Highlights of Research on Food Uses of Palm Oil and its Products

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INTRODUCTION

Palm oil products are becoming important as raw materials in food products. This is due to their unique fatty acid and triglyceride composition and thermal properties. It is important to note that 80% of the palm oil products and its fractions are being used in food formulations. While a great deal of information is available on the use of palm oil and its fractions in food products, much more work is needed in promoting their utilisation.

This paper will discuss the utilisation of palm oil products in making various food products such as margarine, cooking oil, shortening, vanaspati, confectionery fats, *etc.* Other new products developed in PORIM will also be highlighted.

FOOD USES OF PALM OIL AND ITS PRODUCTS

Palm oil in technical terms, is a versatile edible oil. It has a range of distinctive properties which enable it to meet most of the quality and technological requirements in formulating major fats based products. Like all other edible oils and fats, palm products, depending on their technological strengths and weaknesses, can be incorporated in a given food product at very high or low levels. However, the performance of palm oil products have been widened by fat modification processes to a point where much higher levels can be incorporated at competitive costs than was possible in the past.

Frying Oil

Frying is a popular traditional cooking process in the home and is universally used in the food industry to produce snacks and convenience foods. Frying is quick compared with other traditional means of cooking and produces attractive flavours and textures. Domestic frying may be in shallow pans or in deep fat frying. Industrial frying is normally in deep fat fryers.

The good frying properties of palm oil products are due mainly to its moderate degree of unsaturation and the absence of linolenic acid (C18:3). However, the presence of disaturated glycerides in palm olein results in the deposits of solids at low temperatures as indicated by the cloud point of 8°C-10°C compared with liquid vegetable oils at 0°C or below. The liquid vegetable oils on the other hand tend to have poor oxidative stability. PORIM has examined the behaviour of the blends with palm olein. Blends containing about 30% palm olein generally have cloud point of about 0°C and improved oxidative stability. The induction period and cloud point of the palm olein, other liquid oils and their blends are shown in *Table 1.*

A series of frying experiments were carried out with groundnut oil and groundnut oil blended with 30% palm olein. The results of most analytical test show that blend behaved better than 100% groundnut oil. There was slower development of free fatty acids and lower increase in viscosity. It also showed less polymer formation, low smoke point and less formation of conjugated dienes and trienes. Foam development in

TABLE 1. THE INDUCTION PERIOD (I.P) AND CLOUD POINTS OF PALM OLEIN AND BLENDED PALM OLEIN WITH OTHER LIQUID OILS

Oils/Blends	Induction Period (hrs)	Cloud Point (°C)
RBD palm olein	44.0	9.6
Groundnut oil	15.0	1.9
Groundnut oil/Palm olein	21.0	2.0
Maize oil	9.0	-9.5
Maize oil/Palm olein	12.0	-1.9
Rapeseed oil	11.5	-5.0
Rapeseed oil/Palm olein	16.0	0
Soyabean oil	16.0	-9.0
Soyabean oil/Palm olein	19.0	-2.2
Sunflower seed oil	6	-9.5
Sunflower seed oil/Palm olein	7	-2.3

*Palm olein added at 30% in blend.

the two oils was similar. The clarity of the oil blends during their shelf life is also better.

Margarine

Three main types of margarine formulated according to different criteria can be distinguished:

Table margarine. This type of margarine is now divided into the distinct categories of tub and packet margarines.

Tub margarine has fairly low solids at low temperature, thus enabling it to be spreadable direct from the refrigerator. In addition, the fat blends melt completely below 37°C and hence have a very good oral melt down. Formulation containing 25% palm oil is universal but palm olein content could be increased to 40% in a premium tub margarine. By hydrogenating, the level of palm olein can be increased to 50%. As for palm oil, up to 50% can be used for tub margarine but this is at the expense of its oral melt. By interesterification of palm oil with other oils, blends containing up to 80% palm oil are achievable.

