at the third carbon atom from the end of the carbon chain. Fish oil, Flax-seed
10 oil and Algal Oil from microalgae such as *Schizochytrium* are examples of Omega-3 oils. These oils have a dietary significance since the Omega-3 fatty acids cannot be synthesized by a human being, they are required for maintaining good health and, hence, they are required to be consumed through their food sources. Omega-3 oils have acquired a prominent place in market as a food supplementary ingredient for
15 health benefits.

Mention of "DHA" in this specification refers to Docosahexaenoic acid residues in the triglycerides of Omega-3 oils.

However, all PUFA's and Omega-3 oils have fishy or un-pleasant smell which is not liked by many, and making food supplements by using the Omega-3 oils becomes
20 challenging due to the fishy smell. Supplements carrying minimum effective dosage of DHA sources through DHA-rich oils emanate fishy smell as soon as the container in which the same is stored is opened, and cannot be consumed by people who do not tolerate the fishy smell. Examples are fish oil, microbial/Algal Oils made from *Scizochytrium sp.*, *Dunaliella alga etc.* Omega-3 oils such as Flax seed oil is not
25 DHA rich, however, its taste and odor is also not palatable. However, Flax seed oil is considered as valuable in providing precursor Omega-3 backbone which can be

converted by the body by its further unsaturation by endogenous enzymatic routes to EPA, DHA and other polyunsaturated fatty acids needed for the body. Hence, they are also an indirect source of DHA to the body. Hence, there is a need to device a method by which Omega-3 Oils, whether DHA-rich or not, can be used as ingredients for supplementation for all those who cannot tolerate fishy or unfavorable flavor. However, this process of endogenous conversion to EPA and DHA is considered to be slow and inefficient; hence, consumption of DHA-rich oils is considered important/preferred. For the purpose of this specification, "fishy taste/fishy flavor" is a phrase used for taste/flavor of any Omega-3 oil, whether DHA-rich or not, if the taste/flavor of the same is regarded by many as unpleasant. One example of an Omega-3 oil which is not DHA-rich, but is nutritionally valuable and is judged by many as having unpleasant taste/flavor is flax oil or flax-seed oil.

There are liquid preparations of DHA that are made fishy-flavor free. However, liquid preparations have a low storage stability. Hence, solid powder shall be a preferred form. Microencapsulation of Omega-3 oil is available, however, microencapsulation involves material that provides capsule walls, which dilutes the preparation. DHA-enriched Algal oils having about 40% DHA are available; but when they are made available in micro-encapsulated form as an ingredient, they are usually 20% and the diluents ingredient is the one which contributed to capsule wall and it has no nutritional benefit. Solid powder forms of DHA supplemented foods/food-supplements are available, however, they contain too small a quantity of 40% DHA per 100g of the composition and the recommended portion for consumption is one teaspoonful (about 6 gram) with milk, which will carry an insignificant quantity, about 2.4 mg of DHA. Such DHA supplementation in solid powders is irrational. Link at <https://www.puroomega.com/wp-content/uploads/2016/06/Approved-Omega-Health-Claims.pdf> provides summary of requirements stipulated by European Food Safety

Authority on how much should be the daily intake of DHA through a supplement so as to qualify health claims approved for various purposes. According to that information: a claim of "DHA contributes to the maintainance of normal vision" and; a claim of "DHA contributes to maintenance of the normal brain function" can be made only with a daily intake of 250 mg DHA. A claim on "Docosahexaenoic acid (DHA) maternal intake contributes to the normal development of the eye of the foetus and breastfed infants." and "Docosahexaenoic acid (DHA) maternal intake contributes to the normal brain development of the foetus and breastfed infant" Can be made only wherein Information shall be given to pregnant and lactating women that the beneficial effect is obtained with a daily intake of 200 mg of DHA in addition to the recommended daily intake for omega-3 fatty acids for adults, i.e.: 250 mg DHA and eicosapentaenoic acid (EPA). The claim can be used only for food which provides a daily intake of at least 200 mg DHA. A claim on "Docosahexaenoic acid (DHA) intake contributes to the normal visual development of infants up to 12 months of age." can be made only wherein Information shall be given to the consumer that the beneficial effect is obtained with a daily intake of 100 mg of DHA. When the claim is used on follow-on formula, the food shall contain at least 0.3 % of the total fatty acids as DHA.

Making solid powder foods providing above quantities of DHA in taste/flavor masked form is further saddled with a requirement that this should be accomplished in as small quantity of the food as possible. This is a challenging task.

Hence, improved method for making solid compositions supplemented with Omega-3 oils and masked for unpleasant flavor/taste is needed that shall provide

rational/effective quantity of Omega-3 oil in one portion recommended for consumption.

SUMMARY OF THE INVENTION

This invention embodies a “solid edible ingredient matrix:Omega-3 Oil” composite
5 composition that is free from fishy taste/fishy flavor. In a further embodiment, the composite composition of this invention is coated with an ingredient to keep the composition free from fishy taste/fishy flavor during storage.

The composition is designed to keep period of freeness from fishy taste/fishy flavor in storage for at least 6 months.

10 In the “solid edible ingredient matrix:Omega-3 Oil” composite composition according to this invention has solid edible ingredient matrix that comprises a macromolecular composition that absorbs Omega-3 oil coming in its contact; and the ingredient for coating the “solid edible ingredient matrix-Omega-3 Oil” composite composition comprises an ingredient which masks the taste and flavor of the Omega-3 oil when
15 coated on the particles of “solid edible ingredient matrix:Omega-3 Oil” composition.

