Abstract: A food composition comprises at least one of protein and carbohydrate. The composition further comprises 0.3-35 wt.% of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol. It may be used for promoting satiety and/or other health benefits.
FOOD PRODUCTS. INGREDIENTS THEREFOR AND USE OF THOSE FOOD PRODUCTS AND INGREDIENTS

Field of the Invention

The present invention relates to ingredients for incorporation into food products with the aim of promoting satiety, e.g. for the purposes of weight control or weight management, and/or for the treatment of gastro-intestinal disorders related to lipase activity disturbances. The treatment of elevated blood cholesterol concentration is another use. These ingredients also have a number of other potential benefits which will be described in more detail hereinbelow.

Background of the Invention

Gastrointestinal lipid digestion consists of several sequential steps which include physico-chemical and enzymatic events [1]. In humans, the digestion of dietary triacylglycerols begins in the stomach, with the action of gastric lipase at the lipid-water interface [2] and continues in the duodenum with synergistic action of gastric and colipase-dependent pancreatic lipases [1]. The lipolysis products generated and accumulated at the fat globule surface, are transferred into structures formed of phospholipids and bile salts, forming multi- or uni-lamellar vesicles and mixed micelles in the aqueous phase [3]. These are then absorbed by the enterocytes, mainly in the duodenum and jejunum.

Digestion and absorption of a meal can take several hours, depending on the nutrient composition of the meal. Since digestion and absorption are time-demanding events, movement of a meal through the digestive tract must progress in a time-controlled manner to ensure an adequate period for assimilation. Motility of the small intestine determines the amount of time that the contents of a meal are in contact with the digestive enzymes and the absorptive mucosal layer of the small intestine. Gastrointestinal motility is
normally controlled by transit control mechanisms, located in the digestive tract, which act to ensure adequate digestion and absorption of the meal. In a normal healthy bowel, this takes place in the proximal and distal small intestine. These mechanisms are referred to as the "jujenal brake" (for the proximal intestine) and "ileal brake" (for the distal intestine), respectively. The ileal brake is the most potent feedback mechanism with respect to lipids.

The ileal brake is a neurohormonal feedback mechanism, which delays gastric and intestinal transit time, thereby enhancing nutrient digestion and absorption in the proximal small intestine, preventing nutrient overflow into the distal gut and promoting satiety. The ileal brake is mainly triggered by the presence of unabsorbed fat in the ileum. It follows that if at least part of the fat content of a food product could be incorporated in such a way that it survives unabsorbed, to arrive in the ileum, then it would trigger the ileal brake and the resulting feeling of satiety would therefore act as an appetite control.

We have now found that formulating fat components of food product in a new way, can achieve this aim. Further, such products can be of advantage in individuals having disturbed lipase activity. If too little lipase is present in the digestive tract, this can result in adverse conditions resulting from malabsorption. If release of the fat is controlled to take place over a longer period, it allows more time for sufficient lipase to be produced to digest it properly.

The present invention relies on incorporation of at least some of the fat content of a food, in organogel form. An "organogel" as used in the context of any aspect of the present invention, comprises an edible oil, a free phytosterol and a phenolic acid ester of a phytosterol. It is known to use such organogels as a means of using liquid oil components to texturise fat based spreads, in place of solid fat hardstock, as disclosed in EP-A-O 918 465.

Thus, a first aspect of the present invention provides a food composition comprising at least one of protein and carbohydrate, the composition further
comprising 0.3-35 wt.% of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol.

A second aspect of the present invention provides a product comprising particles, granules or flakes of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol.

A third aspect of the present invention provides use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for weight control in a mammal.

A fourth aspect of the present invention provides use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for improving or maintaining gut health in a mammal.

A fifth aspect of the present invention provides use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for reducing or controlling serum cholesterol concentration in a mammal.

**Detailed Description of the Invention**

**The Organogel**

The organogel must comprise an edible oil, a phytosterol and a phenolic acid ester of a phytosterol.

The term "organogel" has been defined in the prior art as a gel with an organic liquid, not water, as the dispersion means. In the organogel of the present
invention, the edible oil, together with dissolved phytosterol and phenolic acid ester of phytosterol, represents the organic liquid and the non-dissolved aggregates of phytosterol and/or phenolic acid ester of phytosterol represent the gel structure. A detailed description of organogels and their properties can be found in an article by Terech and Weiss: Chem. Rev., 97 (8), 3133-3160, 1997. "Low Molecular Mass Gelators of Organic Liquids and the Properties of Their Gels".

