

Interesterification – A Useful Means of Processing Palm Oil Products for Use in Table Margarine

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INTRODUCTION

Fats and oils play an essential role in the human diet and they have the important quality of improving the palatability of foods. Because of this they are used in a great variety of foods: these uses demand widely varying properties *e.g.* in crystallization and melting behaviour.

The main component of oils and fats is the triglycerides whereby the physical nature of the oil or fat is determined by:

- the chain length of the fatty acids in the triglycerides
- the degree of unsaturation of the fatty acids

- the distribution of the fatty acids in the triglyceride molecules.

Every oil and fat has a certain pattern of distribution of the fatty acids among its triglycerides, which also bears on whether it is solid or liquid. Hence, this limits the use of particular oils or fats. In order to extend their uses, special processing techniques are used to modify the original oils or fats. Amongst them are fractionation, hydrogenation, and interesterification, or a combination of these. Interesterification alters the original distribution of fatty acids attached to the glycerol moiety, giving rise to fats with different melting and crystallization characteristics from those of the original fat.

In the production of table margarine, different oils and fats are blended to make a product that is spreadable at refrigerator temperature or in the case of block table margarine, to make its spreadability resemble that of butter. Palm oil products have been widely used as a major component in margarines and shortenings. However, the versatility of palm oil products could be further extended by the interesterification process.

This article describes some materials prepared from palm oil products in PORIM's laboratories by means of interesterification, and discusses their properties and possible uses.

TABLE MARGARINE (tub)

Depending on the type of process used to prepare palm stearin, the melting point and iodine value vary widely. Though direct usage of palm stearin as a hard stock in formulations for industrial margarine and shortening has practical value, direct usage in softer products like table and refrigerated margarines is rather limited. Only about 10%-15% of palm stearin can be

used in tub margarines by blending with liquid vegetable oils. Two typical formulations for table margarines based on palm stearin are the following:

	%	%
Palm olein	40	40
Palm stearin	7	10
Sunflower seed oil	50	-
Rapeseed oil	-	50
Palm kernel oil	3	-

Solid Fat Content	(SFC) (%)	(wideline NMR)
10°C	24.5	21.0
20°C	8.9	4.0
35°C	NA	0.3
40°C	0	0

By the process of interesterification (IE) an excellent margarine base-stock can be made using products from the fractionation of both palm oil and palm kernel oil. The base-stock can be blended with other oils to produce the required margarine.

PHYSICO-CHEMICAL PROPERTIES OF INTERESTERIFIED PALM BLENDS

Blend	Interesterified Blends	
	Palm Kernel Olein (PKOo)	IE(POS/PKOo) IB(POs/PKOo)
Palm Stearin (POS)		
Composition	70:30	(70:30) (60:40)
Slip Melting Point (°C)	45.5	36.2 34.3
SFC (%) (wideline NMR)		

10°C	56.3	50.0	31.8
15°C	42.2	38.6	23.3
20°C	29.8	26.9	15.6
25°C	20.9	17.9	10.8
30°C	16.3	10.4	6.3
35°C	11.1	0.1	2.4
40°C	10.7	-	-

Palm stearin can also be blended with liquid vegetable oils such as rapeseed or

soyabean oil before interesterification to produce blends for margarine formulations.

Composition Slip Melting Point (°C)	Interesterified Base-stock Blend (Palm Stearin (30°C): Rapeseed Oil)(A) 60:40(A)	Base-stock blended with rapeseed oil (B)(A/Rapeseed Oil 60:40)
	35.3	34.4

(wideline NMR)

SFC (%)

10°C	42.5	22.3
15°C	30.2	15.5
20°C	21.6	9.3
25°C	15.2	7.3
30°C	10.1	4.6
40°C	3.7	0.6

Composition Slip Melting Point (°C) SFC (%) (wideline NMR)	Blend Palm Stearin Blend: (50°C):Soyabean Oil(SBO) 50:50	Interesterified Blend (POS : SBO) 50:50
	-	36.6
10°C	35.7	23.7
15°C	28.7	17.6
20°C	25.3	14.0
25°C	20.8	9.1
30°C	15.4	5.8
40°C	11.0	0.8

Useful blends for table margarine can also be obtained by interesterifying ternary

mixtures of different oils to achieve the desired characteristics.