The said macromolecular composition comprises, without limitation, food proteins, food protein concentrates, food protein isolates, nutrient concentrates comprising proteins, protein rich food sources; and the ingredient for coating comprises, without limitation, Xanthan gum, starch gel, sodium alginate gel, Xylitol, beeswax, shellac,
20 Basic Methacrylate copolymer, maize starch-based polymer designed for taste and odor masking or any edible ingredient that forms a film or coating around the particles of the composite and prevents escape of fishy odor/flavor from the composite. Without limitation, the food proteins comprise casein; food protein concentrates comprise soy-protein concentrate, ground-nut protein concentrate, fish
25 protein concentrate and whey protein concentrate; food protein isolates comprise soy-protein isolate; nutrient concentrates comprise nutrient concentrate extracted

from Green Leafy Vegetation, leaf nutrient concentrate also called as leaf protein concentrate also called as leaf proteins; and protein rich food sources comprise pulses.

- 5 This invention also discloses a dietary supplement comprising a “solid edible ingredient matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor as one of the ingredients.

This invention is also embodied in a process for making “solid edible ingredient
10 matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor.

The process comprises steps of: (a) mixing a solid edible ingredient matrix with Omega-3 oil to get “solid edible ingredient matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor; or (b) Co-coagulating an edible ingredient matrix with Omega-3 oil from a fluid mixture and drying the resultant
15 coagulum to get “solid edible ingredient matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor; and (c) coating the dried composition resulting from steps a. or b. with an ingredient to keep the composition free from fishy taste/fishy flavor during storage. Without limitation, the edible ingredient matrix comprises casein and any other food proteins; soy-protein concentrate, ground-nut
20 protein concentrate, fish protein concentrate, whey protein concentrate and any other food protein concentrate; soy-protein isolate and any other food protein concentrate; proteins extracted from Green Leafy Vegetation, leaf nutrient concentrate also called as leaf protein concentrate or as Leaf Protein and any other nutrient concentrate made from green leafy vegetables; and powders of pulses or
25 any other protein rich food source. Without limitation, the ingredient for coating comprises Xanthan gum, starch gel, sodium alginate gel, Xylitol, beeswax, shellac,

Basic Methacrylate copolymer, maize starch-based polymer designed for taste and odor masking or any ingredient that forms a film or coating around the particles of the composite and prevents escape of fishy odor/flavor from the composite.

DETAILED DESCRIPTION OF THE INVENTION

5 It was observed very surprisingly that when Algal oil made from *Schizochytrium* that contains 40% Docosahexaenoic acid (DHA) was added to juice expressed from pulp of a green leafy vegetable of *Methi* (Latin name *Trigonella foenum-graecum* L., English vernacular name Fenugreek), mixed thoroughly in kitchen blender at high speed and the juice expressed from the same is coagulated at or above 80°C, the
10 oil got incorporated by co-coagulation with macromolecular nutrients such as proteins and fats in the juice to provide a green coagulum of nutrients. The green coagulum when made by heating the juice without oil addition, which is formed when green juice expressed from the pulp of a Green Leafy Vegetable is coagulated at or above 80°C, is variously termed as Leaf Nutrient Concentrate (LNC), Leaf
15 Protein Concentrate (LPC), Leaf Proteins (LP) by persons acquainted with Green Crop Fractionation process. Usually this composition (LPC) contains, as dry weight of the coagulum, 45-60% protein, about 10-15% fats, the fats contain fat soluble pigments of the leaves comprising chlorophyll, carotene and xanthophylls, about 6% ash in which 1% is contributed by acid insoluble ash. Exceptional variation in above
20 mentioned average composition may be possible for some exceptional plant species. When oil is added at any stage before coagulation of juice, the resulting product is "oil incorporated LPC" or "LPC:Omega-3 oil" composite composition or "LNC:Omega-3 oil" composite composition. The oil incorporated LPC as a moist cake or after drying was seen to have no or insignificant fishy smell/odor/flavor. It
25 was seen that incorporation of up to about 250 mg of Algal Oil per gram of the dry composition, the resulting coagulum/LNC was a dry powder. In the next composition

prepared to contain 500mg of Algal Oil for every 1 gram of LNC, the resulting dried powder was oily; and with higher proportion of Algal Oil, the resulting powder was too oily and difficult for handling. Hence, there would be a point in between the range of 250 mg to 500 mg per gram of LNC that would give dry powder of Algal Oil incorporated LNC with acceptable level of flow-ability. A flow-able composition is easily handle-able for use as an ingredient for making supplements and one gram of such ingredient incorporates therapeutically significant quantity of DHA containing oil. It satisfies the requirement of a fishy smell masked ingredient that is rich in DHA-containing Omega-3 Oil for direct consumption as source of DHA. It is also useful for use as an ingredient for developing a DHA enriched formulation for the persons who are in need thereof by adding to it other nutrients and excipients. The excipients include, without limitation, edible polymers, flavors and sweeteners including high intensity sweeteners. These "LPC:Omega-3 Oil" powders can also be modified for various applications in a variety of ways which also include granulation. Thus, the "LPC:Omega-3 Oil" powders provide a fishy flavor masked route for incorporating DHA in nutritionally and therapeutically relevant quantities in a convenient portion of the final formulation, or for direct consumption in a more acceptable way than constraining the consumer to tolerate the fishy smell.