About 10%-15% of palm stearin can be used in tub margarine by blending with liquid oils. With interesterification, good margarine base stocks can be made using a higher percentage of palm stearin and palm kernel olein or palm stearin with liquid vegetable oils. Thus by interesterification, higher amounts of palm products, such as palm kernel oil and palm stearin, can be used in the margarine formulations. Some of the formulations are shown in *Table 2.*

By careful selection of blends, a wide range of formulation can be produced. Packet margarine can be produced direct from palm oil blends. As stated earlier, the amount of palm oil is restricted up to 50% but can be increased by interesterification with other liquid oils. *Table 3* shows some of the formulations using interestrified palm products and other liquid oils.

Industrial margarine. The functionality of the industrial margarine is to some extent dependent on the end use, its formula and processing. The best margarine for one purpose may not be so for another.

Industrial margarine requires high level solids, at about 20°C. At this temperature, palm oil has about 23% solids and therefore is a valuable oil for industrial margarine. For cake margarine, the high palmitic acid content in palm oil is also good for aeration of fat/sugar mixtures. In this type of margarine, various levels of palm oil products

TABLE 2. CHARACTERISTICS OF TABLE MARGARINE

Formulation	POs:PO:SBO (5: 30:65)	PO:POo:SBO (30:40:30)	POs:CSO (20:80)
Temperature (°C)	**Solid Fat Content (%)**		
5	19	39	18.7
10	14	30	10.3
15	10	19	6.5
20	8	10	3.7
25	7	7	2.8
30	6	3	2.2
35	3	2	1.1
40	2	0	0.6
SMP (°C)	33	35	34.0
Yield value g/cm^2	786	800	760

TABLE 3. TABLE MARGARINE FORMULATIONS BASED ON INTERESTERIFIED PALM PRODUCTS AND OTHER LIQUID OILS

Formulation	
A	IE(PO:PKO):SBO (87.5:12.5) (30:70)
B	IE(POo:PKOo):SBO (75:25) (30:70)
C	IE(POs:PKOo:SFO):SFO (60:20:20) (55:45)

Source: Nor'aini Sudin *et al.*, (1993). Selected Readings on Palm Oil and its Uses.

can be used, ranging from 50% to 100%. Palm kernel oil has good creaming properties due to its fast crystallisation property enhancing its use in cake margarine. Some formulations using palm products are shown in *Table 4.*

Pastry margarine. The pastry margarine requires relatively high solids content and in addition plasticity which must be retained during the multiple rolling operations in the preparation of the dough. *Table 5* shows some of the formulation using palm oil and its products.

Shortening

Shortenings are formulated to satisfy specific markets or user requirements and therefore show wide variation in their physical characteristics. The factors generally taken into account in order to develop shortenings are type and recipe of the baked product, type of the process involved and users, *i.e.* whether industrial or household. The two main types are plastic shortenings and pumpable or fluid shortenings.

Plastic shortening. Most of the shortenings produced around the world are in consistent form and smooth in texture. Shortenings of the smooth type are used in the bakery industry, catering trade and also in the homes for a variety of uses such as in the preparation of biscuits, cakes, pastries, bread and icing.

TABLE 4. INDUSTRIAL MARGARINE FORMULATION USING PALM OIL PRODUCTS AND OTHER LIQUID OILS

Formulation	POs:PO:SBO (70:30) (60:40)	PO:CAN (60:40)
Temperature (°C)	**Solid Fat Content (%)**	
5	40	41
10	33	37
15	24	30
20	18	23
25	13	18
30	12	14
35	7	10
40	5	7
SMP (°C)	42	42
Yield value g/cm^2	405	839

TABLE 5. PASTRY MARGARINE FORMULATION BASED ON PALM PRODUCTS

Formulation	POs:PKO:POo (75:15 :10)	IE(POs:PKO):POo (70:30) (85:15)
Temperature (°C)	**Solid Fat Content (%)**	
5	67	80
10	60	76
15	49	66
20	40	53
25	30	39
30	23	28
35	17	17
40	15	8
SMP (°C)	45	42
Yield value g/cm^2	725	–

Pumpable shortening. Pumpable shortenings come in the form of suspensions or clear liquids. It should be noted that the fluid shortenings are a special type to be distinguished from liquid shortenings. Both are pourable and pumpable but the fluids are opaque due to the presence of suspended soilds while the liquids are clear. Some thick suspensions are based on beta crystallising fats though in most cases beta prime crystallising fats and high levels of emusifiers are required. Pumpable shortenings are commonly supplied to the industrial sector.