For the avoidance of doubt, as used herein, the term "phytosterol" refers to a phytosterol or a phytostanol, or a mixture thereof. It includes therefore, a phytosterol or mixture of phytosterols, a phytostanol or mixture of phytostanols or a mixture of one or more phytosterols with one or more phytostanols. The phenolic acid ester of a phytosterol may likewise comprise one or more phytosterols and/or one or more phytostanols, in the appropriate esterified form. Such esters may comprise esters of a single phenolic acid or of one or more phenolic acid esters, i.e. a mixture. The term phenolic acids relates to the family of cinnamic acids, of which caffeic acid and ferulic acid are examples.

Preferably, all liquid fat present in the composition of this invention is formed into the organogel. In a particular embodiment the organogel comprises at least 75% of the total liquid fat of the composition.

Preferably, the weight ratio of the phytosterol and the phytosterol phenolic acid ester in the organogel is from 3:1 to 1:3.

Preferably, the total amount of phytosterol ester plus phytosterol phenolic acid ester in the organogel is from 1% to 50%, preferably from 5% to 25% by weight of the organogel.

Preferably, the total amount of edible oil in the organogel is from 50% to 99%, more preferably from 75% to 95% by weight of the organogel.
Preferably, the composition comprises from 0.3% to 35%, more preferably from 0.5% to 20% by weight of the organogel.

Examples of suitable combination of sterols and sterol esters selected from the group of phytosterols are oryzanol and sitosterol (often denoted by β-sitosterol). Also cholesterol is found to be a suitable component that can provide structure to a liquid fatty component when applied at specific levels in combination with other phytosterols.

An additional advantage of the present invention is found in that most of the sterols applicable for providing structure according to the present invention are components obtainable from natural sources. In a preferred embodiment of the invention, the sterols and/or sterol esters applied are components which can also be found in nature. For example, oryzanol and sitosterol are present as minor components in many plants. In quite some cases, these are even present in the plants from which triacylglycerides are obtained.

In particular, sterols and sterol esters found to be highly suitable for providing hardness to the liquid are selected from the group of phytosterols. In this invention the term phytosterol is used to cover the whole group of free phytosterols, phytosterol fatty acid esters and (acylated) phytosterol glucosides.

There are three major phytosterols, namely beta-sitosterol, stigmasterol and campesterol. Schematic drawings of the components meant are as given in "Influence of Processing on Sterols of Edible Vegetable Oils", S.P. Kochhar; Prog. Lipid Res. 22: pp 161-188.

Sitosterol can, for example, be obtained from wood and from refining vegetable oil, and normally comprises also a minor amount of other sterols, like campesterol, stigmasterol, various avenasterols etc. For the present invention, it is not needed that the sterols and/or sterol esters used are highly pure; some
impurities can be present, it is considered not to be of concern in particular, when the polarity is relatively low.

Preferably, the phytosterol comprises 4,4-desmethylsterols, preferably as either/or beta-sitosterol, campesterol, stigmasterol or their fully saturated equivalents, being stanols, and the ferulic acid ester of a plant sterol is oryzanol.

Oryzanol consist of a mixture of ferulic acid esters of unsaturated triterpene alcohols and is also referred to as gamma-oryzanol. In this invention only the term oryzanol is used. For a further description and schematic drawing of oryzanol, reference is made to "Separation of Vitamin E and gamma-Oryzanols from Rice Bran by Normal-Phase Chromatography", M. Diack and M. Saska, JAOCS Vol. 71, no. 11, pp. 1211. Oryzanol can, for example, be obtained from ricebran, and comprises ferulic acid esters of several phytosterols.

Cholesterol is, for obvious health reasons, less desired when the use of in food products is envisaged. For any other of the applications, however, it may be very well applicable.

A highly suitable combination, is particular for food products, is in the use of both oryzanol and sitosterol.