In place of *Methi* any other Green Leafy Vegetable or any other non-vegetable green leafy vegetation can be used provided it is considered edible by human beings and toxic principle, if any, are washed out from the green coagulum by water wash followed by acid water wash at pH 4. The water wash or acid water wash is to be given by suspending the coagulum in the same volume of water as the volume of juice form which the coagulum has been obtained.

The Green Crop Fractionation process has been described by Pirie (1971) (Leaf Protein: its agronomy, preparation, quality and use, Ed. N.W. Pirie, Blackwell Scientific Publications, Oxford and Edinburgh, 1971) as a process comprising steps of making a pulp of green leafy vegetation, removing juice from the pulp to leave
5 behind a fibrous residue and coagulating the juice to get a green coagulum separate from brown juice that remains behind after collecting green coagulum. Alternatively, it is also possible to get, as a first step, a cream colored coagulum from the juice by controlled heating around 40-65°C and, as a second step, obtaining a green coagulum by heating the residual juice further to 80°C or more. Proteins from the
10 juice can also be isolated by alternative processes not discussed here. It is a common knowledge for a person skilled in the Green Crop Fractionation Process that there is a substantial generic similarity, within statistically permissible variation in a biological system, in physical properties and chemical composition between LNCs prepared from green leafy vegetation of all leafy plant species. Hence, what is
15 reported here for LNC/LPC/LP from the Green Leafy vegetable of Methi (Fenugreek) (*Trigonella foenum-graecum* L.) is possible to be extended to ALL leafy plant species that do not contain a toxic ingredient or if the toxic ingredients is washed away from the LNC by hot water washes and acid washes at pH 4. LNC obtained by process described by Pirie can be replaced by protein isolates or
20 protein concentrates obtained from Green Leafy Vegetation by a process that may be different from Pirie's process.

It was also further surprising observation that this result of incorporation of DHA-containing Algal Oil in LNC to result into a product that is practically free from fishy
25 smell and DHA-taste was possible by simply adding Algal Oil to dry powder of LNC

in proportions lesser than 500mg/g LNC. This process is much simpler than co-coagulating the Algal Oil with LNC while the juice is being treated for coagulation.

The LNC itself is a very high value nutritional concentrate, which is recommended
5 for carotenoids supplementation in children vulnerable to dietary deficiency of vitamin A and Xanthophyll that leads to Xerophthalmia and Kwashiorkor in malnourished children, and about 10 gram LNC per day is recommended for protein supplementation in protein malnourished children and patients. To pregnant and lactating women the "LNC: Omega-3 oil" composite ingredient is useful for
10 supplementation of proteins, vitamin A and folate. The children as well as pregnant and lactating women need DHA supplementation also. Hence, the product of this invention "LNC:Omega-3 oil" composite provides new routes of very effective supplementation for reducing the risk of several diseases and as nutritional supplements for overcoming deficiencies in the diet of Omega-3 fatty acids
15 simultaneously with proteins, vitamin A through beta Carotene which is pro-vitamin A which is a safer supplement to pregnant women who need to keep optimum level of vitamin A supplementation. Achieving optimum level of vitamin A level of Vitamin A level in the body is very important for pregnant women because a level below optimum will lead to less than optimum development of fetus, which, after birth,
20 cannot be fulfilled at any time during the further life of the new born. At the same time, to avoid less than optimum level, it is not considered possible to provide even a little excess dose, because even that much could prove to be toxic to the woman. This delicate balance is easily manageable through "LNC:Omega-3 oil" composite composition because LNC provides 100% bio-available beta carotene, the pro-
25 vitamin A, which gets converted to Vitamin A only until the optimum level of Vitamin A in the body is reached, after which the conversion automatically stops; and excess

beta carotene gets stored underneath the skin without any toxic effect until it is again required when Vitamin A levels drop below the optimum level. LNC also provides Xanthophylls for eye health, folate in pregnant women to reduce the risk of neural tube disease in the fetus, highly bio-available iron for pregnant women as well as adolescent girls and anemic patients. Finally, the composite also provided enough DHA for brain development and vision development of the developing infant.

Fishy smell can be avoided by encapsulation also. However, it adds to the cost, dilutes the content of DHA, for example, from 40% in the raw material Algal oil to 20% in the resulting encapsulated DHA-rich oil that involves addition of ingredients that provide microcapsule shells. Further, the masking may not be complete. By comparison, overcoming the fishy flavor by making a composite with LNC is a route that is technologically simpler to operate and control, has far less cost in it. Since the active agent that provides this masking is itself a useful nutritional concentrate, there is no cost spent on non-nutritive ingredients to make microcapsules. The DHA-rich Oil can be incorporated at the level that provides a level desired for the final formulation, hence there is no problem of dilution of DHA which shall put a limitation on the quantity of the other ingredients that can be added in a supplement.