In formulating a consistent fat such as shortening, a common method is to match the solid fat profile for compatible physical characteristics. Bakery shortenings generally have flat solid fat content profile. At 20°C, these shortenings have between 15% -25% solids and have melting point above 38°C. However, even if the solid fat content and the melting point of the two shortening

TABLE 6. SHORTENING FORMULATIONS BASED ON DIRECT BLENDING AND INTERESTERIFICATION OF PALM PRODUCTS AND OTHER LIQUID OILS

Formulation	POs:IE RSO (60:40)	IE:(POs:SBO) (70:30)	IE POo
Temperature (°C)	**Solid Fat Content (%)**		
10	36.8	44.5	49.9
15	29.9	34.7	37.4
20	23.3	26.8	28.9
25	17.7	21.5	19.3
30	14.0	14.8	12.8
35	10.1	13.7	10.6
40	7.4	9.6	6.8
SMP (°C)	46.0	44.0	41.5

are similar, performance of these shortenings in the baked products can still be affected by their structural and compositional differences.

Palm oil at 20°C has 22%-25% solids and has consistency similar to a plastic cake shortening. However, the shortening based on 100% palm oil has defective performance in cakes. On the other hand, palm oil products are valuable ingredients for shortening formulating. These products have the tendency to stabilise the shortenings in the beta prime crystalline form so as to perform effectively in cakes.

The amount of palm oil and its products in cake shortenings generally varies from 30%-40%. In some shortenings, up to 80% palm oil products are used. *Table 6* shows some of the shortening formulations based on direct blending and interesterification.

VANASPATI

Vanaspati is essentially a substitute for or an imitation of ghee. The product is used popularly as an all purpose cooking fat in the Indo-Pakistan sub-continent, Middle-Eastern countries and South East Asia. Vanaspati has a grainular or grainy texture. In India and Pakistan, this grainy characteristic is considered as an important criterion of quality. Vanaspati with a smooth texture is particularly popular in the Middle-Eastern countries. Softer consistency vanaspati favours oil separation. Oil separation occurs in the coarse grained vanaspati. When vanaspati is set to a smooth, grainless state, the oil separation is negligible. However, the oil separation is more acute in products with high and low melting point fat blends than with close melting points fat blends or even straight hardened products. The oil separation is minimal in products with close melting points fat blends. Oil separation is greater in cases of products containing more palmitic acid. *Table 7* shows the formulations of vanaspati based on the blending of palm products with hydrogenated liquid oils. These products have been reported to contain more than 30% *trans* fatty acid.

Palm oil and palm stearin are semi-solid at ambient temperatures. These, therefore, do not need hydrogenation, thus can be termed a *trans*-free vanaspati. Products based on these fats would not only be cheaper in terms of raw materials cost but also in terms of processing cost.

CONFECTIONARY FATS

There are two types of chocolate products, *i.e.* real and imitation chocolate. In real chocolate products, the fats phase consists of two components, *i.e.* cocoa butter and milk fat. In imitation chocolate products, the major part of the cocoa butter is re-

