Effect of Polyglycerol Ester on Resistance to Bloom Formation of Milk and Plain Cocoa Butter Substitutes (CBS) Bar Chocolate

Sabariah Samsudin and Nor Aini Idris

INTRODUCTION

A great deal of effort has been made to inhibit chocolate bloom which is detrimental to the appearance of chocolate. There are two types of bloom; fat bloom, arising from fat in chocolate and sugar bloom formed by action of moisture on the sugar ingredients. Fat bloom can be recognized by a grayish coating on the surface of chocolate (milk or dark) but more visible on dark chocolate (Minifie, 1980). Kleinert (1961), also reported that the presence of butterfat as a natural ingredient in the milk solids of milk chocolate can act as a beneficial anti-bloom agent. Work carried out by Laustsen (1991) has shown that the addition of lactic esters of monoglycerides and sorbitan tristearate can delay the bloom formation of compound coatings. It is therefore the aim of this study to investigate the effect of polyglycerol esters on the stability of CBS milk and plain chocolate stored at various temperatures against bloom formation.

CHOCOLATE FORMULATION AND PREPARATION

The fat used in the formulation was hydrogenated palm kernel stearin, a cocoa butter substitutes (CBS) and palm based polyglycerol ester. The basic formulations of milk and plain chocolates are as follows:

Ingredients	%
Milk Chocolate	
Cocoa powder	6
Icing sugar	42
Skim milk powder	11
Full cream milk powder	7
Cocoa butter substitutes	34
Lecithin	0.4
Polyglycerol ester	*
Plain Chocolate	
Cocoa powder	20
Icing sugar	46
Cocoa butter substitutes	34
Lecithin	0.4
Polyglycerol ester	*

*Levels added was 1%, 1.5% and 2% in each formulation. No additive was added in the control formulation.

Cocoa powder, milk powder and sugar were mixed in a Hobart mixer. Half of the fat was added in to form lumps. The mixture was then refined using the Pascall three roller refiner. The refined product was later conched for 6 hours at 55°C–60°C. At the end of the process, the remaining fat, together with polyglycerol ester and lecithin were added. Chocolate was tempered in the water jacketed vessel connected to a water circulator to regulate the temperature. The chocolate was heated to 60°C for 30 minutes with continuous stirring, cooled at 35°C and then moulded.

Samples of bar chocolate were wrapped and stored at 20°C for 48 hours before being transferred to temperatures of 10°C, 20°C, 30°, cyclic 10/20°C and cyclic 20/30°C for 9 months storage. Visual assessments were done every month and the gradings were as follows:

1 Unacceptable (Completely bloom)
2 Just acceptable (Traces of bloom)
3 Fair (Surface dull, no bloom)
4 Good (Slightly dull, no bloom)
5 Excellent (Glossy, no bloom)

CHARACTERISTICS OF THE CBS IN CHOCOLATE FORMULATION

Table 1 shows physico-chemical characteristics of the fat. The slip melting point of CBS was 32.5°C and the iodine value 0.2 which indicated that the degree of saturation was very high. The free fatty acid of CBS was 0.06% (as lauric acid), which was low and thus the CBS was suitable to be used for chocolate making. The CBS also had a very steep solid fat content profile and this is an important characteristic. The fatty acid composition of CBS shows high content of lauric and myristic acid.

EVALUATION OF MILK AND PLAIN CHOCOLATE

As shown in *Table 2*, all the CBS milk chocolate stored at 10°C were stable with no bloom formation

continued to page 30

(continued from page 21)