The "LNC:Omega-3 Oil" composites of this invention get precipitated in granular form and when recovered as dry granules, they can be used as such or as an ingredient in a formulation for consumption. They do have dark green color and grassy flavor which is not a problem to those who like eating green leafy vegetables. However, for those who want even that to be un-perceptible, it is possible to spheronize them by technology widely known to a person skilled in the art of nutraceutical/pharmaceutical processing or made into spheres in fluidized bed or in

a pan by coating with favorable taste and flavor imparting ingredients or by coating with appropriate edible polymers that would dissolve in stomach in acidic pH or in the intestine in alkaline pH if bland taste is desired.

- 5 It was also surprising that encapsulated composition having 20% DHA which was having moderate fishy smell could be used to make a mouth-melt that was free from fishy smell when LNC was used as one of the components of the composition.

Algal Oil used here is just one example of Omega-3 Oils. All Omega-3 Oils,
10 including without limitation, Polyunsaturated fatty acid rich oils from other *Thraustochytriales*, *Dunaliella* and various other microorganism, flax-seed oil, fish oil etc. have the problem of fishy or disagreeable smell, all are nutritionally valuable and desirable; and the methods described in this specification are equally applicable to all of them.

15

It was further observed that co-coagulation of milk solids from low fat or fat-less milk with added DHA-rich algal oil did result in incorporation of the algal oil in the co-precipitate such that the coagulum/precipitate did not have fishy smell of the algal oil when for each 100ml low-fat cow milk about 300mg of algal oil was used. There is a
20 scope to work out highest quantity of algal oil which can be co-coagulated with milk solids yielding a product without fishy smell. The coagulum was white in color and could be dried and carried the DHA-rich oil as an ingredient for dry powdered food supplements.

It was also possible to get a mix of skim milk powder and algal oil with only marginal
25 fishy smell.

Thus, this invention comprises making a composite of Algal Oil with a solid edible ingredient matrix powder which masks the fishy odor of Algal oil in the resulting composite. Leaf Nutrient Concentrate, Whey Protein Concentrate, Soy Protein isolate, Skim Milk and coagulated cow milk are provided as illustrative examples of
5 edible ingredient matrix that provide the fishy flavor/odor masking effect. However, a person skilled in the art shall immediately recognize that the matrix could be any high molecular weight macromolecular edible ingredient and Oil could be any edible nutritionally valuable oil that has undesirable odor/flavor; wherein the macromolecule has a capability to provide space to bind the oil in such a way that
10 the fishy odor/flavor has no scope to escape from the composite.

In course of time after storing the products made from examples 3, 8 and 9, provided below, that provided successful flavor/odor masking when they were made, it was observed that the fishy flavor started appearing slowly in the products
15 after storage of about 30 days. This needed an improvement. This improvement was provided by adding a protective coat of one or more of a polymer to the composite. Preferably, the coat is provided to the composite of the "solid edible ingredient matrix:Omega-3 oil" composite composition and then other ingredients are added to complete the formulation of the product. The ingredient providing the
20 protective coat can be a starch gel, sodium alginate gel, Basic Methacrylate co-polymer available in market under trade-name Eudraguard®, maize starch-based polymer designed for taste and odor masking available in market under trade-name Eudraguard-Natural® or any ingredient that forms a film or coating around the particles of the composite and prevents escape of fishy odor/flavor from the
25 composite.

The protective coat could also be of any edible ingredient that can melt and provide a coat to the particles/aggregates of particles of the "solid edible ingredient matrix: Omega-3 Oil" composite composition. Two or three successive coats can also be envisaged to be given of the same ingredients or different ingredients in different combinations. Xylitol and Beeswax have been illustrated for the coating of melt-able edible ingredient. Very good sealing and flavor masking was observed by the illustrated embodiments where one or more of the following ingredients were used: Xylitol alone, Beeswax alone, Xylitol coat followed by Beeswax coat, coat of a mixture of Xylitol and Beeswax. A person skilled in the art shall readily visualize alternatives that can be used with same principle for Xylitol, Beeswax and their combinations; and all of them are considered to be incorporated within the scope of this disclosure.

The protective coat can also be of any edible material that is acceptable in pharmaceutical and/or food compositions. Shellac has been illustrated for this group of protective coats that are useable. In illustrative embodiment, Shellac was dissolved in Isopropyl alcohol to saturation and sprayed on the "matrix - DHA rich Algal Oil composite". A person skilled in the art shall readily visualize alternatives that can be used with same principle for Shellac and their combinations.

20

It was also seen that addition of Omega-3 oils such as DHA-rich Algal Oil to soy lecithin helped in better mixing of the oil with the solid edible ingredient matrix.

In this specification and examples, wherever a mention is made of "DHA-oil" or "DHA-rich Oil" or any mention conveying that meaning, it relates to any microbial oil that contains at least 35% DHA residues. Algal oil from *Schizochytrium limacinum* has been used in illustrative examples. However, DHA-rich oils from any other

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microbial source can be replaced to make the compositions of this invention. Compositions of this invention can also be made with all Omega-3 oils that do not have DHA residues but have less polyunsaturated Omega-3 residues which also have fishy flavor or disagreeable flavor. Flax-seed oil is an example of this type.