One preferred group of liquid oils to be incorporated in compositions according to the present invention comprises the vegetable triacylglycerides, which are often used in consumer products include those obtained from seeds, beans, fruits and nuts, or parts of these plant materials such as their germs, and are often obtained by mechanical expelling and/or solvent extraction. Examples of liquid triacylglycerides which are in particular suitable for use in the present invention are sunflower oil, coconut oil, rapeseed oil, flax or linseed oil, soybean oil, maizegerm or corn oil, wheatgerm oil, ricebran oil, palm oil, olive oil peanut oil, and the like.
Also, oils of animal origin can be used in the present invention, and include those obtained from processing fish, for example, fish oil obtained from processing crustaceans, e.g. krill oil, or oils from the meat industry such as lard or tallow.

Other liquid oils that can be applied in the present invention comprise or consist of sucrose polyfatty acid polyesters, sometimes known as "sucrose polyesters".

Within the scope of the present invention is a composition according to any aspect in which the "liquid oil" used is an oil which is not actually liquid at room temperature. The term liquid oil means an oil which is liquid at the temperature incorporated. For example, oils can be applied at temperatures higher than room temperature whereby it is still desired that the fat at its application temperature is not liquid. As is well known, most solid fats melt when heated effectively to become liquid oils. Preferably, temperature of incorporation of the organogel into the food composition is less than 80°C, because of the tendency for organogel to become less stable at higher temperatures.

A non-limiting description of suitable food products in which the present invention may be imported comprises drinks, including dry mixes to prepare drinks, juices, sports drinks, bars, fat based food products such as spreads, margarines, dressings, mayonnaises, creamers, ice creams, sauces, soups, yoghurts, desserts, toppings, condiments, and bakery, pastry, biscuits and cereal products.

Some typical specific applications of organogel food products to enhance satiety feelings:

- bar/biscuit; a bar shape product with an outer layer of an organogel containing coating and/or a filling based on organogel. The outer layer is composed predominantly from hardened palmkernel oil, sugar, instant milk powder, cacao powder and lecithin. The filling is a semi-soft solid material made from edible fats and organogel.
ready-to-drink formulation is a drink made from milk-powder, edible oils and organogel. The drink may be fortified with vitamins and minerals and formulated in such a way that they will fulfil an optimal nutritional profile. It may be used as a meal replacer.

In general, any food product according to the present invention may include one or more additional components selected from carbohydrates, for example starches or sugars such as glucose, fructose, maltose, sucrose, as well as proteins, for example soy or casein protein, fats and oils, for example edible fats and oils, in particular unsaturated oils such as marine or plant seed oils, vitamins, including fat-soluble vitamins, provitamins, e.g. tocopherols, B-vitamins, carotenoids, fat-soluble anti-oxidants such as tocotrienols and emulsifiers, for example lecithin, phospholipids or lysophospholipids.

According to a particularly preferred embodiment, the present composition is an aqueous emulsion comprising particles of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol, the particles having a volume weighted average particle diameter of from 0.1 µm to 10 µm, preferably from 0.5µm to 10µm.

According to another preferred embodiment, the present composition is an aqueous emulsion comprising particles of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol, the particles having a volume weighted average particle diameter of from 10 µm to 50 µm, preferably from 20µm to 50µm.

As used herein, the term "volume weighted average particle diameter" is determined and calculated by M. Alderliesten, "Mean Particle Diameters. Part i: Evaluation of Definition Systems", Particle and Particle Systems Characterisation 7, 233 - 241 (1990).
Powdered products

Another aspect of the present invention provides a product, preferably a powdered product, comprising particles, granules or flakes of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol.

Medical uses

A further aspect of the present invention relates to the use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for promoting satiety, weight control and/or weight maintenance in a mammal. In other words, this aspect of the invention relates to the use of the organogel in the treatment or prevention of obesity or overweight.

Yet another aspect of the present invention relates the use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for improving or maintaining gut health in a mammal.

Finally, the present invention also provides the use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for reducing or controlling serum cholesterol concentration in a mammal. The control of serum cholesterol concentration is of particular relevance in the treatment or prevention of cardiovascular diseases. The present invention will now be explained in more detail, by way of the following examples, and with reference to the accompanying drawings, which are summarised as follows:
Brief Description of Drawings

Figure 1 shows a diagram to illustrate the preparation of an organogel;

Figure 2 shows a plot of lipolysis rate of several organogel containing emulsions in comparison with a reference lipolysis curve; and

Figure 3 shows the effect of sterol organogel, alcohohacid organogel and beeswax on the rate of lipolysis of olive oil.