TABLE 7. VANASPATI FORMULATIONS BASED ON PALM PRODUCTS AND OTHER LIQUID OILS

	Formulations		
	PO:POs:HCSO (54:6 :40)	PO:POs:HSBO (65:9 :26)	POs:HCSO:HSBO (70:7 :23)
Temperature (°C)	Solid Fat Content (%)		
5	63.4	65.5	66.0
10	51.8	57.6	56.7
15	42.3	45.2	45.2
20	31.4	32.7	32.6
25	20.1	21.2	20.5
30	13.4	13.8	15.8
35	7.5	8.2	8.4
37	5.4	7.0	6.2
40	1.0	0.1	0.4
SMP (°C)	38.3	38.5	38.0

Source: Teah Y.K. *et al.*, PORIM Report PO(89)85

placed by vegetable fats of having consistency and melting behaviour similar to cocoa butter. Fats which replace partly or wholly cocoa butter in chocolate products are known as Cocoa Butter Replacer (CBR) or Cocoa Butter Alternative (CBA) fats. These fats are further classified into Cocoa Butter Equivalent, Cocoa Butter Substitute and Cocoa Butter Extender.

Cocoa butter equivalent. These fats behave like cocoa butter in all respects and to mix with cocoa butter in all proportions without altering their melting, rheological and processing properties of cocoa butter. These fats are formulated from fats and fat fractions rich in symmetrical triglycerides. Palm mid-fraction mixed with a fraction from the fat of one or other of the SOS type fat such as Sal, Shea or Illipe fats gives a product of same behaviour as cocoa butter.

Cocoa butter substitute. These fats are not fully compatible with cocoa butter. They are usually made from lauric oils. Palm kernel oil, either modified or in its natural state, is suitable due to its steep solid fat content profile.

Cocoa butter extender. These fats can be mixed with cocoa butter only to some extent, without significantly altering its melting, rheological and processing properties. A useful confectionery fat can be made starting with palm olein, particularly a double fractionated olein with a high POo content. The product has a limited compatability with cocoa butter. The olein is selectively hydrogenated to 35°C-37°C melting point to produce CBS suitable for making soft coating for soft cake and confectionery centers. Such a fat is also suitable as a creaming fat for biscuits and wafer filling, toffee fat, *etc.* Palm olein and Shea or Sal olein blended at 70:30 ratio can be hydrogenated to 38°C melting point to produce a CBS for making non-tempering bakery coatings. This fat can tolerate 15%-20% cocoa butter and up to 15% milk fat.

CREAMERS

Non Dairy Creamer

Palm oil is becoming the choice oil with which to reconstitute skimmed milk powder. Its outstanding property, referred to so often when discussing the applications of palm oil in nutrition, is its stability. This it owes to its inherently stable fatty acids.

Non dairy creamer or coffee whiteners

TABLE 8. NON-DAIRY CREAMER FORMULATION

Ingredients	%
Hydrogenated palm kernel oil (38°C)	16.0
Sodium caseinate	6.0
Maltodextrine (28 DE)	26.8
Emulsifier	0.5
Stabiliser (carrageenan)	0.03
K_2HPO_4	0.3
Water, colour and flavour up to	100

Source: Teah Y.K *et al.* (1994). Palm Information Series No. 26.

are prepared as substitutes for cream, evaporated milk or fresh milk in coffee, tea and drinking chocolate. They are formulated as replacement for their natural counterparts on the basis of their longer shelf life, easier storage and production economics – which often lead to lower retail prices.

The purpose of coffee whitener is the development of desirable colour change, but it also imparts body to the food to which it is added. A properly formulated product will impart a desirable cream-like flavour to a food or beverage.

Several types of fats are used in coffee whiteners, but the main criteria for selecting the fat are good palatability and a high degree of resistance to oxidation. The fat has to take into consideration the temperature during transit and storage apart from the requirements described earlier. A fat with a melting point of 38°C-40°C and an iodine value of less than three meets this requirement. Thus hydrogenated palm kernel oil with a melting point of 38°C is suitable, especially in a tropical countries. A general formulation is shown in *Table 8* where palm kernel oil is used in the formulation.