5 The compositions having low or no fishy smell but containing 300mg or more of 40% DHA rich algal oil per dosage are valuable ingredients for food supplements on account of the fact that for those who do not tolerate fishy smell, even a slight smell is enough for them to get off that composition. For the purpose of this specification, while stipulating 300mg or more of DHA-rich algal oil is presumed to have about
10 40% DHA in Algal Oil so that each dosage provides 125mg of DHA. If algal oil used has a different level of DHA, so much algal oil is construed to be required which shall provide 125 mg of DHA per dose. The examples are given below which are illustrative of working of this invention without limiting the scope of the claims to these examples. Persons skilled in the art shall immediately be able to visualize
15 various equivalent variations of practicing this invention without departing from the essential and inventive features of the invention; and all of such variations are considered incorporated as a part of and as embodiments covered within the scope of this invention. The gelling agent can be gellan gum, Xanthan gum, carragenan, locust bean gum and like.

20

EXAMPLE 1: Co-coagulation of Omega-3 Oils with Leaf Nutrient concentrate

Roots of about 1400 gram of Green Leafy Vegetable of *Methi* (Fenugreek) were cut off, the shoot portion with leaves was cut in small pieces by kitchen knife and was
25 pulped by adding some additional water in a kitchen blender. The resulting pulp was strained through a cotton cloth to get juice separate from the fibrous residue. The

juice was divided in to seven 100ml portions. Per drop weight of a 40% DHA containing Oil from *Schizochytrium* (Algal Oil) was determined; which was 0.0225 g per drop. Accordingly, in first portion of 100 ml, nothing was added, and in next six portions, 2 drops, 4 drops, seven drops, 10 drops, 20 drops and 40 drops were
5 added.

The first portion of the juice containing no oil added was added slowly to water boiling in a container; the art of addition of juice was controlled such that boiling of water continues or at least the temperature does not fall below 80° celcius. It is also
10 possible to maintain different temperature lower than 80° celcius; and this shall also be regarded as within the scope of the claims. However, 80° celcius or more is recommended for a good quality precipitate. The resulting coagulated mixture was filtered through a cotton cloth to get the coagulum separate from a brown juice that filters off through the cotton cloth.

15

To the rest of six portions to which oil has been added, each of them was thoroughly mixed for about two minutes on the kitchen blender at highest speed setting, the blended juice was added slowly to water boiling in a container at a rate which shall keep the water boiling to get coagulated juice. The coagulated juice was added to a
20 150 ml container to observe whether there is any oil floating at the top after standing. No oil layer was seen in any of the rest of the six portions, except for a few droplets in the last portion wherein the oil added was about 0.9g in 100 ml juice; which indicated that ALL oil that was added formed a composite with the LNC.

The dough of moist green coagulum recovered after straining through cotton cloth
25 from each of above seven portions of coagulated juice was spread in dishes and dried at room temperature under a fan.

It was seen that the juice with no oil added provided 900mg of dry powder of LNC. Based on this the Omega-3 oil in the “LNC:Omega-3 Oil” composite composition was calculated.

5

After drying, it was seen that from a composition comprising a ratio of “LNC:40% DHA-rich Algal Oil” ranging from the proportion [900 mg LNC:450 mg 40% DHA rich Algal Oil], which corresponds to [1g LNC:500mg 40% DHA rich Algal Oil], the dry powder was oily on its surface; and the dry powder corresponding to [900mg
10 LNC:0.225g 40% DHA rich Algal Oil], which corresponds to [1g LNC:250 mg 40% DHA rich Algal Oil] and below this level of 40% DHA rich Algal Oil, the composite composition was dry and non-oily. Thus, the optimum point for maximum allowable 40% DHA rich Algal Oil per gram of LNC lies somewhere in between the 250mg to 500 mg 40% DHA rich Algal Oil per 1 gram of dry LNC.

15

Example 2: Making composite of (LNC:40% DHA rich Algal Oil) from dry LNC

To LNC 50g was added 15 g oil 40% DHA rich Algal Oil. The resulting (LNC:40% DHA rich Algal Oil) composite was not oily and has no fishy flavor/smell/taste.

20 **Example 3:** Dietary supplement from (LNC:40% DHA-rich Algal Oil) composite.

In 25 g water taken in kitchen blender, was added 50 g glucose and 3 g carboxy Methyl Cellulose (CMC) and mixed well at highest speed for about two minutes. The blended mix was heated to boiling and the (LNC:40% DHA-rich Algal Oil) of Example 2 comprising LNC 50g and 15 g oil 40% DHA-rich Algal Oil was the added
25 to get a dough. To the dough was added 5 gram of wheat fiber, the dough was granulated by shredding, dried, ground and stored. The resulting powder was dry,

not oily and had no DHA smell or DHA taste and 1 gram of the dry powder contained about 120mg DHA.

Example 4: Use of LNC for masking fishy smell in a Mouth-melt composition

- 5 To 3.68 g DHA encapsulated 20% DHA having medium fishy smell was added 1.47g of Cinnamon extract, 1ml of Nutmeg oil and the mix was blended in a kitchen blender for about 2 minutes at highest speed setting. To the blend was added 29.41 g Xylitol and 11.76 g glucose and the mix was blended further in kitchen blender. The resulting blend had prominent DHA taste and fishy flavor/odor/taste.

10

- To dry powder of 3.68g LNC was added 3.68 g DHA encapsulated 20% DHA having medium fishy smell, 1.47g of Cinnamon extract, 1ml of Nutmeg oil and the mix was blended in a kitchen blender at highest speed setting. To the blend was added 29.41 g Xylitol and 11.76g g glucose 11.76 g and the mix was blended further in
15 kitchen blender. The resulting blend had no DHA taste and no fishy flavor/odor/taste.