Example 1: Materials & Methods

(a) Preparation of organogels

Plant sterol edible oils (organogels) were prepared by dissolving a 1:1 molar ratio mix of sitosterol (or crude sterols of the desmethyl sterol type) with oryzanol in heated oil (90 °C). Gel strengths were controlled by the total %-weight (4%, 8%, 16% and 25%) of all sterols in the oils. Gel formation was optimised in separate experiments where it was found that at least 60 minutes was needed to create optimal gel formation. The oils were maintained at 90 °C during this stirring process. After complete dissolution, the oil was left to cool to room temperature, to form a gel and subsequently stored at 4 °C, as indicated in Figure 1.

(b) Preparation of the emulsions containing organogels

A 10% fat emulsion was made using an Ultra Turrax. This method was chosen for the high shear performance and choice of bandwidths and can produce different fat particle sizes, however other equipment can be used to create similar particle sizes. Purified water and xanthan gum (0.15%) were mixed at high speed creating a slightly viscous solution. Triton X-100 (1%) was then
added. Finally the edible oil was added and mixed at high speed. All emulsions were prepared with a droplet size of about 2µm. Xanthan gum was chosen as a stabilising agent and does not affect reaction speed. Triton X-100 was added due to its ability to act as an emulsifying agent.

(c). Measurement of particle size
The particle size was measured with the use of Helium-Neon Laser Optical Spectrometry (HELOS).

The HELOS measures particle-size with the use of laser diffraction method. This type of measurement can only be used on suspenndable solutions with ball shaped particles. Typical diameters of the organogel droplets in the emulsion systems where in the range of about 2 micrometers.
(d). Lipolysis measurements

A 'Simulated Gastrointestinal Model' based on the gastric and duodenal conditions described in the USP 27/NF 22, monograph <721> "Dissolution" was used to study lipolysis rate. The gastric digestion conditions were simulated with a 10ml sample volume (1.5 % organogel or reference emulsion).

The pH electrodes were calibrated using pH 4.00 and pH 7.00 buffers. The electrode was classed acceptable if the electrode slope was within -55mV/pH and -59mV/pH. Saline solution (20ml containing 150mM sodium chloride and 5mM potassium chloride) was placed in the pH-chemostat vessel (held at 38 °C). After 5 minutes stirring, 12.5 mg of gastric lipase and 12.5 mg of pepsin (dissolved in 2.5 ml of 0.25mol/L HCL) were added to the diluted sample solution to start the gastric digestion. The system was left for 1 hour (pH 1-2) to stimulate the gastric phase. The pH was tested every 15 minutes.

After the gastric phase, the pre-titration was started. The end-point pH was set to pH 7.5 where neutralisation occurred. At this point, the intestinal phase was started through the immediate addition of a bile salts solution (250 mg bile salts into 4.5mL solution of 0.005mol/L Tris, 0.02mol/L CaCl2.H2O, 0.04mol/L NaCl, pH 7.0 - stirred in a water bath (37 °C) for 20-30 minutes). Subsequently, pancreatin (30mg) was added to bile salt solution and pH was controlled by the addition of 0.1 mol/L NaOH over the period of hydrolysis. This process was simulated over a period of 60 to 90 minutes to simulate the length of time for food to reach the ileum.

The pH-stat measurement is based on the principle that hydrolysis of TAG results in the formation of 2FFA and 1 MAG and that the formation of FFA decreases the pH. By measuring the amount of sodium hydroxide needed to keep the pH constant at the end-point pH of 7.5, the extent of hydrolysis can be calculated.
The 100% value for lipase based hydrolysis is calculated from the total amount of FAs released from the sn-1 and sn-3 positions of the TAG, taking into account the sample amount in the pH-stat vessel and also corrected for the amount of organogel replacing part of the TAG in the emulsion.

(e). Results
The effect on the lipolysis rate of organogels formed in different edible oils based on the above described methods are listed in Table 1. There is a considerable decrease for the amount of fatty acids released from the oil with organogels after 30 minutes of lipolysis time. Especially, this effect is noticeable for the organogels strengths of 8% or higher.

