PALM-BASED LIQUID COCONUT MILK SUBSTITUTE

FIELD OF INVENTION

The present invention relates to a palm-based liquid coconut milk substitute ("santan sawit"), to a formulation of ingredients to make said liquid coconut milk substitute and to a method for preparing said liquid coconut milk substitute.

BACKGROUND OF THE INVENTION

Coconut milk, or "santan" as known in Malaysia, is an oil-in-water emulsion extracted from the grating of coconut with/without addition of water (Chiew Chan *et al.*, 2005 *"Effect of homogenizing pressure and sterilizing condition on quality of canned high fat coconut milk", Journal of Food Engineering*). It is milky white liquid of unbroken cells containing the coconut oil, and is much used in Malaysian cuisine, especially in the traditional Malay foods due to its pleasant taste and smell.

Not-with standing the taste, santan has deleterious effects on human health. Coconut milk or coconut oil, if taken in large quantities or frequently, is considered a bad food for health (Mensink and Kantan, 1992 *Arteriosclerosis &Thrombosis,* 12 : 911-919), Hayes *et al.*, 1992 *FASEB J*, 6(8) :2600-2607)) as more than 90% of its fatty acids are saturated, and mainly lauric (C12:0) and myristic (C14:0) which have been identified as risk factors in the development of a variety of lifestyle diseases, such as heart disease, certain cancers, obesity and diabetes (Langenhoven *et al.,* 1996 MRC Food Composition Tables, 3rd Edition (1991),p.95; www.eatwell.gov.uk/asksam/healthydiet). Coconut milk contains 41 - 49% C12:0 and 20 - 24% C14:0, with palmitic acid (16:0) at 9-14% and very low linoleic (18:2) of <2% (Ng and Chong, 1979 *Med J Mal,* 33(4):331-333). Therefore, consuming coconut milk is associated with increased plasma low density lipoprotein (LDL) cholesterol levels and increased arterial thrombosis tendency.

There is thus a need to formulate coconut milk substitutes to obviate the health defects of coconut milk. In 1998, Palm Oil Research Institute (PORIM) produced a palm-based coconut milk powder substitute in a powdered form using a spray drying technique (Malaysian Patent No. MY-133041-A). Without water, it stored better, and had improved flavour and nutritive value, and enhanced stability and was easier to

handle during storage and transport (Zaida *et al.*, 1997 *Production and characterization of palm-based santan powder, PORIM Information Series No.45).*

Ng and Tee (1998)("Replacing coconut santan with palm oil santan: impact on dietary C12-16 saturated fatty acids, serum total cholesterol and cardiovascular risk", *Malaysian Journal of Nutrition Vol. 4 No. 1 & 2*) substituted coconut milk with the above-mentioned palm oil-based coconut milk powder substitute in a hypothetical 2,300 kcal diet containing one santan dish in each of 5 daily meals with fat. The palm oil reduced the dietary C12:0 – C16:0 fatty acids from 10.8% kcal to 4.8% kcal, i.e., a reduction of 6.0% kcal. Almost all the lauric (12.0) and myristic (14:0) were removed, while palmitic (16:0) increased 3.3% kcal and linoleic (C18:2) by 1.13% kcal.

Accordingly, an objective of the present invention is to provide a formulation and method for producing a trans-free palm-based liquid coconut milk substitute that resembles coconut milk in appearance, taste, aroma, with improved storage stability compared to that of coconut milk and which is a healthier food than coconut milk.

SUMMARY OF THE INVENTION

A first aspect of the present invention relates to a trans-free palm-based liquid coconut milk substitute with the following food analysis composition on a weight basis: 50-70% moisture, 0.1-3.0% ash, 1.0-3.0% protein, 20-40% fat and 4.0-8.5% carbohydrate.

A second aspect of the present invention relates to a trans-free palm-based liquid coconut milk substitute made from a formulation of ingredients comprising, on a weight basis, the following:
10-70% palm-based oil, 4-10% food additives which preferably include coating materials in the form of polysaccharides and or modified carbohydrates, 0.5-3.0% stabilizer, 0.1-1.0 % of a first emulsifier (emulsifier 1), 0.1-1.0% of a second emulsifier (emulsifier 2) and 40-80% water. Optionally, 0.1-5.0% permitted flavour and or 0.1-1.0% preservative may be added.

A third aspect of the present invention relates to a method for preparing a palm-based liquid coconut milk substitute comprising premixing a palm-based oily phase with any desired food additives, stabilizer, emulsifiers and water, to form a premix or pre-

emulsion followed by homogenizing the premix in two-stages to form an emulsion, and finally pasteurizing the emulsion, cooling and packaging. It is recommended that the food additives include coating materials preferably in the form of polysaccharides and or modified carbohydrates. Optionally, preservative and flavour (flavouring) may be added.

Features of the present invention will become apparent from the following detailed description and the accompanying drawings. It is to be understood, however, that the drawings are designed solely for the purpose of illustration and not as a definition of the limits of the invention.

BRIEF DECRIPTION OF THE DRAWINGS

Figure 1 is a flow chart illustrating, inter alia, the method of preparing a palm-based liquid coconut milk substitute of the present invention.

Figure 2 shows micrographs of palm-based liquid coconut milk substitute (without flavour) of the present invention at 5, 10, 15, 20 and 25°C.

Figure 3 shows the appearances of palm-based liquid coconut milk substitute of the present invention at 5°C at one (1) day, seven (7) days and thirty (30) days respectively after preparation.

DETAILED DESCRIPTION OF SOME PREFERRED EMBODIMENTS OF THE PRESENT INVENTION

A first aspect of the present invention relates to a trans-free palm-based liquid coconut milk substitute for which the food analysis compositions include compositions which comprise (based on a weight basis-g/100g), moisture (50.0 - 70%), ash (0.1 – 3.0%), protein (1.0 – 3.0 %), fat which includes palm-based fat (20.0 – 40.0 %) and carbohydrate (4.0 – 8.5%).

A second aspect of the present invention relates to a trans-free palm-based liquid coconut milk substitute made from a formulation of ingredients comprising, on a weight basis,

10 – 70% palm-based oil, 4-10% food additives, 0.5-3.0% stabilizer, 0.1-1.0% of a first emulsifier (emulsifier 1), 0.1-1.0% of a second emulsifier (emulsifier 2) and 40-80% water.

It is recommended that the food additives include coating materials preferably in the form of polysaccharides and or modified carbohydrates. Optionally, 0.1-5.0% flavour and 0.1-1.0% preservative may also be added.

The palm-based liquid coconut milk substitute of the present invention may be made using palm-based oil comprising one or more different types of palm oil (mesocarp oil from the oil palm) and or palm kernel oil (kernel oil from oil palm). The oil may be refined, bleached and deodorized (RBD), giving RBD palm oil in the form of a light golden product. RBD palm olein (RBD POo), super olein (POoo), palm mid fraction (PMF), RBD palm kernel oil (RBD PKO) and or RBD palm kernel olein (RBD PKOo) can also be used as the palm-based oil in this invention. The palm-based oil comprises, on a weight basis, approximately 10-70% of the ingredients in the formulation. A preferred range for the palm-based oil is 20-50%, on a weight basis, of the ingredients in the formulation.

