CRYSTALLISATION OF PALM OLEIN

by: SIEW WAI LIN

OCTOBER 1998

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PORIM INFORMATION SERIES ISSN 0128-5726

INTRODUCTION

Palm olein is the liquid fraction obtained from the fractionation of palm oil. A second fractionation of palm olein yields a product of higher iodine value(IV) and is called double-fractionated palm olein. Single fractionated palm olein may also be of high IV and thus all oleins of IV greater than 56 are also known as 'super oleins'.

Palm olein is widely used throughout the world as cooking oil. However, its usage is limited by the tendency to crystallise at low temperatures. From experience, it has been observed that palm oleins tend to crystallise when subject to temperature fluctuations. This crystallisation causes the formation of clouds, sometimes observed as white sediments at the bottom of the bottle containing the olein. The visual observation of these crystals is often seen as a defect by consumers although there is in actual fact no deterioration of oil quality. In spite of this problem of usage in cold climates, palm olein remains one of the most versatile oils and is widely used as a stable frying oil.

COMPOSITION

Palm olein can be classified into three main categories according to the iodine value, *i.e.*IV <60, IV of 60-65 and IV>65. In general, the ratio of POP/POO triglycerides affect the crystallisation behaviour of the oil(*Table 1*). Two grades of palm olein are commonly traded. The normal palm olein has a minimum IV of 56 and a maximum slip point of 24°C. The 'super olein' is traded as having a minimum IV specification of 60 and a maximum slip point of 19°C. The properties of these two types of oleins are given in *Table 2*. Oleins with high IV are expected to be able to resist crystallisation as given in *Table 3*. However, one may find at times that there are oleins with higher IV than another, yet having less resistance to crystallisation. Other factors may influence the cold stability of the olein.

Nucleation of palm olein during prolonged storage is found to be different from nucleation of palm olein that occurs within 24 hrs(Mohd Zaki *et al.*, 1997). In this study, the triglycerides PPP, MPP and PPS are found to be the components influencing the crystallisation of palm oleins. An earlier study by Swe *et al.*(1994) found that, upon prolonged storage of palm oleins, there were sediments in the crystals which were high in diglycerides content. This work was confirmed by Siew and Ng(1996a and 1996b) where the crystals obtained from palm oleins subject to prolonged temperature fluctuations of between 28°C and 10°C, were found to be high in diglycerides content.

TABLE 1. CRYSTALLISATION BEHAVIOUR OF PALM OLEIN

Nucleation Test (11°C)	IV	POP/POO/Ratio
< 1 hr (11 samples)	59.3 ± 3.0	0.89 ± 0.24
1 to 6 hrs (9 samples)	61.4 ± 2.9	0.83 ± 0.22
> 6 hrs (13 samples)	63.6 ± 2.8	0.56 ± 0.20

ISSN 0128-5726

Palm Oil Research Institute of Malaysia, Ministry of Primary Industries, Malaysia.
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia. Tel: 03-8259155, 8259775, Homepage: http: //porim. gov. my. Telefax: 03-8259446

TABLE 2. CHARACTERISTICS AND COMPOSITION OF PALM OLEIN
(Siew *et al.*, 1992, 1993; Tang *et al.*, 1995)