Figure 2. shows a plot of the reduced rate of lipolysis, observable from the less steep curves, of several organogel containing emulsions and a reference lipolysis curve. The reference curve is that of an ideal emulsion being a very fine soy-bean oil emulsion, not containing any organogel or other lipolysis inhibitory compounds. Lipolysis is complete within about 10 minutes. The rate of lipolysis is expressed as percentage of the theoretical amount \[ \frac{FA(t)}{FA(0)} \times 100 \] versus time.

Figure 3 shows the effect of 16% sterol organogel, 16% alcohohacid organogel and 16% beeswax on the rate of lipolysis of olive oil. This figure illustrates that the effect of organogel on the rate of lipolysis is specific for the sterol-based organogels.
Example 2 - Ready-to-drink formulation

A meal replacement ready-to-drink liquid may be prepared according to the formulation below.

Table 1

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>80.5</td>
</tr>
<tr>
<td>Sucrose</td>
<td>2.0</td>
</tr>
<tr>
<td>Organogel *</td>
<td>2.0</td>
</tr>
<tr>
<td>Skimmed milk solids</td>
<td>2.0</td>
</tr>
<tr>
<td>High fructose corn syrup</td>
<td>8.0</td>
</tr>
<tr>
<td>Carrageenan gum</td>
<td>1.0</td>
</tr>
<tr>
<td>Caramel flavouring</td>
<td>1.5</td>
</tr>
<tr>
<td>Colourings, other flavourings</td>
<td>1.0</td>
</tr>
<tr>
<td>Vitamin / mineral premix</td>
<td>2.0</td>
</tr>
</tbody>
</table>

* Organogel is defined as the mixture of the sterols in the edible oil.

The ingredients are added to the water and the composition mixed until an homogenous product is obtained.

The composition shows good satiety effects.
Example 3 - meal replacement bar product

A meal replacement bar product comprising an encapsulated satiety agent may be prepared according to the formulation below.

Table 2

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Honey</td>
<td>16.0</td>
</tr>
<tr>
<td>Sucrose</td>
<td>10.0</td>
</tr>
<tr>
<td>Whey protein isolate</td>
<td>3.0</td>
</tr>
<tr>
<td>Soy protein</td>
<td>13.0</td>
</tr>
<tr>
<td>Chopped dried fruit and nuts</td>
<td>20.0</td>
</tr>
<tr>
<td>Soy flour</td>
<td>5.0</td>
</tr>
<tr>
<td>Peanut butter</td>
<td>5.0</td>
</tr>
<tr>
<td>Maltodextrin</td>
<td>4.0</td>
</tr>
<tr>
<td>Oats</td>
<td>6.0</td>
</tr>
<tr>
<td>Bran fibre</td>
<td>2.0</td>
</tr>
<tr>
<td>Flavourings</td>
<td>2.0</td>
</tr>
<tr>
<td>Organogel</td>
<td>2.0</td>
</tr>
<tr>
<td>Vitamin / mineral premix</td>
<td>2.0</td>
</tr>
<tr>
<td>Chocolate flavoured coating</td>
<td>To 100%wt</td>
</tr>
</tbody>
</table>

The bar is made by thoroughly mixing together the honey and corn syrup with the peanut butter. The remaining ingredients except the chocolate flavoured coating are added and the mixture is further mixed and formed into a bar shape. To coat it the bar is passed through a curtain of molten chocolate flavoured coating. The bar is allowed to cool to solidify the coating.
Table 3  Percentage of fatty acids released from different oils related to the theoretical maximum (indicated as % dFA/dt after 30 min), after 30 minutes of *in vitro* intestinal digestion with varying amounts of Organogel