Food additives are substances added to food to preserve flavour or improve its taste and appearance. Some additives are manufactured from natural sources such as soybeans and corn, which provide lecithin to maintain product consistency, or beets, which provide beet powder used as food coloring. As mentioned earlier, food additives in the form of coating materials (which may be polysaccharides and or modified carbohydrates) are amongst the ingredients in the formulation of the trans-free palm-based liquid coconut milk substitute of the present invention. Food additives including polysaccharides and or modified carbphydrates comprise approximately 4-10%, on a weight basis, of the ingredients in the formulation.

Examples of emulsifiers which can be used are sodium casienate, monoglyceride and diglyceride, and maltodextrin. Panodan and or Dimodan OT may also be used. Emulsifiers are used at two stages in the method of preparing the liquid coconut milk substitute. A first emulsifier(s) (sometimes referred to as "emulsifier 1") comprise(s) approximately 0.1-1.0%, on a weight basis, of the ingredients in the formulation. In one of the preferred embodiments of the invention, the range used for emulsifier(s) 1 is 0.1-0.5%, on a weight basis, of the ingredients in the formulation. A second emulsifier(s) (sometimes referred to as "emulsifier 2") comprise(s) approximately 0.1-1.0%, on a weight basis, of the ingredients used in the formulation; in one of the preferred embodiments of the invention, the range used for emulsifier(s) 2 is 0.01-0.05%.

Examples of stabilizers which may be used are carrageenan, guar gum, acacia gum (gum Arabic), alginates, xanthan gum, starch, tripolyphosphate. Sodium casienate can also act as a stabilizer as well as an emulsifier. Stabilizers comprise approximately 0.5-3.0%, on a weight basis, of the ingredients used in the formulation.

The percentage of water, on a weight basis, in the formulation of ingredients used to make the coconut milk substitute of the present invention is in the approximate range of 40-80%, on a weight basis, of the ingredients in the formulation.. In one of the preferred embodiments of the invention, water comprises approximately 50-70%, on a weight basis, of the ingredients in the formulation.

Preservative food additives can be used alone or in conjunction with other methods of food preservation. Preservatives may be anti-microbial preservatives, which inhibit the growth of bacteria and fungi, or antioxidants such as oxygen absorbers, which inhibit the oxidation of food constituents. Common anti-microbial preservatives include calcium propionate, sodium nitrate, sodium nitrite, sulfites (sulfur dioxide, sodium bisulfite, potassium hydrogen sulfite, etc.) and disodium EDTA. Preservatives comprise approximately 0.1-1.0%, on a weight basis, of the ingredients in the formulation.

Virgin coconut flavour or permitted artificial flavour may be used to impart a coconut aroma to the liquid coconut milk substitute. Flavour comprises approximately 0.1-5.0%, on a weight basis, of the ingredients in the formulation.

A third aspect of the present invention relates to a method for preparing a palm-based liquid coconut milk substitute comprising premixing a palm-based oily phase with coating materials, stabilizer, one or more emulsifiers and water, and optionally preservative and permitted flavouring, to form a premix or pre-emulsion followed by homogenizing the premix in two-stages to form an emulsion, and finally pasteurizing the emulsion, cooling and packaging. Figure 1 shows a flow chart for preparing a palm-based liquid coconut milk of the present invention.

The method of preparing a palm-based liquid coconut milk substitute of the present invention involves emulsification and homogenization. Emulsification forms a heterogeneous system with two or more immiscible phases, where the internal, or discontinuous phase, was distributed within an external, or continuous, phase (David, 1991 *"Functional Food Ingredients From Palm Oil", PORIM Intl. Palm Oil Conference – Chemical & Technology*). Homogenization is to ensure that the emulsion is stable. In coconut milk, stabilization is conducted by adding suitable emulsifiers and stabilizers followed by homogenization to reduce the fat globule size (Chiew Chan *et al.*, 2005 *"Effect of homogenizing pressure and sterilizing condition on quality of canned high fact coconut milk", Journal of Food Engineering*).

A recommended embodiment of the method for preparing a trans-free palm-based liquid coconut milk substitute of the present invention includes the following steps:

(i) Preparing a water phase by mixing a first emulsifier(s), stabilizer, coating materials (eg polysaccharides) and any other food additives, if desired, together with water by using a mixer machine at a speed of 6000 - 9000 rpm for 5-10 minutes;

(ii) Preparing an oily phase by mixing palm-based oil such as palm oil with a second emulsifier(s);

(iii) Adding the oily phase of step (ii) slowly and gradually to the water phase prepared in step (i) whilst the aforesaid mixture of two phases is continually

mixed and is being heated to 50-70°C for 10-15 minutes until all ingredients are dissolved to become a premix of the said two phases i.e. a pre-emulsion;

(iv) Homogenizing the pre-emulsion from step (iii) in a two-stage homogenizer at 30-60 MPa to form an emulsion;

(v) Pasteurizing the emulsion of step (iv) at 60-85°C for 15 seconds - 5.0 minutes or sterilizing the emulsion at 120-135°C for 4 -5 seconds;

(vi) Storing the emulsion in a container, the said emulsion being the trans-free liquid coconut milk substitute.

The palm-based liquid coconut milk substitute of the present invention was evaluated for its stability and shelf life compared with commercial coconut milk. Commercial coconut milk usually cannot keep more than 10 hours at room temperature, after which it turns rancid with separation of the emulsion. Samples of the palm-based liquid coconut milk substitute of the present invention were studied at five temperatures i.e. 5, 10, 15, 20 and 25°C, for the physical properties important in determining its acceptance - emulsion stability, colour, flavour, viscosity and appearance.

Preparation of "santan sawit"

In an embodiment of the present invention, a first emulsifier(s), water, coating materials, stabiliser and preservatives were mixed with a mixer machine at a speed of 6000-9000 rpm for 5-10 minutes until the mixture was thoroughly mixed so as to form the water phase. Then the oily phase was prepared (by mixing a palm-based oil with a second emulsifier(s) and added slowly and gradually to the water phase while the mixture of the two phases was continually mixed and heated to 50-70°C for 10-15 minutes, to make sure all ingredients were dissolved and become one solution of oil phase and water phase i.e. a pre-emulsion or premix. Homogenization of the pre-emulsion then followed using a two-stage homogenizer at pressure 30-60 MPa to form an emulsion. The homogenizing process was to reduce the size of the fat globules in order to prevent their rising to the surface, or, at least, greatly minimize the gravity separation. The homogenized mixture was called oil-water type emulsion. This emulsion was then pasteurized at 60-85°C for 15seconds - 5 minutes or sterilized at 120-135°C for 2-5 seconds before being put in an air-tight container. The samples were finally stored in 250 ml bottles at different temperatures i.e. 5, 10, 15, 20 and 25°C.

Homogenization is an important process in the preparation of the trans-free palm-based coconut milk substitute. Reducing the fat globule size to a minimum will create a greater surface area and lighter reflection with greater whitening effect. Hence, homogenization at 30-60 MPa on a dual valve homogenizer will usually produce a stable emulsion with fat globules in the desirable size range of 0.1 – 2.0 micron in diameter.

Formulation

A number of embodiments of the above-mentioned formulation are available to prepare the palm-based liquid coconut milk of the present invention, as illustrated by the Examples.

Palm oil, palm olein, and or palm kernel oil was used as the main ingredient in two of the embodiments of the formulation. The difference between the two embodiments of the formulation was that one was 'plain' and the other had coconut flavour added to mimic coconut milk. There were differences between the palm-based liquid coconut milk substitute of the present invention with coconut milk in their flavour, nutritional value and storage stability. Coconut milk had, of course, a strong natural coconut flavour but the palm-based liquid coconut milk substitute was bland. Virgin coconut flavour or artificial flavour was then used to impart a coconut aroma to the liquid coconut milk substitute.