Ice Cream

Ice cream is oil in water emulsion in which the aqueous phase contains milk solids in solution or in the colloidal state. A carbohydrate-type stabiliser is also in the solution. The final product is a foam, with an emulsion of somewhat modified composition as the continuous phase. The ice cream foam is required to be stable at about -5°C, when some 50% of the water is in the frozen state.

In the preparation of an ice cream, the homogenised ice cream mix is stored at 5°C for three hours or more and is then ready for the combined freezing and aerating step. This takes place in a scrape surface heat exchanger where the mix is rapidly chilled to -5°C. At the same time, about 50% volume of air is introduced with strong agitation. The product leaving the freezer is essentially in finished form, but for storage it is chilled further to -18°C or lower.

Palm and palm kernel oil are suitable ingredients for ice cream manufacturing. They have been widely used with or without modification in the ice cream industry to replace milk fat. *Table 9* shows the composition of ice cream where the fat part is composed of palm kernel oil or blends of palm products.

Whipped Cream

The whipped cream structure is essentially the same as that of ice cream. The factors controlling structural stability are somewhat different in comparison with ice cream. Cream has a much higher fat content, it is not frozen, and it needs to be stable at room temperature. Continuous regions of free fat in a partly crystalline state are important in the structure. If

TABLE 9. COMPOSITION OF ICE CREAM

Ingredients	%
Fat	9-12
Milk solid other than fat	10-11
Sugar	13-16.5
Emulsifier	0.4-0.7
Stabiliser	0.1-0.2
Inorganic salts	1.0

Source: Berger K.G. (1994). Palm Information Series No. 30

excessive shear forces are used during the whipping of cream, it is rather easy to get too much churning, leading to the separation of 'butter'.

The higher fat content of creams makes the melting characteristics of the fat very important. A solids content of a few per cent at mouth temperature results in a greasy residue on the palate, which consumers don't like. For this reason, palm kernel products are superior. However, palm kernel oil does not provide sufficient structural stability at ambient temperatures. Thus, the use of partly hydrogenated palm kernel oil is an improvement. The extent of hydrogenation can be carefully adjusted for stability at higher ambient temperatures, but increased hydrogenation inevitably raises the solids content at 37°C and leads to some reduction in palatability.

Some desirable characteristics, such as mouthfeel and good whipping properties, can be made by interesterifying hydrogenated palm kernel oil (I.V. 1.1) with palm stearin (I.V. 19) at 66:34 ratio. The solid fat contents of this blend at 37°C was very similar to that of the hardened palm kernel oil, but between 37°C and 25°C it was somewhat higher, conferring greater stability on the whipped cream.

NEW PRODUCTS

Trans-Fatty Acid Free Margarine

The formulations for the various types of *trans*-fatty acid free margarines prepared by either direct blending or interesterifion are shown in *Tables 10* and *11*. *Table 10* shows the formulations and some characteristics of the table margarine. This type of margarine is catogerised into packet and tub. These formulations have been tested and found to be satisfactory. Interesterification of palm oil products, increase the percentage of palm oil products incorporated in these types of margarines. The interesterification reduces the solid content of the blend to a level suitable for margarine manufacture. The oral melting properties are correspondingly improved by interesterifying palm oil products, specially palm stearin, with non-lauric liquid vegetable oil. *Table 11* shows the formulations for industrial margarine. Direct blending of palm oil with/without other liquid vegetable oil products is suitable for industrial margarine. This type of margarine requires high solids at 20°C. At this temperature, palm oil has about 23% solids and therefore is a valuable oil for industrial margarine. Various levels of palm oil products can be used in this margarine, ranging from 50% to 100%.

TABLE 10. *TRANS* FATTY ACID FREE TABLE MARGARINE

Type	Tub	Packet
	IE(POs:PKO):RSO (60 :40) (50:50)	IE(POs:PKOo):RSO (70:30) (60:40)
Temperature (°C)	Solid Fat Content (%)	
5	33.4	–
10	27.8	–
15	19.9	22.0
20	13.5	15.8
25	9.5	10.5
30	6.4	6.7
35	1.7	2.6
37	1.6	2.0
SMP (°C)	33.2	35.8

Source: Yusof MSA *et al.*, 1996, Palm Information Series No. 55.