<table>
<thead>
<tr>
<th></th>
<th>Control Oil</th>
<th>Oil + organogel 4%</th>
<th>Oil + organogel 8%</th>
<th>Oil + organogel 16%</th>
<th>Oil + organogel 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SEM</td>
<td>Mean ± SEM</td>
<td>Mean ± SEM</td>
<td>Mean ± SEM</td>
<td>Mean ± SEM</td>
</tr>
<tr>
<td>Rice Bran Oil</td>
<td>76 ± 1%</td>
<td>80 ± 2%</td>
<td>69 ± 2%</td>
<td>56 ± 1%*</td>
<td>42 ± 3%*</td>
</tr>
<tr>
<td>Hi-Oryzanol Rice Bran Oil</td>
<td>89 ± 1%</td>
<td></td>
<td>84 ± 2%</td>
<td>60 ± 2%**</td>
<td></td>
</tr>
<tr>
<td>Sunflower Oil</td>
<td>76 ± 5%</td>
<td>90.2 ± 5%</td>
<td>72 ± 8%</td>
<td>61 ± 1%</td>
<td>56 ± 1%*</td>
</tr>
<tr>
<td>Olive Oil</td>
<td>81 ± 4%</td>
<td>75 ± 1%</td>
<td>56 ± 3%*</td>
<td>37 ± 1%**</td>
<td></td>
</tr>
<tr>
<td>Corn Oil</td>
<td>84 ± 4%</td>
<td>68 ± 8%</td>
<td>54 ± 2%*</td>
<td>49 ± 3%*</td>
<td>45 ± 2%**</td>
</tr>
<tr>
<td>Canola Oil</td>
<td>97 ± 9%</td>
<td>79 ± 2%</td>
<td>75 ± 2%</td>
<td>51 ± 1%*</td>
<td></td>
</tr>
<tr>
<td>Rapeseed Oil</td>
<td>84 ± 4%</td>
<td>81 ± 3%</td>
<td>85 ± 4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm Oil</td>
<td>88 ± 2%</td>
<td>81 ± 3%</td>
<td>85 ± 4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coconut Oil</td>
<td>102 ± 1%</td>
<td>78 ± 4%*</td>
<td>56 ± 2**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Values are mean ± SEM (n=2); significant differences are indicated by * p<0.05 and ** p<0.01 as compared to control oil (no organogel added).*
### Table 4  Percentage of fat hydrolysed between 30 and 90 minutes

<table>
<thead>
<tr>
<th>% dFA/dt between 30 and 90 min</th>
<th>Control Oil</th>
<th>Oil + 4% Organogel</th>
<th>Oil + 8% Organogel</th>
<th>Oil + 16% Organogel</th>
<th>Oil + 25% Organogel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olive Oil</td>
<td>9%</td>
<td>9%</td>
<td>23%</td>
<td>34%</td>
<td>ND</td>
</tr>
<tr>
<td>Canola Oil</td>
<td>6%</td>
<td>ND</td>
<td>12%</td>
<td>24%</td>
<td>ND</td>
</tr>
<tr>
<td>Palm Oil</td>
<td>6%</td>
<td>ND</td>
<td>19%</td>
<td>39%</td>
<td>ND</td>
</tr>
<tr>
<td>Coconut Oil</td>
<td>5%</td>
<td>ND</td>
<td>22%</td>
<td>31%</td>
<td>ND</td>
</tr>
</tbody>
</table>

ND - the lypolysis for these concentrations was not determined.
References


CLAIMS

1. A food composition comprising at least one of protein and carbohydrate, the composition further comprising 0.3-35 wt.% of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol.

2. A composition according to claim 1, wherein the weight ratio of the phytosterol and the phytosterol phenolic acid ester in the organogel is from 3:1 to 1:3.

3. A composition according to claim 1 or 2, wherein the total amount of phytosterol ester plus phytosterol phenolic acid ester in the organogel is from 1% to 50%, preferably from 5% to 25% by weight of the organogel.

4. A composition according to any one of the preceding claims, wherein the total amount of edible oil in the organogel is from 50% to 99%, more preferably from 75% to 95% by weight of the organogel.

5. A composition according to any one of the preceding claims, comprising from 0.5% to 20% by weight of the organogel.

6. A composition according to any one of the preceding claims, the phytosterol comprises 4,4-desmethylsterols, preferably as either/or beta-sitosterol, campesterol, stigmasterol or their fully saturated equivalents, being stanols, and the ferulic acid ester of a plant sterol is oryzanol.

7. A composition according to any one of the preceding claims, wherein the composition is a product selected from drinks, including dry mixes to prepare drinks, juices, sports drinks, bars, fat based food products such as
spreads, margarines, dressings, mayonnaises, creamers, ice creams, sauces, soups, yoghurts, desserts, toppings, condiments, and bakery, pastry, biscuits and cereal products.