Parameter	Superolein			Normal RBD Palm Olein		
	Range	Mean	Std. Dev.	Range	Mean	Std. Dev.
Refractive Index $_D$ 40°C	1.4631-1.4641	1.4634	0.0003	1.4589-1.4592	1.4590	0.0003
App. Density (g/ml)	0.9042-0.9054	0.9046	0.0003	0.8969-0.8977	0.8972	0.0001
Slip Melting Point (°C)	12.9-16.6	15.1	0.91	19.2-23.6	21.5	0.76
Cloud Point (°C)	2.8-5.7	4.4	0.71	5.6-12.3	9.7	1.05
Iodine value, Wijs	60.1-67.5	61.9	2.05	56.0-60.0	56.8	0.62
Fatty Acid Composition (wt. %)						
C12:0	0.2-0.4	0.3	0.06	0.2-0.4	0.27	0.05
C14:0	0.9-1.1	1.0	0.06	0.9-1.20	1.09	0.07
C16:0	30.1-37.1	35.4	1.80	36.8-43.2	40.93	0.95
C18:0	3.2-4.3	3.8	0.26	3.7-4.8	4.18	0.17
C18:1	43.2-49.2	45.1	1.65	39.8-44.6	41.51	0.84
C18:2	10.7-15.0	13.4	0.94	10.4-12.9	11.64	0.36
C18:3	0.2-0.6	0.3	0.11	0.1-0.6	0.40	0.12
C20:0	0-0.4	0.3	0.17	0.3-0.5	0.37	0.07
Triglyceride Composition by C-No (wt. %)						
C44	-	-	-	0-0.5	0.09	0.08
C46	0.1-0.2	0.2	0.02	0.4-1.4	0.77	0.27
C48	1.7-2.6	1.9	0.20	2.4-3.9	3.28	0.32
C50	23.0-34.2	30.8	3.35	37.9-40.9	39.52	0.55
C52	50.2-59.6	53.4	2.43	41.9-43.7	42.74	0.44
C54	11.6-15.9	13.6	1.23	11.8-13.5	12.8	0.37
C56	0.1-0.4	0.2	0.09	0.5-1.1	0.67	0.11
Solid Fat Content, % (by NMR) Temperature (°C)						
2.5	0.5-52.4	32.3	20.09	-	-	-
5.0	0-44.7	27.1	16.58	-	-	-
7.5	0-37.0	22.4	13.63	-	-	-
10.0	0-26.3	17.5	8.96	23.9-45.5	38.3	3.29
12.5	0-17.2	11.3	5.96	-	-	-
15.0	0-9.0	0.9	2.31	10.7-25.9	19.9	2.32
17.5	0-3.5	0.9	0.99	-	-	-
20	-	-	-	0-9.0	5.7	1.41
25	-	-	-	0-4.3	2.1	1.02

TABLE 3. PALM OLEIN'S RESISTANCE TO CRYSTALLISATION AT 5°C-20°C
(Reproduced with kind permission from Idris *et al.*, 1993)

Temperature °C	IV 60	IV 63	IV 65
5	3h	< 1d	< 1d
10	> 5h	> 1d	1d
15	> 5h	1d	4d
20	> 5h	37d	35d

Note: h-hours, d-days

SOLID FAT CONTENT

The solid fat contents of palm oleins are given in *Table 2*. The amount of crystals formed at different temperatures is related to the iodine value of the oil. The amount of solids is very much reduced in oleins with IV of 61 and above(*Figure1*). Obviously such samples would have better cold stability than samples with high solids. The relationship between cloud point and iodine value is shown in *Figure 2*.

USES OF OLEIN

Olein from palm oil is used as a cooking and frying oil in the tropics. Its use in temperate countries is increasing although limited to the summer months. Increased usage as a cooking or salad oil has been promoted through the blending of palm olein with polyunsaturated oils(Nor Aini, 1994). Blends of polyunsaturated oils such as sunflower, soybean, safflower, groundnut and canola up to 30% superolein are found suitable for use in temperate countries.