TABLE 1. PHYSICO-CHEMICAL CHARACTERISTICS OF COCOA BUTTER SUBSTITUTES (CBS) FAT

	Cocoa Butter Substitutes (CBS)
Slip Melting Point (°C)	32.5
Iodine Value (Wij's)	0.2
Free Fatty Acid (%)	0.06
Solid Fat Content (%)	
5°C	96.6
10°C	95.7
15°C	95.6
20°C	94.9
30°C	91.0
32.5°C	15.2
35°C	3.6
37°C	1.8
40°C	-
Fatty Acid Composition (wt. %)	
C:6	0.1
C:8	1.9
C:10	2.7
C:12	55.5
C:14	21.5
C:16	8.5
C:16-1	0.1
C:18	8.2
C:18-1	0.1
C:18-2	1.0
C:18-3	0.1

until 9 months storage. Even after one year, the chocolate formed no bloom but they showed loss of gloss (*Figure 1*). At 20°C, traces of bloom appeared at 8 months of storage. However at 30°C the appearance of all chocolates showed a dull surface even during the first week of storage but at 9 months samples containing polyglycerol ester had less bloom compared with the control sample (*Figure 2*).

At 10/20°C and 20/30°C, samples containing high levels of polyglycerol ester showed a glossy surface up to 3 months storage (*Table 3*). However traces of bloom appeared on the samples stored at 10/20°C and 20/30°C at 8 months and 5 months of storage respectively.

Table 4 shows the visual assessment on the CBS plain chocolate stored at 10°C, 20°C and 30°C. At 6 months storage a control 10°C plain chocolate was completely coated with bloom compared to chocolate added with the polyglycerol ester. The same trend was also observed in the control chocolate stored at 20°C after 7 months storage. However at 30°C, chocolate with polyglycerol ester added was more resistant to bloom formation until 9 months storage compared to 10°C and 20°C chocolate (*Figure 3*).

TABLE 2. VISUAL ASSESSMENT ON APPEARANCE OF COCOA BUTTER SUBSTITUTES MILK CHOCOLATE STORED AT 10°C, 20°C AND 30°C.

Month	10°C				20°C				30°C			
	C	1%	1.5%	2%	C	1%	1.5%	2%	C	1%	1.5%	2%
1	4	5	5	5	5	5	5	5	3	3	3	3
2	4	5	5	5	5	5	5	4	3	3	3	3
3	4	4	4	4	5	5	4	4	3	3	3	3
4	4	4	4	4	5	4	4	4	3	3	3	3
5	4	4	4	4	4	4	4	4	3	3	3	3
6	4	4	4	4	4	4	4	4	3	3	3	3
7	4	4	4	4	4	4	4	4	3	3	3	3
8	3	3	3	3	2	2	2	2	2	2	2	2
9	3	3	3	3	2	2	2	2	1	2	2	2

Score: Gradings C: Control

TABLE 3. VISUAL ASSESSMENT ON APPEARANCE OF COCOA BUTTER SUBSTITUTES MILK CHOCOLATE STORED AT 10°C/20°C AND 20°C/30°C

Month	10°C/20°C				20°C/30°C			
	C	1%	1.5%	2%	C	1%	1.5%	2%
1	4	5	5	5	5	5	5	5
2	4	5	5	5	3	4	5	5
3	4	4	4	5	3	3	3	3
4	4	4	4	4	3	3	3	3
5	4	4	4	4	2	2	2	2
6	4	4	4	4	2	2	2	2
7	4	4	4	4	2	2	2	2
8	2	2	2	2	2	2	2	2
9	2	2	2	2	1	2	2	2

Score: Gradings C: Control

Notes: 5 : Excellent (Glossy, no bloom)
4 : Good (Slightly dull, no bloom)
3 : Fair (Surface dull, no bloom)
2 : Just Acceptable (Traces of bloom)
1 : Unacceptable (Completely bloom)

Data on the appearance of CBS plain chocolate stored at cyclic 10/20°C and cyclic 20/30°C are shown in *Table 5*. At cyclic temperature 10/20°C bloom formation appeared at 5 months storage on the control chocolate compared to the polyglycerol ester added chocolate (*Figure 4*). Chocolate stored at higher cyclic temperature (20/30°C) with polyglycerol ester added showed more resistance to bloom formation compared to the lower cyclic temperature (10/20°C).

CONCLUSION

Polyglycerol ester added plain chocolate appeared to reduce bloom formation better at high or high cyclic temperature. The presence of milkfat in milk chocolate also had some role in inhibiting bloom formation. The effect of polyglycerol ester in inhibiting bloom formation was more pronounced in plain than in milk chocolate.