Food Analysis Composition

Proximate food analysis of the liquid coconut milk substitute of the present invention was done for fat, protein, moisture, ash, carbohydrate (by calculation) and energy content (calories, by calculation) as shown in Table 1.

Table 1: A Proximate composition of trans-free palm-based liquid coconut milk substitute (based on a weight basis-g/100g)

Component	Palm-based liquid coconut milk substitute (g/100g)	Coconut santan
Total Fat(g/100g)	20.0 – 40.0 ± 0.1	29 -34
Protein (g/100g)	1.0 – 3.0 ± 0.1	3.0-3.5
Moisture (g/100g)	50.0 – 70 ± 0.2	60-75
Ash (g/100g)	0.1 – 3.0 ± 0.2	2.2
Carbohydrate (by difference)	4.0 – 8.5 ± 0.1	3.0-7.3
Vitamin A (μg/100g)	< 100.0	< 100.0
Vitamin C(mg/100g)	< 2.0	0
Vitamin E (mg/100g)	2.5 – 5.0 ± 0.2	0
[a]Energy (kcal/100g)	200.2 – 412.0	289.4 – 353.6

Values are means ± standard deviation of triplicate determinations. [a]Energy (kcal/100g) conversion factors: protein and carbohydrates – 4 kcal per g, fat – 9 kcal per g. Calculation: (fat x 9) + (protein x 4) + (car x4) + (ashx2)

Table 1 shows the compositions of palm-based liquid coconut milk substitute. The total compositions are taken as 100%. These included fat, protein, moisture, ash, vitamin A, C and E. The carbohydrate content was obtained by calculation of a difference versus chemical analysis followed by appropriate calculations.

Determination of fat content

Fat was extracted from the palm-based liquid coconut milk substitute and commercial coconut milk using the Soxhtex method (Tecanor Model Soxtex, HT6, Hoganas, Sweeden) to determine their fat contents. The weight of the fat by deduction after extraction and drying was taken as the content of fat in the samples.

Determination of protein content

Protein was determined using the Micro-Kjeldahl test according to AOCS method (1989). The principles of the test are to heat a substance with sulfuric acid, which decomposes the organic nitrogen.

Determination of moisture contents

The moisture contents were determined using AOCS Test Method Ca 2c-25 (AOCS, 1997). The samples were dried in an oven for four hours at 102°C, and moisture was taken as the loss in mass.

Determination of ash content

Ash's content was determined by combusting the samples in a muffle furnace at 550°C for X hours according to AOCS Test Method Ca 11-55 (AOCS, 1997). The residue was weighed for the ash value. Ash is defined as the inorganic residue after incineration of the sample under specified conditions, and expressed as a percentage by mass.

Determination of carbohydrate content

The carbohydrate content was determined by calculation of a difference versus chemical analysis followed by the appropriate calculations. The calculation is:
% Carbohydrate = 100% – [% protein – % moisture – %fat – % ash] (FAO Food and Nutrition Paper 77, FAO Corporate Document Repository).

Generally, coconut milk compositions are as follow: 60-75% moisture, 29-34% fat, 3.0-3.5% protein, 3.0 % fiber, 2.2% ash and 3.0-7.3% carbohydrates (Gonzalez, 1990 "Coconut milk" In: J.A Banzon, O.N Gonzalez, S.Y de Leon, & P.C Sanchez, *"Coconut as food"* (pp 15-48). Quezon City, Phillipines : Phillipine Coconut Research and Development Foundation; Tee *et al.,* 1997 *Nutrient Composition of Malaysian Foods 4th Edition, Malaysian Food Composition Database Programme, c/o Institute for Medical Research, Kuala Lumpur, ISBN 967-99909-8-2*).

The mean fat content in coconut milk as reported by Hagenmaier (1980) ("Coconut aqueous processing" by Hagenmaeir, Robert D, San Carlos Publications (Cebu City, Phillipines) 1980) was 33.4%, much higher than in this study. Fat is important in diets because it promotes fat-soluble vitamin absorption (Bogert *et al.,* 1994 *Int. J Food Sci Nutr., 45 : 223-230*). Fats also play a vital role in maintaining healthy skin and hair, insulating the body organs against shock, maintaining the body temperature, and promoting healthy cell function. They also serve as energy stores for

the body. Fats are broken down in the body to release glycerol and free fatty acids. The glycerol is converted to glucose by the liver and used as a source of energy. Recently, fat has acquired a bad reputation. But the fact is, everyone needs a little fat in their diet. However, the type of fat is important because it not only affects the overall health, it also influences the cholesterol levels and heart health.

As shown in Table 1, protein was slightly lower in the palm-based liquid coconut milk substitute compared to coconut milk. Nevertheless, both contents were moderate. However, even the protein and ash values in coconut milk are lower than those reported by Hagenmair (1980) ("Coconut aqueous processing" by Hagenmaeir, Robert D, San Carlos Publications (Cebu City, Phillipines) 1980) and Thampan (1975) ("The coconut palm and its products" by P.K Thampan, Cochin: Green Villa Pub. House 1975). Protein is the basic chemical building block of living organisms and essential for growth and repair (Donald, 2004 *"Physical and Biochemical Properties of Palm Oil"*).

The compositions of the coconut milk depend largely on the amount of water used to extract the milk from the coconut meat. The moisture in coconut milk was higher than in the palm-based liquid coconut milk substitute due to the water added to squeeze the coconut meat. Single-stage extraction without added water or less water produces coconut milk of high fat content.

The moisture content is very important in coconut milk. More water predisposes the coconut milk to faster deterioration and a shorter shelf life as hydrolysis of the lipids is promoted with the concomitant increase in FFA and development of off-flavours. It has been recommended that the moisture content in coconut milk be 50 – 60 % for reasonable shelf-life (Anon, 1988) (Development of new CGIAR initiatives coconut research. Consultative Group on International Agricultural Research Technical Advisory Committee, Hyderabad, India. Roma: FAO 63p).

Ash in nutritional analysis is the material left after combustion of the substance in a furnace. It is therefore not an ingredient, but can be considered food trace elements or minerals. Both palm-based liquid coconut milk substitute and coconut milk may contain ash which comparable to the values in the literature (Hagenmaier, 1980 ("Coconut

aqueous processing" by Hagenmaeir, Robert D, San Carlos Publications (Cebu City, Phillipines) 1980); Buccat *et al.,* 1973 ("Production of proteins and other food productsfrom coconut-Laboratory phase", NIST Project Report); Thampan, 1975("The coconut palm and its products" by P.K Thampan, Cochin: Green Villa Pub. House 1975)).

The carbohydrate content was obtained by difference after determining the contents of moisture, protein, ash and fat. The value of carbohydrate for palm-based liquid coconut milk substitute is comparable with the value for coconut milk reported by Banzon and Velasco (1982)("Coconut production and utilization" by Banzon, Julian A & Velasco, Jose R, published by Phillipine Coconut Research and Development Foundation (Pasig, Metro Manila, Phillipines) of 7.3%. The main carbohydrates present in coconut milk are sugars (primarily sucrose) and some starch (Seow and Gwee, 1997 *International Journal of Food Science and Technology, 32, pp89-201*).

Cholesterol content was found to be nil or undetectable.