8. A composition according to any one of the preceding claims wherein the composition is an aqueous emulsion comprising particles of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol, the particles having a $d_{34}$ average particle diameter of from 0.1 µm to 10 µm, preferably from 0.5 µm to 10 µm.

9. An aqueous emulsion comprising particles of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol, the particles having a $d_{3,4}$ average particle diameter of from 10 µm to 50 µm, preferably from 20 µm to 50 µm.

10. A product comprising particles, granules or flakes of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol.

11. Use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for promoting satiety, weight control and/or weight maintenance in a mammal.

12. Use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for improving or maintaining gut health in a mammal.

13. Use of an organogel comprising an edible oil, a phytosterol and a phenolic acid ester of a phytosterol in the manufacture of a food product for reducing or controlling serum cholesterol concentration in a mammal.
F 7875 (V)

Fig 1/3

Oil → 90°C → 1 hr (90°C) → To RT

β-Sit

1:1

Oryz

0.25%

Warm

90% → 10%

Tx100

Xan

H₂O

Mix

Ultra Turax

pH Stat
Fig 2/3

A

FA 75 (t)/ FA (0) %

0 10 20 30 40 50 60 70 80 90 100

Time (min)

- Olive oil
- Olive oil + 8% Organogel
- Olive oil + 16% Organogel

B

F A(t)/ F A

0 10 20 30 40 50 60 70 80 90 100

Time

- Coconut
- Coconut oil + 8%
- Coconut oil + 16%
Fig 3/3

- Olive oil
- Olive oil + 16% organogel
- Olive oil + 16% beewax
- Olive oil + 16% oil:acid

%FA(t)/FA(0) vs Time (min)
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

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

INV. A23L1/30 A23L2/38 A23L1/164 A61K31/56 A61P1/00
A61P3/06

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A23L A61K

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 practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>EP 0 960 567 A (UNILEVER N.V.; UNILEVER PLC) 1 December 1999 (1999-12-01) column 1, paragraph 1; column 2, paragraph 11 - column 3; paragraph 15; column 5, paragraph 25 - paragraph 26; column 11 - column 12; examples 5-7; column 12 - column 13; claims 1,2</td>
<td>1-10,13</td>
</tr>
<tr>
<td>X</td>
<td>EP 0 918 465 A (UNILEVER N.V.; UNILEVER PLC) 2 June 1999 (1999-06-02) cited in the application page 1, paragraph 4; page 2, paragraphs 8,11; page 5, paragraph 18; page 5; example 1</td>
<td>1-7,9,10</td>
</tr>
</tbody>
</table>

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

E: earlier document but published on or after the international filing date

I: 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: 28 February 2007

Date of mailing of the international search report: 06/03/2007

Name and mailing address of the ISA/ European Patent Office, P B 5818 Patentlaan 2 NL - 2280 HV RUISWijk
Tel (+31-70) 340-2040, Tx 31651 epos nl, Fax (+31-70) 340-3016

Authorized officer: Incei sa, Levent

Form PCT/ISA/210 (second sheet) (April 2005)
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
</table>
| X        | EP 0 990 391 A (KAO CORPORATION)  
5 April 2000 (2000-04-05)  
page 1, paragraph 1  
page 2, paragraph 22  
page 4, paragraph 30 - paragraph 36 | 1,3-5,  
7-10,13 |
| T        | ANONYMOUS: "Emulsification : Preparing Mayonnaise"  
INTERNET ARTICLE, [Online]  
11 September 2000 (2000-09-11), XP002362217  
Particle size of oil droplets in emulsions (mayonnaise) is about 1-10 microns.  
the whole document | 9,10 |
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EP 0962150 A2</td>
<td>08-12-1999</td>
</tr>
<tr>
<td>EP 0918465 A</td>
<td>02-06-1999</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2279402 A1</td>
<td>24-09-1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN 1515197 A</td>
<td>28-07-2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN 1448059 A</td>
<td>15-10-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CN 1258199 A</td>
<td>28-06-2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 9948378 A1</td>
<td>30-09-1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 3720057 B2</td>
<td>24-11-2005</td>
</tr>
</tbody>
</table>