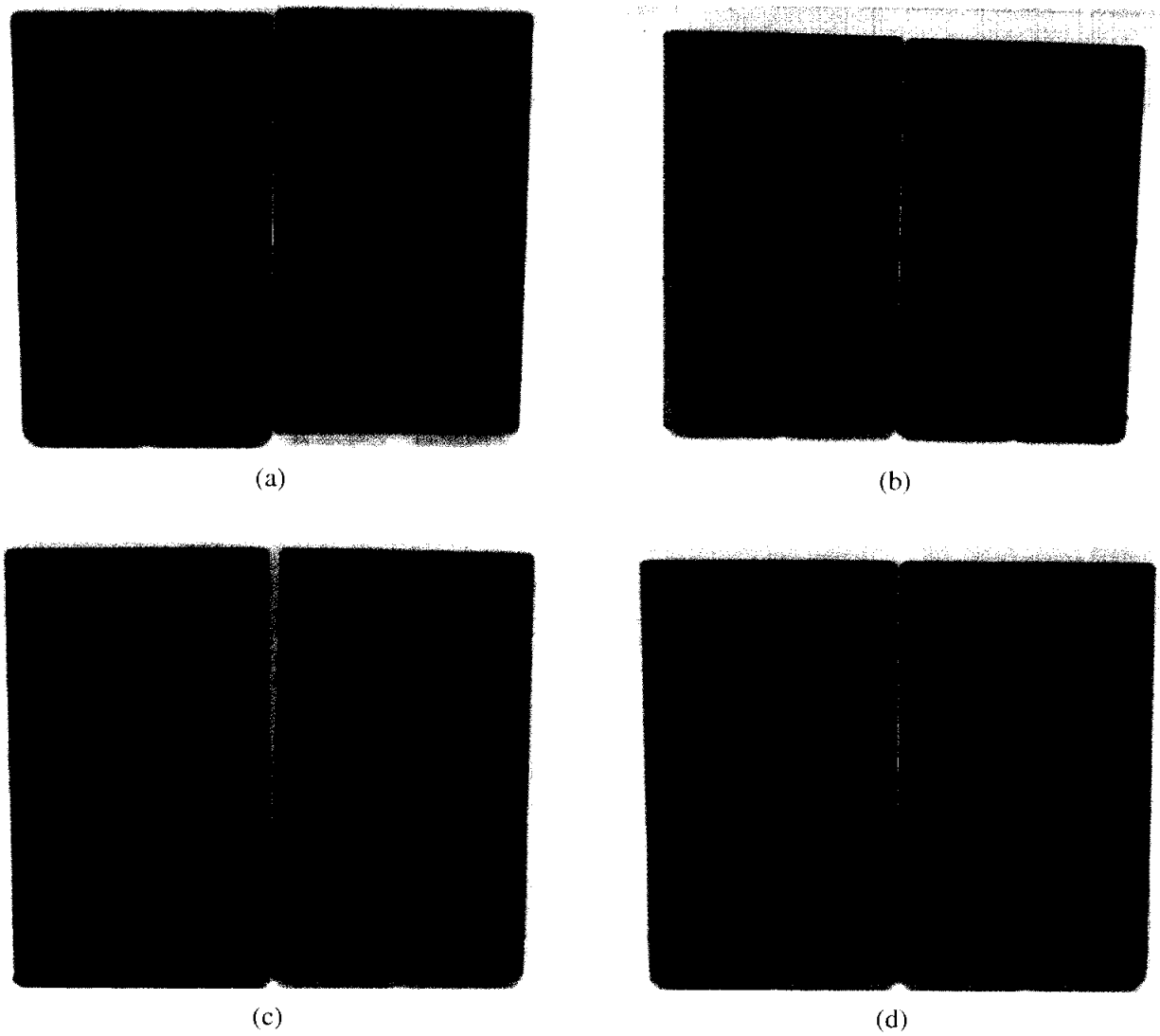


Figure 1. Appearance of CBS Milk Chocolate with a) control, b) 1%, c) 1.5% and d) 2% Polyglycerol Ester, Stored at 10°C for 1 year.