The energy content of the palm-based liquid coconut milk substitute of the present invention is approximately 200-410 kcal/100g, as seen in Table 1 where the calculated metabolizable energy is 200.2 – 412.0 kcal/100g. Thus, the palm-based liquid coconut milk substitute is a richer source of energy than coconut milk, as seen in Table 1 where the calculated metabolizable energy of coconut milk is 289.4-353.6 kcal/100g.

Table 2: Slip melting point (°C) and iodine value (°C)

Fat/oil	Melting point (°C)	Iodine Value (°C)
RBD palm oil	33 – 39	50 – 55
Crude palm olein	20 - 24	50 – 56
RBD Palm olein	22 – 24	56 – 59
Super olein	13 – 16	65 -80
RBD palm kernel	26 – 28	16 – 19
RBD palm kernel olein	22 – 25	21-25

Table 2 shows the melting points and iodine values of various types of palm-based oil. Preferably, the fat is a vegetable fat/oil having a slip melting point of 10° C to 40° C. Examples of such fats are RBD palm oil, palm olein, super olein, palm kernel oil and palm kernel olein as shown in Table 2. The melting point is usually defined as the point a material changes from solid to liquid (O'Brien, 1998 *"Fats and Oils. Formulating and Processing for Applications" second edition, CRC Press*). However, natural fats do not have a true melting point, and the slip melting point is used instead. All fats are comprised of a mixture of different triacylglycerols, each with its individual melting point. As the temperature of the fat is raised, more and more of its triacylglycerols melt until the fat 'slips', thence the 'slip melting point'.

Table 3: Physicochemical characteristics of palm-based liquid coconut milk substitute (extract from palm oil) and coconut milk

Parameter	Palm-based liquid coconut milk substitute	Coconut milk
Slip melting point (°C)	**20 - 40**	**20 – 30**
Free fatty acids (mg/g)	**<0.05**	**1.2 -2.0**
Iodine value (mg /g)	**40-60**	**10 – 15**
Viscosity (cps)	**18– 30**	**20 – 33**

In Table 3, the slip melting point of palm oil extracted from palm-based liquid. Palm oil has a higher slip melting point than coconut oil simply because palm oil has more long chain triglycerides (LCTs) – generally, the longer the fatty acid chains, the higher the melting point. Palmitic and oleic acids are the main contributors to the semisolid nature of palm oil. The slip melting point was determined according to AOCS Method Cc 3-25 (1964) using an open capillary tube. A fat column was put in an open capillary tube, then tempered at 10 ± 1°C for 16 hours before heated in a water-bath until the fat rose in the tube under hydrostatic pressure. The temperature at which the fat began to rise was taken as the slip melting point. Each sample was analysed in duplicate.

In Table 3, palm-based liquid coconut milk substitute has lower free fatty acids than coconut milk, making the latter more prone to spoilage as rancidity results from the decomposition of fats (Seow and Gwee, 1997 *International Journal of Food Science*

and Technology, 32, pp 89-201). Fats decompose by hydrolysis or oxidation or both, and the free fatty acids released can undergo further auto-oxidation, generating highly reactive molecules which produce the unpleasant and obnoxious odors and flavours in rancid foods. The high content of natural antioxidants in palm oil contents antioxidants can retard the development of rancidity by oxidation. Palm oil has abundant vitamin E (tocopherols and tocotrienols), beta-carotene and phenolic compounds which are all natural antioxidants. As shown in Table 1, palm-based liquid coconut milk substitute of the present invention contains high vitamin E of 2.5–5.0(mg/100g) while coconut milk does not have any. Vitamin E is natural antioxidant which is good for health.

The iodine value (IV) is a measure of the unsaturation in an oil. Palm-based liquid coconut milk substitute of the present invention has an IV 40-60 and coconut milk 10-15. The higher IV in palm-based liquid coconut milk substitute indicates its lower saturation vis-à-vis coconut milk (O'Brien, 1998 *"Fats and Oils. Formulatinmg and Processing for Applications" second edition, CRC Press*).

Samples of the palm-based liquid coconut milk substitute were measured using a viscometer (Brookfield, Model DV2, USA). Spindle #1 was used to measure the viscosity. The speed of the viscometer was set at 100 rpm and the CPS at 10°C.

Table 4: Fatty acid contents (%) of palm-based liquid coconut milk substitute (extracted from palm oil) and coconut milk

	Fatty Acid						
	Lauric C12:0	**Myristic C14:0**	**Palmitic C16:0**	**Palmitoleic C16:1**	**Stearic C18:0**	**Oleic C18:1**	**Linoleic C18:2**
Palm – based coconut milk substitute	0.25	1.0	41.7	0.2	3.7	42.0	10.7

Coconut milk	49.1	18.4	8.3	-	2.5	5.2	1.2

Values are means ± standard deviation of triplicate determinations.

The fatty acid compositions of the milks are shown in Table 4. The physical characteristics of the milks are dependent on the degree of unsaturation, carbon chain length, isomeric fatty acid forms and the molecular configuration of the fats. Palm-based liquid coconut milk substitute of the present invention contains high palmitic, stearic and oleic acids, while coconut milk contains high lauric (C12:0, 49%), myristic (C14:0, 18.4%), palmitic (C16:0, 8.3%) acids and very low oleic (C18:0, 5%) acid. In respect of the fatty acids, coconut milk is the more saturated, which may be a causal factor for artherogenicity, such as an increased arterial thrombosis tendency (Hornstra *et. al.,* 1975 *Atherosclerosis* 22:499-519) and elevated plasma low-density lipoprotein cholesterol (LDLC) levels (Ng *et al.,* 1991, *Am J Clin Nutr,* 53: 1015S-1020S). Ng *et al.* (1999) ("Replacing coconut santan with palm oil santan: impact on dietary C12-16 saturated fatty acids, serum total cholesterol and cardiovascular risk", *Malaysian Journal of Nutrition Vol. 4 No. 1 & 2*) have shown that replacing coconut milk with palm-based coconut milk substitute can reduce the intake of C12:0-C16:0 saturated fatty acids, and lower serum total cholesterol and cardiovascular risk. Palm kernel oil is also used in this invention even though its fatty acids content almost similar with those in coconut oil.

Fatty acid composition was determined according to Shehata *et al.* (1970) (*Can. Inst. Food Sci. Technol J. 4:61)*. The principles of the analysis were to extract the lipids from the sample, and the lipids reacted with sodium methylate to produce fatty acid methyl esters. The methyl esters were then subjected to gas chromatography with a flame ionization detector. They were separated isothermally at 170°C on a glass column (1.8 x 3.0 mm) packed with 10% PS 2330 on 100/200 Chromosorb WAW (Supercoport Inc., Bellefonte, PA). Gas chromatography includes those chromatograph techniques which mobile phase is a moving gas (O'Brien, 1998 *"Fats and Oils. Formulating and Processing for Applications" second edition, CRC Press*).

Storage stability

The palm-based liquid coconut milk substitute of the present invention as prepared above was evaluated for its stability and shelf life compared with commercial coconut milk. Commercial coconut milk usually cannot keep more than 10 hours at room temperature, after which it turns rancid with separation of the emulsion. Samples of the palm-based liquid coconut milk substitute were studied at five temperatures i.e. 5, 10, 15, 20 and 25°C, for the physical properties important in determining its acceptance - emulsion stability, colour, flavour, viscosity and appearance.