Example 5:

To 150 ml juice was added 1.5g moderately fishy smelling encapsulated Algal Oil containing 20% DHA. Juice was coagulated as described in Example 1. Coagulum dried. The coagulum was free from fishy taste/smell.

5

Example 6:

Cow milk was boiled, cooled in refrigerator and the fat that came on surface was removed. To 100ml of this low-fat milk, 300mg algal oil with 40% DHA was added, the mix was emulsified in kitchen blender for two minutes, 20 gram table salt (sodium chloride) was added and the mix was heated to boiling. This resulted in coagulation of milk solids. The supernatant did not contain any oil droplets. Thus, algal oil was co-coagulated with the coagulum. The coagulum was filtered through cloth. The coagulum was recovered, 200ml of water containing 20% table salt was added and the mixture heated to boiling and then again filtered through cloth. The resulting coagulum was spread on polythene cloth as a thin film, which was dried under a fan at a room temperature of about 20°C. The dried film was further dried to friable state by giving brief exposure to the microwave heating and was powdered in mortar and pastel. The product was white in color and had no fishy smell.

10

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Example 7:

To 10 gram Skim milk powder was added algal oil containing 40% DHA and mixed well. The resulting mix was while and had only marginal fishy smell.

20

Example 8:

Dietary supplement from (Whey Protein Concentrate:40% DHA rich Algal Oil) composite.

25

A Whey Protein Concentrate:40% DHA rich Algal Oil composite was prepared as described in the following:

To 50g Whey Protein Concentrate 15g of 40% DHA rich Algal oil was added accompanied with grinding. To the mixture, 5g Xanthan gum powder was added. To this mixture was added 15g cocoa powder, 15g Xylitol and was stored. The resulting powder was dry, not oily and had no DHA smell or DHA taste. This product melted very smoothly in mouth and gave cool feeling.

Example 9:

Dietary supplement from "Soy Protein Isolate: DHA-rich Algal Oil composite".

A "Soy Protein Isolate:40% DHA-rich Algal Oil composite" was prepared as described in Example 8 by taking soy protein isolate instead of Whey Protein Concentrate.

To 50g Soy Protein Concentrate 15g of DHA rich Algal oil was added accompanied with grinding. To the mixture, 5g Xanthan gum powder was added. To this mixture was added 15g cocoa powder, 15g Xylitol and was stored. The resulting powder was dry, not oily and had no DHA smell or DHA taste. This product melted very smoothly in mouth and gave cool feeling

Example 10:

Preparation of starch gel coated "solid edible ingredient matrix:Omega-3 Oil" composite composition

Process of making the products in Examples 3, 8 and 9 was modified by adding the "LNC: DHA-rich Algal oil" composite composition, "Whey Protein Concentrate: DHA Algal Oil" composite composition or "Soy Isolate: DHA-rich Algal oil" composite

composition to a gel prepared from starch in water; and the resulting product was dried, preferably air dried thereafter.

The steps followed for making starch gel coated composite are as follows:

Step 1: 11.2 g DHA oil is mixed with 2g of soy lecithin and 2 g of Nutmeg oleoresin.

5 Nutmeg oleoresin was added for imparting agreeable natural flavor. Preparations were also made by using Ginger oleoresin to replace Nutmeg oleoresin. The flavor component can be any that is used for food preparations. In some embodiments curcumin also could be added as natural color.

Step 2: 38 g of edible ingredient matrix (LNC/Whey Protein Concentrate/ Soy
10 Protein Isolate in this example) was weighed. Oil of step 1 was mixed with the edible ingredient matrix. To this mixture was added 5 g of Xanthan gum.

Step 3: 6 g of starch is mixed with 24 ml water and was heated to boiling to form a gel. This proportion can be varied to vary the extent of coating.

Step 4: Mixture of step 2 was gradually mixed in gel so that the gel was evenly
15 spread/mixed/coated on particles of the composite. The mixture was passed through the domestic mixer to provide uniform mix of small granules/powder.

The granules/powder was dried at room temperature at about 25 degrees celcius under breeze of air.

38g of Maltodextrin was added to mixture of step 4. The mixture was mixed
20 thoroughly in a ribbon blender.

Food colour and flavor can be added at this step. It is possible to use different proportions of "starch gel: the matrix:" composite to arrive at optimum coating for

long enough storage stability, preferably up to two years, with respect to absence of fishy flavor / fishy flavor masking.

The starch gel coated “solid edible ingredient matrix:Omega-3 Oil” composite composition has remained free from fishy flavor for more than 6 months in the
5 storage.

Example 11:

Preparation of “sodium alginate gel coated matrix: Oil composite”

The process of making the products in Examples 3, 8 and 9 was modified by adding a sodium alginate coat to the “LNC:DHA-rich Algal oil composite”, “Whey Protein
10 Concentrate: DHA rich Algal Oil composite” and “Soy Protein Isolate: DHA-rich Algal oil composite”; and the resulting product was dried, preferably air dried thereafter.

The steps followed for making “sodium alginate gel coated composite” are as follows:

Step 1: 11.2 g DHA oil is mixed with 2g of soy lecithin and 2 g of Nutmeg oleoresin
15 for imparting agreeable natural flavor.