TABLE 11. FORMULATIONS OF *TRANS* FATTY ACID FREE INDUSTRIAL MARGARINE

Formulation	POs:PO:POo:SBO (10:40 :30 :20)	PO:POs:PKO (60:20 :20)
Temperature (°C)	Solid Fat Content (%)	
5	48.1	64.7
10	40.1	52.7
15	27.8	35.9
20	16.0	24.7
25	9.0	15.4
30	5.1	10.6
35	3.6	7.1
37	1.6	4.1
40	0.9	–
SMP (°C)	36.4	43.5

Source: Yusof MSA *et al.*, 1996, Palm Information Series No. 55.

Palm kernel oil has good creaming properties due to its fast crystallisation behaviour, enhancing its use in industrial and cake margarine.

Palm-based Reduced Fat Spread

Reduced fat spreads can be formulated to meet the demands of convenience and health. It is normally formulated using 40% to 60% fat and is used for spreading on bread. In this product, the oil exerts a major influence in determining the shape, size and arrangement of the fat crystals. This network of crystals determines the melting characteristics of the products and provides the form and texture of the finished spread.

Palm oil and its products should make significant contributions to the development of reduced fat spread from an economic standpoint, nutrition and improved product texture. Up to 30% palm oil could be used in the formulation. Alternatively, palm oil may be interesterified with other fats which contain shorter chain fatty acids such as palm kernel oil to give blends with cooler, quicker melting characteristics. A higher percentage of palm olein may also be used in the formulation. The basic formulation of reduced fat spread is shown in *Table 12.*

Trans-Free Pourable Margarine

A pourable margarine is a margarine in fluid form. It has a higher amount of liquid and its solid fats content is below a defined level in order to maintain fluidity and to prevent emulsion break. Like any other margarine, a pourable margarine contains 80% fat and 20% other ingredients. The oils and fats contained in the product are responsible for the behaviour of the entire product. They influence the polymorphic behaviour of the product. Thus, a pourable margarine formulation differs form the conventional one by having a higher amount of liquid oil.

Palm oil, palm olein and other fractions have been proven to be a good ingredient for the formulation of pourable margarine.

TABLE 12. FORMULATION OF THE REDUCED FAT SPREAD

Ingredients (%)	Product Type	
	60%	40%
Fat	59.5	39.5
Emulsifier	0.5	0.7
Water	39.0	51.7
Stabiliser	1.0	8.0
Potassium sorbate	–	0.1

Source: Noor Lida *et al,* 1997, Palm Information Series No. 64.

TABLE 13. *TRANS* FATTY ACID FREE VANASPATI BASED ON DIRECT BLENDING AND INTERESTERIFYING

Oils Type	Composition (%)					
	Blending			Interesterifirying		
	1	2	3	4	5	6
POS	60	60	60	80	80	80
SBO	40	–	–	20	–	–
RSO	–	40	–	–	20	–
SFO	–	–	40	–	–	40

Source: Nor Aini Idris *et al.*, 1997. Palm Information Series No. 66.

The favourable physico-chemical characteristics of palm olein produces the desired consistency required for a pourable margarine.

Palm-based *Trans*-Free Vanapati

Trans-free vanaspati formulations prepared by direct blending or interesterification are shown in *Table 13*. It shows that vanaspati based on direct blending of 60% palm stearin and 40% other liquid oils such as soyabean, rapeseed and sunflower oils have good characterisitics. By interesterification, a higher amount of palm products – up to 80% palm stearin could be used in the formulation. Some of the tested products were similar to conventional hydrogenated vanaspati with respect to appearance and consistency. The interesterified vanaspati had softer consistency than direct blends of palm stearin with other oils.