For storage studies, palm-based liquid coconut milk substitute, palm-based coconut milk with artificial coconut flavour and coconut milk were stored at five temperatures i.e. 5, 10, 15, 20 and 25°C. An extra sample at 5°C was kept in the dark to observe the effect of light on the milk stability. The physical stability was first assessed on the finished milks immediately after preparation. All the samples (250 ml) were placed in clear plastic bottles. The study was done in triplicate with the samples stored for 28 days.

Light oxidation is known to occur, breaking down the fatty acids to give coconut milk a burnt, or "activated", flavour. The broken down fatty acids yield aldeydes and ketones, identified as the causes of various off-flavours in coconut milk. The effects of storage temperature on the microscopic structure of the coconut milks proved to be significantly different. Both coconut milk and coconut milk substitutes were investigated for their stability during storage at different temperatures.

In an embodiment of the present invention, two formulations of "santan sawit" were prepared. The difference between the two formulations was that one was 'plain' and the other had coconut flavour added to mimic coconut milk. The particle size distributions and photomicrographs of said palm-based liquid coconut milk substitutes (with and without flavour) and coconut milk (coconut "santan") are shown in Table 5. The particle sizes of coconut milk were smaller after storage at 5°C and 10°C (4.6μm and 6.0 μm) compared to palm-based liquid coconut milk substitute (17.1 μm and 16.9 μm), respectively. The particle sizes for both milks had no significant difference after storage at 15°C, 20°C and 25°C, respectively. The particle size of coconut milk slightly increased with increasing temperature, while the palm-based liquid coconut milk

substitute showed decrease in particle size during storage at different temperature. Figure 2 shows photomicrographs of the palm-based liquid coconut milk substitute (without fiavour) at 5, 10, 15, 20 and 25°C.

Table 5: Globule sizes of palm-based liquid coconut milk substitute and coconut milk

	Coconut santan		Palm santan (without flavor)		Palm santan (with flavor)	
Temperature (°C)	Equivalent Diam (μm²)	Area (μm²)	Equivalent Diam (μm²)	Area (μm²)	Equivalent Diam (μm²)	Area (μm²)
5	4.6	239.2	17.1	239.2	6.3	80.5
10	6.0	183.1	16.9	236.2	7.1	100.0
15	7.4	271.0	8.15	105.2	5.9	54.1
20	8.4	238.3	7.4	154.0	6.7	121.9
25	8.9	195.4	8.7	142.8	8.8	206.5

The first characteristic evaluated was appearance, which is important for giving the initial impression and influencing subsequent judgments on the product. From the storage observation, palm-based liquid coconut milk substitute of the present invention at temperatures 5, 10, 15°C were stable with no odour developed more than 20 days compared to temperatures 20°C and 25°C (Figure 2). Palm-based liquid coconut milk substitute of the present invention stored at 5°C still stayed fresh for more than 30 days without separation and deterioration as shown in the pictures of Figure 3.

Coconut milk, on the other hand, turned rancid very fast - it could not keep for over 5 hours at room temperature. It suffered phase separation and the surface colour changed from white to green. A rancid smell developed. After Day 2, it turned brown and produced a stench.

Untreated coconut milk spoils rapidly even under chilled storage. Its generation tie for multiplication of bacteria drops from 232 min at 10°C to 44 min at 30°C (Seow

and Gwee, 1997 *International Journal of Food Science and Technology, 32, pp 89-201*) being a very rich medium for the growth of all common spoilage microorganisms.

Sensory analysis provides an understanding of the product quality, directions for product quality, profiles of competing products, and evaluations of product reformulation from a consumer perspective (Stone and Sidel, 1993 "Sensory Evaluation Practices", Academic Press, San Diego).

Benefits/advantages of the liquid coconut milk substitute

Various traditional Malaysian foods like *nasi lemak, bubur pulut hitam*, curry and sago were prepared using both palm-based liquid coconut milk substitute and coconut milk, and evaluated by a sensory panel for appearance, aroma/odour, taste and overall quality on a nine-point scale (Figure 3). The palm-based liquid coconut milk substitute (with and without flavour) scored better for appearance, but there was no significant difference in aroma except for *bubur pulut hitam* and *nasi lemak* ($P < 0.05$). Aroma is the odour of a food, resulting from volatiles inhaled and smelled by a person. The aroma of coconut milk was better in these two foods. There was a significant difference in the taste of meat curry, sago and *nasi lemak*, with palm-based liquid coconut milk substitute the better product. However, the overall quality for *nasi lemak* went to coconut milk. There was no significant difference in the other foods tested.

Palm-based liquid coconut milk substitute was successfully produced to resemble coconut milk in appearance, taste and storage stability. With its lower contents of lauric and myristic acids and higher palmitic and oleic acids, palm-based liquid coconut milk substitute should be the healthier product compared to coconut milk. The fat and carbohydrate contents of palm-based liquid coconut milk substitute are also higher, although in coconut milk they are very much dependent on the amount of water used in its preparation. The high vitamin E content in palm-based liquid coconut milk substitute is an extra boost – as an essential nutrient in the human diet and as an antioxidant to increase the storage life of the product. In the physico-chemical properties, the palm product, with its lower saturation, had the higher slip melting point.

In storage stability, palm-based liquid coconut milk substitute won hands down, being able to keep for over a month under some conditions. The coconut product could not even keep for a day even in the refrigerator.

Examples

The following examples serve to further illustrate the formulation and method disclosed in the present invention.

EXAMPLE 1:

The palm-based liquid coconut milk substitute in this Example 1 was produced from the following ingredients:

Ingredients	Percentages (%)
Palm oil	10-50
food additives (polysacaride/modified carbohydrates)	4-10
Stabilizer	0.5 – 3.0
permitted flavor	0.1 -1.0
emulsifier 1	0.1-0.5
Preservative	0.1-0.5
Emulsifier 2	0.01 – 0.05
Water (distilled)	50-70
Total	100.0

Different type of palm oils and palm kernel oils were used in the production of palm-based liquid coconut milk substitute as shown below using the same formulation:

Fat/oil	Melting point (°C)	Iodine Value (°C)
RBD palm oil	33 – 39	50 – 55
RBD palm olein	19 – 24	56 – 62
Superolein	13 – 16	65 – 80
Palm kernel oil	26 – 28	16 – 19
RBD palm kernel olein	22 – 25	21 – 25
Palm Mid Fraction	35 – 38	32 – 48

Palm Oil (PO)/RBD Palm Oil (RBD PO)

Palm oil is a fat, with melting point of 33-39°C, iodine value 50-55 and solid fat content about 22-29%. Its fatty acid composition is based on palmitic acid (40 - 47%), oleic acid (37 - 41%) and linoleic acid (9-13%). A major advantage is that unlike hydrogenated oils with the same melting point, it contains no trans fatty acids which are now accepted to be risk factors for heart disease. Crude PO is normally traded on the basis of 5% FFA, but most of the exported PO is RBD (refined, bleached and deodorised) grade with FFA 0.1% max.

Palm Olein (POo)/RBD Palm Olein (RBD POo) - Palm Olein (POo) is the softer fraction obtained on fractionation of palm oil, the harder fraction being the stearin. The main characteristics of POo are SMP 19-24°C, IV 56 - 62 and SFC 0 - 9 % at 20°C. Its average fatty acid composition is palmitic acid (39 -43%), oleic acid (40 - 45%) and linoleic acid (9 -15%). However, RBD POo is usually traded on the specification of FFA 0.1% max, SMP 24°C max and IV 56 min. on loading. There is a good inverse correlation between the IV and the SMP and SFC of olein, and buyers should aim for the highest value. POo is much more stable to oxidation and flavour deterioration than any other major seed oils. Its main disadvantage is easily to become cloudy, or even semi-solid, in temperate climates.