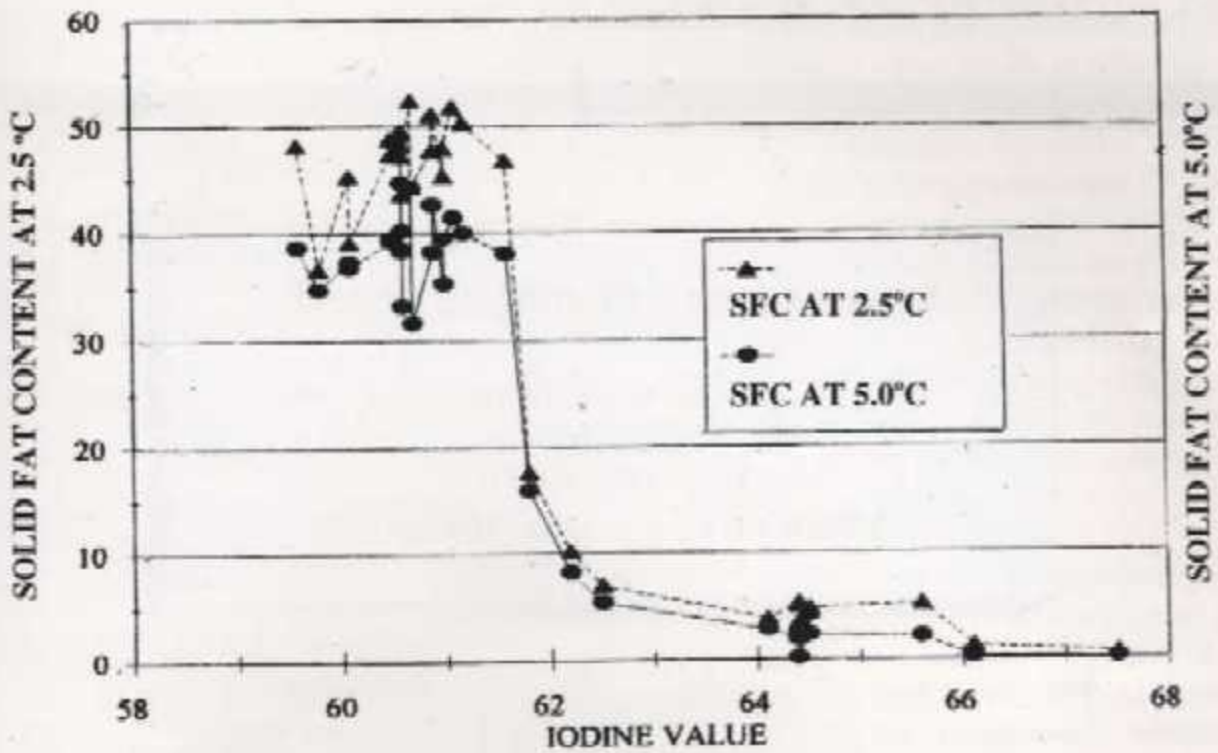

Figure 1. Solid Fat Content at 2.5°C Versus Iodine Value of Palm Olein

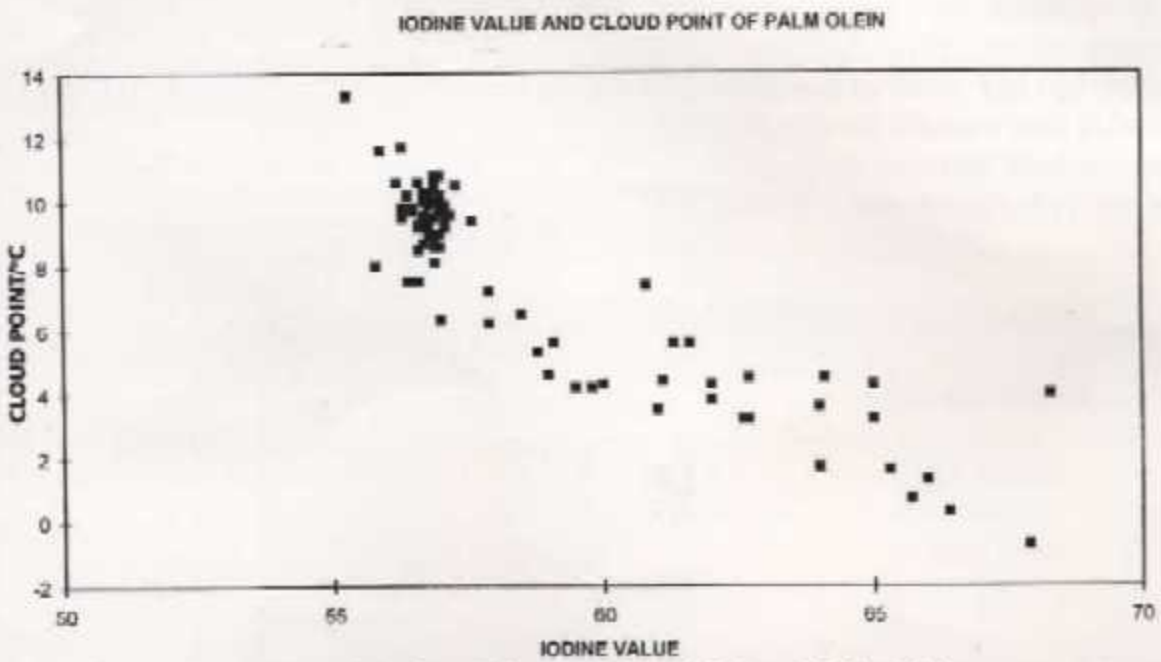

Figure 2. Iodine Value and Cloud Point of Palm Olein

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For more information kindly contact:

Director-General
PORIM
P. O. Box 10620
50720 Kuala Lumpur, Malaysia.