Step 2: 38 g of matrix (LNC/Whey Protein Concentrate or Soy Protein Isolate in this example) was weighed. Oil of step 1 was mixed with the matrix. To this mixture was added 5 g of Xanthan gum.

Step 3: 10g of 4% sodium Alginate slurry made in water was slowly mixed with the
20 resulting matrix of step 1. There after, 4% calcium chloride solution was sprayed on the sodium alginate coated composite.

Step 4: 38 g maltodextrin was added to mixture of step 3 and mixed well. In some embodiments, maltodextrin was added after air drying.

The granules/powder was dried at room temperature at about 25 degrees celcius under breeze of air.

Food colour and flavor can be added at this step. It is possible to use different proportions of “sodium alginate gel: the matrix composite” to arrive at optimum
5 proportion for long enough storage stability, preferably up to two years, with respect to absence of fishy flavor / fishy flavor masking.

The “sodium alginate gel coated matrix: Oil composite” has remained free from fishy flavor for more than 6 months in the storage.

Example 12:

10 Sealing by Xylitol

Xylitol 6.25g was molten by heating in a pan and 25g of “LNC:DHA-rich Algal oil” composite prepared as described in Example 2 was added to the pan and mixed well. The resulting mixture was passed while hot through sieve #40 mesh and allowed to cool. This provided fishy flavor masking without flavor also.

15 Addition of nutmeg oleoresin 0.5g to the above mix resulted in further improvement in palatability when dispersed in milk.

The Xylitol coated “LNC:DHA-rich Algal oil” composite remained free from fishy flavor for more than 6 months in storage.

Example 13:

20 Sealing by Xylitol and Beeswax

Xylitol 6.25g was molten by heating in a pan and 25g of “LNC:DHA-rich Algal oil composite” prepared as described in Example 2 was added to the pan and mixed well. The resulting mixture was passed while hot through sieve #40 mesh and allowed to cool. This provided fishy flavor masking without flavor also. This was

25 followed by melting of 1 g Beeswax to which the cooled mixture coated with Xylitol is

added, mixed well and again passed through sieve of #60 mesh size and allowed to cool.

Addition of nutmeg oleoresin 0.5g to the above mix resulted in further improvement in palatability when dispersed in milk.

- 5 The Xylitol and beeswax coated "LNC:DHA-rich Algal oil" composite remained free from fishy flavor for more than 6 months in storage.

Example 15:

Sealing by Shellac

- Saturated solution of Shellac was prepared in Isopropyl alcohol. A 25g of "LNC:DHA-rich Algal oil" composite was heated in a pan over a boiling water bath. The saturated solution of Shellac was sprayed by hand held sprayer on the heated "LNC:DHA-rich Algal oil" composite composition accompanied by stirring so that Isopropyl alcohol evaporated resulting in the composite covered by coating of Shellac.

- 15 This provided fishy flavor masking without flavor also.

This was followed by melting of 1 g Beeswax to which the cooled mixture coated with Xylitol is added, mixed well and again passed through sieve of #60 mesh size and allowed to cool.

- 20 Addition of nutmeg oleoresin 0.5g to the above mix resulted in further improvement in palatability when dispersed in milk.

The shellac and beeswax coated "LNC:DHA-rich Algal oil" composite remained free from fishy flavor for more than 6 months in storage.

- 25 Example 16:

Preparation for kid:

212 g of Algal oil from *Schizochytrium* containing 40% DHA is mixed well with 45.32g of soy lecithin, 30.21g of Vit. E and 15.11g of nutmeg oleoresin to give mixture 1. The mixture 1 is mixed well with 1359g of soy isolate (80% protein) to give mixture 2. 20g of Basic Methacrylate Copolymer [Poly[(dimethylaminoethyl methacrylate)- co -(methyl methacrylate)-co-(butyl methacrylate)]

(available under trade-name Eudraguard® made by Evonik Nutrition and Care GMBH, Kirschenalli, 64293 Darmstadt, Germany) is mixed well with 200 ml of water in a blender and the suspension is sprayed on the mixture 2 and is allowed to dry at room temperature until moisture level is 5%. Mixture was prepared of 3.208g of sugar, 69.49g of cacao powder and 30g of nutmeg oleoresin to provide mixture 3. All the mixture is blended well. The preparation forms good delicious suspension in milk which and doesn't have fishy taste or fishy smell of the algal oil.

Example 17:

Preparation for Pregnant and lactating mothers:

212 g of DHA oil is mixed well with 45.32g of soy lecithin, 30.21g of Vit. E and 15.11g of Ginger oleoresin to give mixture 1. The mixture 1 is mixed well with 1359g of Leaf Protein Concentrate to give mixture 2. 20g Basic Methacrylate Copolymer [Poly[(dimethylaminoethyl methacrylate)- co -(methyl methacrylate)-co-(butyl methacrylate)] is mixed well with 200 ml of water in a blender and the suspension is sprayed on the mixture 2 and is allowed to dry at room temperature until moisture level is about 5% to give "mixture 3". 278g of maltodextrin powder and 30g of mango flavor is added to mixture 3. All the mixture is blended well. The preparation forms good suspension in milk and doesn't taste or smell of fishy oil.