Double Fractionated Palm Olein, or Super Olein (DFPOo or POoo)

Double Fractionated Palm Olein, or Super Olein is a softer type of olein obtained by fractionation of the standard olein, in order to achieve the maximum possible fluidity. The main characteristics of POoo are SMP 13-17°C, IV 60 - 68 and SFC 0 - 26% at 10°C. Its major fatty acids are palmitic acid (30 - 37%), oleic acid (40 - 47%) and linoleic acid (10 -15%). POoo is used for bottling, as it remains fully liquid in tropical climates and also in temperate climates if blended with sufficient seed oil. Its great advantage over the major seed oils is its much greater resistance to oxidation.

Palm Kernel Oil (PKO) - Palm Kernel Oil (PKO), is derived from the kennel of the palm fruit and so it is a co-product of palm oil production. But PKO is the minor product. This oil together with coconut oil compose the lauric group, so named because their fatty acid composition is based predominantly on lauric acid. PKO has a slip melting point of 26-28 °C, iodine value 16 - 19 and SFC (20°C) about 40%. Its fatty acid composition consists mainly of lauric acid (C12:0) about 48%, myristic acid (C14:0) 14-

17% and oleic acid (C18:0) 12-17%, with total saturates of about 80 - 85%. Crude PKO is usually traded on the basis of FFA 5% max., moisture and impurities 1% max. and IV 19 max. on loading. PKO is very similar to coconut oil and has very similar uses. PKO is also fractionated into PKOs (palm kernel stearin) and PKOo (palm kernel olein).

Palm Kernel Olein (PKOo) - Palm Kernel Olein (PKOo) is the secondary product of PKO fractionation, normally selling at a small discount to PKO. Compared with PKO, the olein has higher IV, and lower melting point and SFC at all temperatures. Typical values are, IV 21 - 25, SMP 22 - 25°C and SFC (20°C) about 17%. Its major fatty acids are approximately, lauric acid (C12:0) 43 - 47% and oleic acid (C18:1) 17 -20%.

Palm Mid Fraction (PMF) - is a speciality fat produced by multiple fractionation of palm oil. Its main characteristic is a very high content in symmetrical disaturated triglycerides (mainly POP) resulting in a very steep SFC/Temperature curve. PMF is produced in a wide range of characteristics, eg. IV 32- 48, SMP 32 - 38°C, SFC (20°C), 45-90%.

The palm-based liquid coconut milk substitute was prepared by mixing all the emulsifiers and water at the speed of 6000-9000 rpm until the mixture (water phase) was thoroughly mixed for 5-10 minutes. Then the oily phase was prepared and added to the emulsifiers. The mixture was heated to 50-70°C and was held for 10-15 minutes to make sure all ingredients were dissolved and become one solution of oil phase. The oily phase was slowly added to the water phase with the stabilizer while the mixture continually mixed. It was then followed by homogenization at pressure 40-50 MPa in this embodiment; the range in the present invention is 30-60 MPa. MPa. through a two-stage homogenizer. The homogenized mixture was called oil-water type emulsion. Each emulsion need to be recycled two times to achieve a narrow particle size distribution around 0.1 – 2.0 μm.

Homogenization is a mechanical treatment of the fat globules in palm-based liquid coconut milk substitute brought about by passing palm-based liquid coconut milk substitute under high pressures through a tiny orifice, which results in a decrease in the average diameter and an increase in number and surface area, of the fat globules. The homogenizing process was to reduce the size of the fat globules in order to prevent their rising to the surface, or, at least, greatly minimized the gravity separation, decrease in

the mean diameter of the fat globules and increase in density of the globules owing to the absorption of a protein membrane. Thus, enhanced the stability of the palm-based liquid coconut milk substitute. The emulsion was then pasteurized at 50-75°C for 15 seconds - 2.0 minutes in this embodiment; the range of the present invention is e 60-85°C for 15 seconds – 5.0 minutes. Alternatively the emulsion can be sterilized at 120-135°C for 2–5 seconds before it is placed in the air-tight container.

Ultra-high temperature processing (UHT) is the partial sterilization of food by heating it for a short time, around 1-2 seconds at a temperature exceeding 120-135°C which is the temperature required to kill any spores in milk. UHT process was carried out at 60-85°C in 15 seconds – 5.0 minutes. Even though, pasteurization eliminates potential pathogenic microorganisms, but it is not sufficient to inactivate the thermo resistant spores in milk. The term sterilization refers to the complete elimination of all microorganisms. Sterilization refers to the complete elimination of all microorganisms at temperature 120-135° C in a short time (4 – 5 seconds).

Emulsifiers - The emulsifiers are most generally used at about 0.5 based on total mix weight but levels as high as 1.0% is quite common. If the mix is properly emulsified, and other factors such as pH are properly controlled, the emulsion should remain stable for the shelf life of the product, it should "bloom" uniformly and show no signs of fat separation (oiling off) when used. Sufficient coconut flavour was added so that the product is satisfactory to meet the demands of the consumers.

Stabilizers – Stabilizers that are hydrophilic colloids perform a two-fold function. The Primary need for a colloid usually is to improve the colloidal solubility of the protein. A colloid such as carrageenin, know to undergo a complex reaction with the protein. The stabilizers used at about 0.5% based on total mix weight but levels as high as 1.0% are quite common.

Example 2

Palm-based liquid coconut milk substitute was obtained as in Example 1 but in this formulation sodium benzoate was added in the formulation. Any types of oil mentioned above can be used to produce palm-based liquid coconut milk substitute of the present

invention. The palm-based liquid coconut milk substitute in this Example 2 was produced from the following ingredients:

Ingredients	Percentages (%)
Palm oil	20 – 50
Modified carbohydrate/food additive	4-10
Stabilizer	0.5 – 3.0
Permitted flavor	0.1 -5.0
emulsifier 1	0.1-1.0
Preservative	0.1-1.0
Emulsifier 2	0.1 – 1.0
Sodium benzoate	0.1-1.0
Water	40-80
Total	100.0

Example 3

In this Example 3, palm-based liquid coconut milk substitute was obtained from any oil mentioned in the above, homogenized and pasteurized/sterilized as in Example 1 but in this formulation, hydrocolloids at 0.1 -1.0 % was added. Functions are to improve the functionality of the product, thickener, foaming, improving stability, improving freeze-thaw stability, preventing crystal growth, stabilising suspensions or emulsions and retards ice crystal growth. The hydrocolloids products do not impart starchy taste to the finished application but allow the flavour in the ingredients to remain at peak levels without contributing any fat to the product. In terms of nutritional benefits, hydrocolloids are non-caloric, high in soluble dietary fiber, adhesive for flavour, used to control body and viscosity of the emulsion of palm-based liquid coconut milk substitute. Any types of oil mentioned above can be used to produce palm-based liquid coconut milk substitute.

Ingredients	Percentages (%)
Palm oil	20 – 50
Modified carbohydrate/food additive	4-10
Stabilizer	0.5 – 3.0
Permitted flavor	0.1 -5.0

Emulsifier 1	0.1-1.0
Preservative 1	0.1-1.0
Emulsifier 2	0.1 – 1.0
Preservative 2	0.1-1.0
Hydrocolloids	0.1 – 1.0
Water	40-80
Total	100.0

Example 4

In this Example 4, palm-based liquid coconut milk substitute was obtained after, homogenization and pasteurization/sterilization as in Example 1 but no coconut flavour was added.