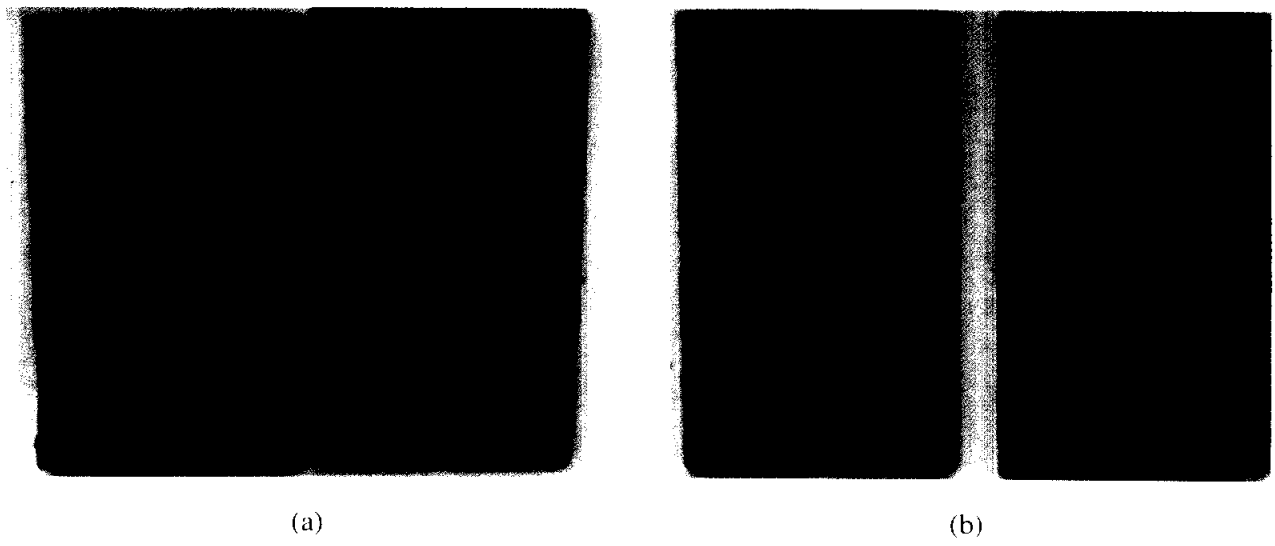


Figure 2. Appearance of CBS Milk Chocolate with a) Control, and b) 1% Polyglycerol Ester, Stored at 30°C for 1 year

TABLE 4. VISUAL ASSESSMENT ON APPEARANCE OF COCOA BUTTER SUBSTITUTES PLAIN CHOCOLATE STORED AT 10°C, 20°C AND 30°C.

Month	10°C				20°C				30°C			
	C	1%	1.5%	2%	C	1%	1.5%	2%	C	1%	1.5%	2%
1	4	4	5	5	5	5	5	5	3	3	3	3
2	4	4	4	4	4	4	4	4	3	3	3	3
3	4	4	4	4	4	4	4	4	3	3	3	3
4	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	2	3	3	3	3	3	3	3
6	1	2	2	2	2	2	2	2	3	3	3	3
7	1	2	2	2	1	2	2	2	2	3	3	3
8	1	1	1	1	1	1	1	1	2	2	2	2
9	1	1	1	1	1	1	1	1	2	2	2	2

Score : Gradings C: control

TABLE 5. VISUAL ASSESSMENT ON APPEARANCE OF COCOA BUTTER SUBSTITUTES PLAIN CHOCOLATE STORED AT 10°C/20°CAND 20°C/30°C

Month	10°C/20°C				20°C/30°C			
	C	1%	1.5%	2%	C	1%	1.5%	2%
1	5	4	5	5	5	5	5	5
2	4	4	4	5	3	4	4	4
3	4	4	4	4	3	3	3	3
4	3	3	3	3	2	3	3	3
5	2	3	3	3	2	3	3	3
6	1	1	2	2	2	3	3	3
7	1	1	2	2	1	2	2	2
8	1	1	1	1	1	2	2	2
9	1	1	1	1	1	1	1	1