Example 18:

DHA oil-Protein coating:

2.5g of Basic Methacrylate Copolymer [Poly[(dimethylaminoethyl methacrylate)- co -(methyl methacrylate)-co-(butyl methacrylate)] (Eudragrad®) is suspended in 25 ml of water, to which is added 50g of mixture 1 of example 16. The dough is prepared and wet granulated. The granules are dried at room temperature
5 to a moisture of about 5-10%. The granules are further ground to make finer granules. These granules do not taste of fishy oil and there is no fishy flavor. This can be used as a DHA rich ingredient in different formulations for kids as well as elders as source of DHA.

Claims :

1. A “solid edible ingredient matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor.
2. The “solid edible ingredient matrix:Omega-3 Oil” composite composition according to claim 1 coated with an ingredient to keep the composition free from fishy taste/fishy flavor during storage.
3. The “solid edible ingredient matrix:Omega-3 Oil” composite composition according to claim 2 wherein the period of freeness from fishy taste/fishy flavor in storage is at least 6 months.
4. The “solid edible ingredient matrix:Omega-3 Oil” composite composition according to claim 2 wherein:
 - (a) the solid edible ingredient matrix comprises a macromolecular composition that absorbs Omega-3 oil coming in its contact,
 - (b) the ingredient for coating the “solid edible ingredient matrix:Omega-3 Oil” composite composition comprises an edible ingredient which masks the taste and flavor of the Omega-3 oil when coated on the particles of “solid edible ingredient matrix:Omega-3 Oil” composition.
5. The “solid edible ingredient matrix:Omega-3 Oil” composite composition according to claim 4 wherein:
 - (a) the macromolecular composition comprises food proteins, food protein concentrates, food protein isolates, nutrient concentrates comprising proteins, protein rich food sources,
 - (b) the ingredient for coating the “solid food ingredient matrix:Omega-3 Oil” composite composition which masks the taste and flavor of the Omega-3 oil when coated on the particles of “solid food ingredient matrix:Omega-3 Oil” composition comprises Xanthan gum, starch

gel, sodium alginate gel, Xylitol, beeswax, shellac, Basic Methacrylate copolymer, maize starch-based polymer designed for taste and odor masking or any ingredient that forms a film or coating around the particles of the composite and prevents escape of fishy odor/flavor from the composite. .

- 5
6. The “solid edible ingredient matrix:Omega-3 Oil” composite composition according to claim 5 wherein:
- (a) food proteins comprise casein,
 - (b) food protein concentrates comprise soy-protein concentrate, ground-
10 nut protein concentrate, fish protein concentrate, whey protein concentrate,
 - (c) food protein isolates comprise soy-protein isolate, whey protein isolate,
 - (d) nutrient concentrates comprises nutrient concentrate extracted from
15 Green Leafy Vegetation, leaf nutrient concentrate also called as leaf protein concentrate also called as leaf proteins, and
 - (e) protein rich food sources comprise pulses.
7. A dietary supplement comprising a “solid edible ingredient matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor as one of
20 the ingredients.
8. A process for making “solid edible ingredient matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor.
9. The process according to claim 8 which comprises steps of:
- (a) mixing a solid edible ingredient matrix with Omega-3 oil to get “solid
25 edible ingredient matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor; or

(b) Co-coagulating an edible ingredient matrix with Omega-3 oil from a fluid mixture and drying the resultant coagulum to get “solid edible ingredient matrix:Omega-3 Oil” composite composition that is free from fishy taste/fishy flavor,

5 and

(c) coating the dried composition resulting from steps a. or b. with an ingredient to keep the composition free from fishy taste/fishy flavor during storage.

10. The process according to claim 9 wherein:

10 (a) edible ingredient matrix comprises casein and any other food proteins; soy-protein concentrate, ground-nut protein concentrate, fish protein concentrate, whey protein concentrate and any other food protein concentrate; soy-protein isolate and any other food protein concentrate; proteins extracted from Green Leafy Vegetation, leaf
15 nutrient concentrate also called as leaf protein concentrate or as Leaf Protein and any other nutrient concentrate made from green leafy vegetables; powders of pulses or any other protein rich food source.,

(b) the ingredient for coating comprises Xanthan gum, starch gel, sodium alginate gel, Xylitol, beeswax, shellac, Basic Methacrylate copolymer,
20 maize starch-based polymer designed for taste and odor masking or any ingredient that forms a film or coating around the particles of the composite and prevents escape of fishy odor/flavor from the composite

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A23L

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

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

Databases: TotalPatent One, IPO Internal Database

Keywords :Omega-3 fatty acid, protein isolates, protein concentrate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US20040017017A1 (GENERAL MILLS INC) [29-Jan-2004] *Refer Whole document*	1-10
X	US20100310728A1 (GENERAL MILLS HOLDINGS II LLC & GENERAL MILLS INC) [09-Dec-2010] *Refer Whole document*	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"E" earlier application or patent but published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

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Information on patent family members

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Citation	Pub.Date	Family	Pub.Date
US 20040017017 A1	29-01-2004	EP 1526782 B1	28-10-2009
		CA 2493519 A1	29-01-2004
		DE 60329847 D1	10-12-2009
		DK 1526782 T3	01-03-2010
		ES 2334993 T3	18-03-2010
		WO 2004009054 A3	06-05-2004
US 20100310728 A1	09-12-2010	EP 2437616 A1	11-04-2012
		CN 102458138 B	20-08-2014
		CA 2762824 A1	09-12-2010
		WO 2010141821 A1	09-12-2010