Ingredients	Percentages (%)
Palm oil	20 – 50
Modified carbohydrate/food additive	4-10
Stabilizer	0.5 – 3.0
Emulsifier 1	0.1-1.0
Preservative 1	0.1-1.0
Emulsifier 2	0.1 – 1.0
Preservative 2	0.02 - 0.1
Hydrocolloids	0.1 – 1.0
Water	40-80
Total	100.0

Example 5

In this Example 5, palm-based liquid coconut milk substitute was obtained as in Example 1 but in this formulation, antioxidant preservatives were added. Functions are to delay rancidity, prevent food spoilage from bacteria, molds, fungi, or yeast (antimicrobials); slow or prevent changes in color, flavour, or texture; and maintain freshness. It is an important metabolite in virtually all living organisms and is especially abundant naturally in citrus fruits and berries. Any types of oil mentioned above can be used to produce palm-based liquid coconut milk substitute.

Ingredients	Percentages (%)
Palm oil	20 – 50
Modified carbohydrate/food additive	4-10
Stabilizer	0.5 – 3.0
Permitted flavour	0.1 -5.0
Emulsifier 1	0.1-1.0
Preservative 1	0.1-1.0
Emulsifier 2	0.1 – 1.0
Preservative 2	0.1-1.0
Hydrocolloids	0.1 – 1.0
Antioxidant preservatives	0.1 - 0.6
Water	40-80
Total	100.0

Example 6

In this Example 6, palm-based liquid coconut milk substitute was obtained as in Example 1 but in this formulation extra vitamin E was added in the formulation. Again any types of oil mentioned in the above can be used to produce palm-based liquid coconut milk substitute. Vitamin E is present in crude palm oil (CPO) and residual oil from palm pressed fiber at concentrations of about 600 – 1000 and 2000 - 4000 ppm. The vitamin E isomers that are present in palm oil include α-tocopherol, α-tocotrienol, γ-tocotrienol and δ-tocotrienol.

Palm oil is the richest natural source of tocotrienols. Palm oil vitamin E extract consist largely of tocotrienols (70%) and only 30% tocopherol. Vitamin E emerged as an essential, fat-soluble nutrient that functions as an antioxidant to the human body. It is essential, because it is required to sustain life and the body cannot manufactures its own vitamin E. Therefore, foods and supplements must provide it. Vitamin E possesses powerful neuroprotective, anticancer, anti-inflammatory, anti-microbial, anti-angiogenic, and cholesterol-lowering properties.

In this formulation, Vitamin E added was in the range of 0.01 – 0.1 %. Any types of oil mentioned above can be used to produce palm-based liquid coconut milk substitute.

Ingredients	Percentages (%)
Palm oil	20 – 50
Modified carbohydrate/food additive	4-10
Stabilizer	0.5 – 3.0
Permitted flavour	0.1 -5.0
Emulsifier 1	0.1-1.0
Preservative 1	0.1-1.0
Emulsifier 2	0.1 – 1.0
Preservative 2	0.1-1.0
Hydrocolloids	0.1 – 1.0
Vitamin E	0.05 – 0.1
Water	40-80
Total	100.0

Example 7

In this Example 7, palm-based liquid coconut milk substitute was obtained as in Example 1 using any types of oil mentioned above but in this formulation, the palm-based liquid coconut milk substitute was fortified with Calcium. To "fortify" a product means to add a missing nutrient or supplement a nutrient present in an insignificant amount. Tolerate upper intake level of calcium is around 2,500 mg calcium/day. Calcium is an important mineral for health. It involves in many functions in the body. The fortification of palm-based liquid coconut milk substitute with calcium is an attempt to increase calcium intake. Adequate intake of calcium helps people build strong bones as children and minimize bone loss through osteoporosis as older adults. The bones gain and lose calcium continuously as the body balances its needs for stored calcium in the bones with the need for calcium in the blood and body fluids to help with muscle contraction, blood clotting, nerve impulses, hormone secretion and enzyme activation.

Ingredients	Percentages (%)
Palm oil	20 – 50
Modified carbohydrate/food additive	4-10
Stabilizer	0.5 – 3.0
Permitted flavour	0.1 -5.0
Emulsifier 1	0.1-1.0
Preservative 1	0.1-1.0
Emulsifier 2	0.1 – 1.0
Preservative 2	0.1-1.0
Hydrocolloids	0.1 – 1.0
Calcium	0.1-1.0
Water	40-80
Total	100.0

Example 8

In this Example 8, palm-based liquid coconut milk substitute was obtained as in Example 1 using any types of oil mentioned above but in this formulation, palm oil fractions or palm kernel oil fractions was blending with other vegetable oils namely corn oil or soybean oil or rapeseed oil or sunflower oil or peanut oil in different ratios, 50: 50, 60: 40, 70: 30, 80: 20 and 90: 10, in which the palm oil fractions or palm kernel fractions in the higher ratio in the blend.

Palm oil/POo/POoo/PKO/PKOo/PMF	Sunflower oil/ corn oil/ soybean oil/ rapeseed oil/peanut oil
50	50
60	40
70	30
80	20
90	10

Ingredients	Percentages (%)
Palm oil: sunflower oil (50:50)	20 – 35
Modified carbohydrate/food additive	4-10
Stabilizer	0.5 – 3.0
Permitted flavour	0.1 -5.0
Emulsifier 1	0.1-1.0
Preservative 1	0.1-1.0
Emulsifier 2	0.1 – 1.0
Water (distilled)	40-80
Total	100.0

Example 9

In this Example 9, palm-based liquid coconut milk substitute was obtained as in Example 1 using palm oil at 15% on a weight basis.

INGREDIENTS	%	Weight (g)
Palm Oil	15.0	79.5
Maltodextrin	7.8	41.3
Sodium Caseinate	1.3	6.9
Coconut Flavor	0.5	2.65
Dimodan OT	0.2	1.06
Tryppolyphosphate	0.2	1.06
Panodan	0.03	0.159
Water	75.0	397.5
Total	100	530.0

The role of the ingredients in the table above are as follows:

1) Palm-based oil is palm oil.

2) Food additive (polysacaride/modified carbohydrates) is Maltodextrin.
3) Stabilizer is sodium caseinate (which acts as emulsifier and stablilizer).
4) Permitted flavour is coconut flavour.
5) Emulsifier 1 is dimodan OT.
6) Preservative is trypolyphosphate.
7) Emulsifier 2 is panodan.

Example 10

In this Example 10, palm-based liquid coconut milk substitute was obtained as in Example 1 using palm oil at 60% on a weight basis.

INGREDIENTS	%	Weight (g)
Palm Oil	60.0	318.0
Maltodextrin	7.8	41.3
Sodium Caseinate	1.3	6.9
Coconut Flavor	0.6	3.2
Dimodan OT	0.2	1.1
Tryppolyphosphate	0.2	1.1
Panodan	0.03	0.16
Water	30.0	159.0
Total	100	530.0

The role of the ingredients in the table above are as follows:
1) Food additive (polysacaride/modified carbohydrates) is Maltodextrin.
2) Stabilizer is sodium caseinate (acts as emulsifier and stablilizer).
3) Permitted flavour is coconut flavour.
4) Emulsifier 1 is dimodan OT.
5) Preservative is trypolyphosphate.
6) Emulsifier 2 is panodan.