Composition Slip Melting Point (°C) SFC (%) (wideline NMR)	Blend Palm Stearin: Rapeseed Oil: Palm Kernel Oil 40 : 40 : 20	Interesterified Blend (POS : RSO : PKO) (40:20:20)
	42.5	29.3

10°C	32.3	26.3
15°C	24.4	16.9
20°C	17.8	8.6
30°C	11.4	1.4
40°C	7.7	-

BLOCK TABLE MARGARINE

By careful choice of blends, a wide range of formulations can be produced. Packet or block table margarine is formulated to simulate butter, so that the spreadability of the product at 15°C-20°C is important. Under normal circumstances,

the direct use of palm oil in blends for block margarine is restricted to a maximum of 50 per cent. However, by means of interesterification higher levels of palm oil could be used. A blend based on interesterified palm oil can be produced which resembles block margarine made in Denmark.

BLOCK MARGARINE FORMULATION BASED ON INTERESTERIFIED PALM PRODUCTS

Temperature (°C)	Commercial Danish Margarine Composition SFC (S) (magnetic NMR)	Intesterified Blends	
		Palm Olein: Palm Kernel Oil IE (70:30) 33.3	Palm Stearin: Palm Kernel IE (75:25) 32.5
15°C	33.0	34.6	33.5
20°C	19.3	22.7	22.5
30°C	4.9	7.8	6.9
40°C	0.7	-	-

TRANS-FREE TABLE MARGARINE

Trans fatty acids produced during the hydrogenation of vegetable oils are currently the subject of controversy. The nutritional effects of *trans* fatty acids are also a matter of controversy, but there are numerous publications

indicating that the effects are undesirable. *Trans*-free margarine could be produced conveniently by particular countries by interesterifying palm products with the oils and fats indigenous to those countries. A good example of a *trans*-free margarine formulation is the following:

Blend	Intesterified Blend B	
	Palm Stearin: Palm Kernel Olein: Sunflower Seed Oil IE (80:20) 36.5	Intesterified Blend B with sunflower seed oil IE (80): SFO 34.5
10°C	33.7	16.0
15°C	24.6	14.0
20°C	18.9	11.0
30°C	7.1	5.9

Fatty acid composition

C8:0	0.7
C10:0	0.5
C12:0	6.6
C14:0	2.6
C16:0	28.6
C18:0	3.9
C18:1 <i>cis</i>	27.2
C18:1 <i>trans</i>	-
C18:2 <i>trans; cis</i>	-
C18:2 <i>cis; cis</i>	28.6
C20:0	0.2
C18:3	0.3
Others	-
Saturates	43.1
Monounsaturates	27.1
Polyunsaturates	28.9
<i>Trans</i>	nil
Yield values of Margarine	
10°C	400-500gcm ⁻²
20°C	200-300gcm ⁻²

Many other useful blends based on interesterified palm products with other vegetable oils are available. They may be produced as a base stock which can be blended with other oils and fats for different applications. Some of the

it allows the combination of the properties of different oils and fats. Many of these interesterified fat mixtures could be used in formulations for margarine and shortenings.

CONCLUSION

Intesterification of oil and fat mixtures is very important in industry, and the products are extremely versatile. Its principal advantage is that

Palm oil products can be used through direct blending to achieve the desired characteristics demanded for many food products. However, through interesterification the versatility of palm products is further extended, and the process could be used to 'tailor make' a range of product types as required.

Palm oil	70	65	-	-	-	-	-	50
Sunflower seed oil	-	35	35	35	-	-	-	-
Palm olein	-	-	65	-	50	-	-	-
Palm stearin	-	-	-	55	50	70	70	-
Palm kernel olein	-	-	-	15	-	-	-	-
Palm kernel oil	-	-	-	-	-	30	-	50
Soyabean oil	30	-	-	-	-	-	30	-
SFC (%)	(wideline NMR)							
10°C	28.5	26.2	23.9	43.3	67.4	52.3	39.4	45.3
15°C	17.0	18.4	17.8	32.6	60.5	39.4	29.9	31.9
20°C	11.8	11.2	10.7	23.8	50.1	27.8	21.7	18.3
25°C	8.2	7.3	4.8	16.6	37.8	18.0	14.9	9.6
30°C	4.2	5.5	2.9	10.8	30.9	11.1	7.6	1.7
40°C	-	1.7	0.5	-	16.9	-	4.0	-