Palm-based Salad Dressing

The commonly used oils in the manufacture of salad dressings are sunflower, corn, soyabean, canola and cottonseed oils. Palm oil is not used because it tends to break the emulsion at low temperature. Nevertheless, palm olein, the liquid fraction of palm oil has been used for making salad dressings. It was found that higher IV palm oleins (IV 60-67) were suitable to be used as salad oil and for making salad dressings. The use of high IV olein is preferred due to its consistent supply, availability and competitive price compared to other vegetable oils such as sunflower, soyabean, corn, canola or cottonseed. Another advantage is that palm olein is a very stable oil due to its high content of vitamin E, a natural antioxidant.

Microencapsulated Palm based Product

Microencapsulation is a technique by which droplets of liquid oil or solid fat particles of palm oil based products (core material) are coated with thin film of coating agent. The structure formed by the coating agent around the core material protects the core against deterioration and releases it under desired conditions. The coated oils or fats are then spray dried to produce fine oils or fats powder. This technique is economical and flexible and produce products of good quality.

Coating materials for microencapsulation by spray frying technique should have bland flavour, high solubility and possess the necessary emulsification properties, film-forming and good frying characteristics. The coating materials commonly used include natural gums, carbohydrates and proteins.

Studies carried out showed that under carefully selected conditions, spray drying technique has proven to be successful in producing powdered oil containing up to 70% palm oil and even greater when the higher melting point fraction of palm oil was used. The microencapsulated oils have good free flowing properties and are mechanically stable.

Palm-based 'Santan' Powder

Palm-based 'santan' powder, produced through spray drying, is formulated to reduce deterioration, improve flavour and nutritive value and enhance stability during storage and transportation. The spray drying technique offers an attractive approach to transform liquid emulsion 'santan' into a more stable and free flowing powder form. The feed material is an emulsion in which the disperse phase to be encapsulated is the palm oil and the continuous phase is a solution made up of wall material and emulsifiers for stabilisation. To enhance the flavour and aroma, 8%-15% of artificial coconut flavour is incorporated into the formulation. An anti-caking agent is added in the formulation after the spray drying process to prevent waxy surface formation and improve powder flow. Consumer acceptability, in terms of colour, aroma, appearance and taste, conducted with the food product prepared with palm-based 'santan' powder received scores comparable to that of commercial 'santan' made from coconut milk.

Palm-based Processed Cheese

Processed cheese is made by blending natural cheese in the presence of water, colouring matter and emulsifying salts. The blend is heated and agitated to produce a homogenous mixture. Processing of cheese using heat and agitation will result in the cheese constituents separating but not melting. The curd will shrink and allow fats and moisture to escape.

Different fractions of palm-based oils comprising 30% palm oil and 70% palm kernel olein could be blended and used in the formulation. The use of palm-based products will improve the nutritional value, have better functionality and preservation qualities.

Palm-based Chocolate Pastel

Chocolate pastel is a kind of chocolate without the cocoa added. The products rely on the milkfat and added essence like vanilla, lemon, orange and others for their flavour. The colour of these products are basically white while food colour can be added to improve the appeal and variety. These products have a good bloom resistance because of the incorporation of milkfat. Milkfat is known to have properties that inhibit bloom formation in chocolate.

Palm mid-fraction has excellent physico-chemical properties for use in chocolate pastel. Palm mid-fraction does not impart a waxy taste and contain no *trans*-fatty

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Palm Based Processed Cheese

Cont. from pg. 31

acid. Palm mid-fraction which also has a low content of linoleic acid (C18:2) is therefore not prone to oxidation.

The ingredients for making the chocolate are the fats (palm and palm kernel products), full cream milk powder, skim milk powder, sugar, lecithin, flavour and colour. The pastel can be manufactured using conventional chocolate making equipment.

OTHER PRODUCTS

Apart from the above major uses, the palm and its products are also being used in products such as yoghurt, chocolate drinks, baby food, convenient food and snacks and many more. PORIM will continue its effort to develop more food products using palm oil products.

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