While specific embodiments have been disclosed and described in this specification, it should be understood that other alternatives, modifications, substitutions, variations and substantial equivalents might be apparent to those skilled in the art. Such changes and modifications can be made without departing from the scope of the invention to adapt it to various conditions. Thus, the appended claims as filed are intended to embrace all embodiments that fall within the scope of the following claims.

CLAIMS:

1. A trans-free palm-based liquid coconut milk substitute with the following food analysis composition:

50 -70 % moisture, 0.1-3.0% ash, 1.0-3.0% protein, 20.0-40.0% fat and 4.0-8.5% carbohydrate.

2. A trans-free palm-based liquid coconut milk substitute of claim 1 comprising an energy content in a range of about 200-.410 kcal/100g.

3. A trans-free palm-based liquid coconut milk substitute of claim 1 with physicochemical properties which include:

slip melting point in the range of about 20-40°C, less than 0.05 mg/g free fatty acids, iodine value in the range of about 40-60 mg/g and viscosity in the range of about 18 –30 cps.

4. A trans-free palm-based liquid coconut milk substitute of claim 1 comprising on a weight basis:

0 cholesterol, <100 μg/100g Vitamin A, <2 mg/100g Vitamin C and 2.5-5.0 mg/100mg Vitamin E.

5. A trans-free palm-based liquid coconut milk substitute made from a formulation of ingredients comprising on a weight basis, the following:

10 – 70% palm-based oil, 4-10% food additives, 0.1-1.0 % first emulsifier, 0.1-1.0% second emulsifier, 40-80% water, and 0.5-3.0% stabilizer.

6. A trans-free palm-based liquid coconut milk substitute of claim 5 wherein the palm-based oil comprises 20-50% on a weight basis of the formulation of ingredients.

7. A trans-free palm-based liquid coconut milk substitute of claim 5 wherein the water comprises 50-70% on a weight basis of the formulation of ingredients.

8. A trans-free palm-based liquid coconut milk substitute of claim 5 further comprising on a weight basis, 0.1-5.0% flavour.

9. A trans-free palm-based liquid coconut milk substitute of claim 5 further comprising on a weight basis 0.1-1.0% preservative.

10. A trans-free palm-based liquid coconut milk substitute of claim 5 further comprising on a weight basis 0.1-5.0% flavour and 0.1-1.0% preservative.

11. A palm-based liquid coconut milk substitute of claim 5 wherein the palm-based oil comprises one or more of the following:

Palm oil, palm kernel oil, Refined, Bleached and Deodorised Palm Oil (RBD PO), Refined, Bleached and Deodorised Palm Olein (RBD POo), Super Olein (POoo), Palm Mid Fraction (PMF), Refined, Bleached and Deodorised Palm Kernel Oil (RBD PKO) and Refined, Bleached and Deodorised Palm Kernel Olein (RBD PKOo).

12. A palm-based liquid coconut milk substitute of claim 5 wherein the food additives include coating materials in the form of polysaccharides and or modified carbohydrates.

13. A palm-based liquid coconut milk substitute of claim 5 wherein the emulsifiers comprise one or more of the following:

sodium casienate, monodiglyceride, diglyceride, maltodextrin, dimodan OT, panodan.

14. A palm-based liquid coconut milk substitute of claim 5 wherein the stabilizers comprise one or more of the following:

carrageenan, guar gum, acacia gum (gum Arabic), alginates, xanthan gum, starch, tripolyphosphate, sodium casienate.

15. A palm-based liquid coconut milk substitute of claim 8 wherein the flavour comprises one or more of the following :

Virgin coconut flavour, artificial flavour.

16. A palm-based liquid coconut milk substitute of claim 9 wherein the preservative comprises one or more of the following :
Anti-microbial preservatives, antioxiodants.

17. A palm-based liquid coconut milk substitute of claim 16 wherein the anti-microbial preservative comprises one or more of the following :
Calcium propionate, sodium nitrate, sodium nitrite, disodium EDTA, sulfites such as sulfur dioxide, sodium bisulfite, potassium hydrogen sulfite, sodium benzoate.

18. A method for preparing a palm-based liquid coconut milk substitute comprising premixing a palm-based oily phase with food additives, stabilizer, emulsifiers and water, to form a premix or pre-emulsion followed by homogenizing the premix in two-stages to form an emulsion, and finally pasteurizing the emulsion, cooling and packaging.

19. A method for preparing a palm-based liquid coconut milk substitute of claim 18 which includes:

(i) Preparing a water phase by mixing a first emulsifier(s), stabilizer, food additives which may include polysaccharides and or modified carbohydrates together with water by using a mixer machine at the speed of 6000 - 9000 rpm for 5-10 minutes;

(ii) Preparing an oily phase by mixing the palm-based oil with a second emulsifier(s);

(iii) Adding the oily phase of step (ii) slowly and gradually to the water phase prepared in step (i) whilst the aforesaid mixture of two phases is continually mixed and is being heated to 50-70°C for 10-15 minutes until all ingredients are dissolved to become a premix of the said two phases i.e. a pre-emulsion;

(iv) Homogenizing the pre-emulsion from step (iii) in a two-stage homogenizer at 30-60 MPa to form an emulsion, said emulsion being the palm-based liquid coconut milk substitute;

(v) Pasteurizing the emulsion of step (iv) at 60-85°C for 15 seconds - 5.0 minutes or sterilizing said emulsion at 120-135°C for 4 -5 seconds.

20. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein homogenization in step (iv) produces an emulsion with fat globules having an average particle size in a range of about 0.1-2.0 micron in diameter.

21. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein hydrocolloids are used to improve the functionality of said coconut milk substitute and as a preservative in a range of about 0.1 – 1.0 %.

22. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein the food additives further comprise artificial flavour and or virgin coconut flavour.

23. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein the food additives further comprise antioxidant preservatives in a range of about 0.1 – 0.6% to prevent oxidative flavour deterioration and delay rancidity.

24. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein the food additives further comprise Vitamin E as a preservative in a range of about 0.01 -0.1%.

25. A method for preparing a palm-based liquid coconut milk substitute according to claim19, which further comprises fortification with calcium in a range of about 0.1 – 1.0%.

26. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein the palm-based oil comprises one or more of the following:

Palm oil, palm kernel oil, Refined, Bleached and Deodorised Palm Oil (RBD PO), Refined, Bleached and Deodorised Palm Olein (RBD POo), Super Olein (POoo), Palm Mid Fraction (PMF), Refined, Bleached and Deodorised Palm Kernel Oil (RBD PKO) and Refined, Bleached and Deodorised Palm Kernel Olein (RBD PKOo).

27. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein the emulsifiers comprise one or more of the following: sodium casienate, monodiglyceride, diglyceride, maltodextrin, dimodan OT, panodan.

28. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein the stabilizers comprise one or more of the following: carrageenan, guar gum, acacia gum (gum Arabic), alginates, xanthan gum, starch, tripolyphosphate, sodium casienate.

29. A method for preparing a palm-based liquid coconut milk substitute according to claim 19 wherein the palm-based oil is blended with one or more vegetable oils.

30. A method for preparing a palm-based liquid coconut milk substitute according to claim 29 wherein ratios for blending are 50:50, 60:40, 70:30, 80:20 and 90:10 of the palm-based oil to the vegetable oil.

31. A method for preparing a palm-based liquid coconut milk substitute according to claim 29 or 30 wherein the vegetable oils comprise one or more of corn oil, soybean oil, rapeseed oil, sunflower oil and peanut oil.