Score : Gradings C: Control

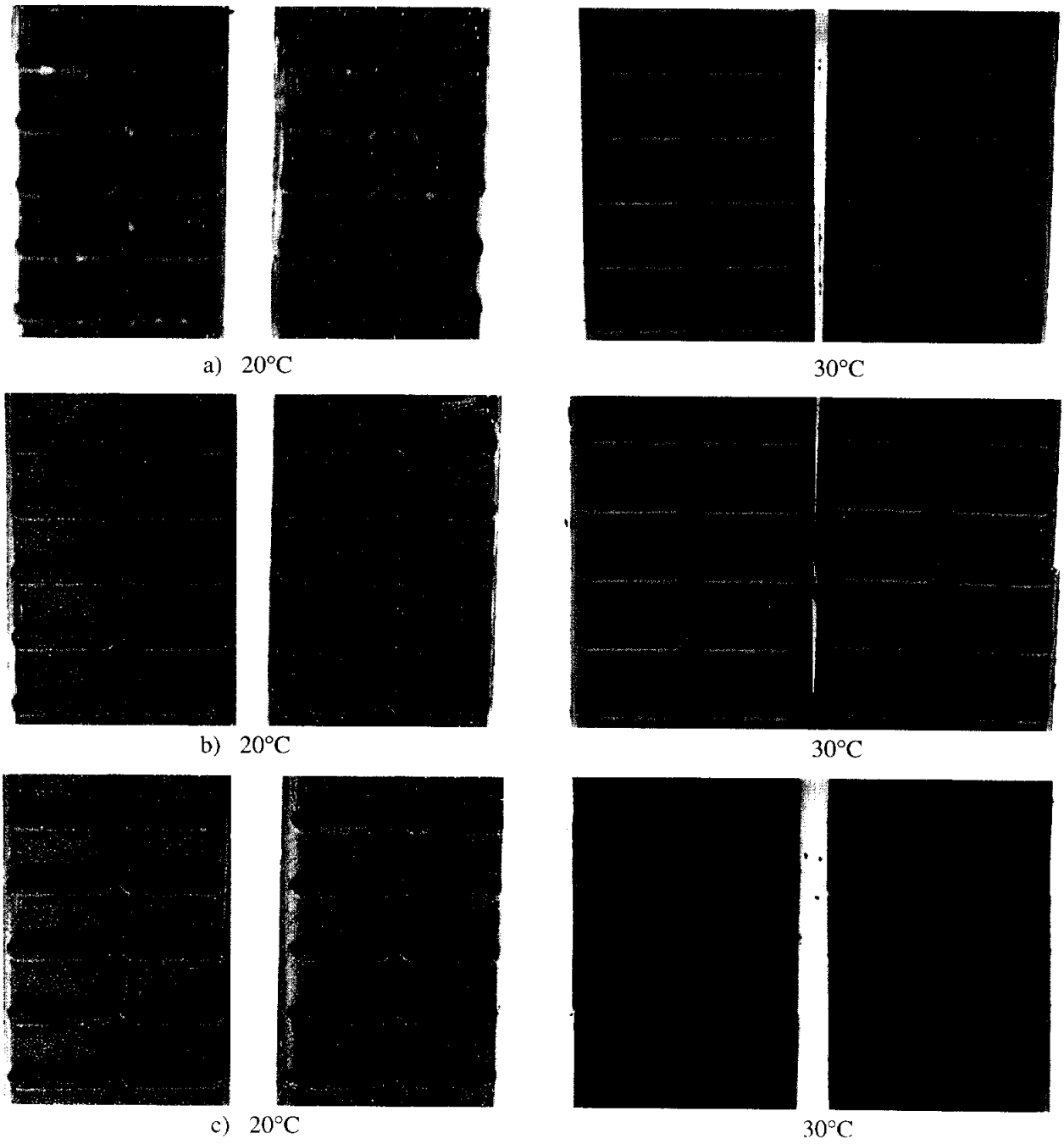
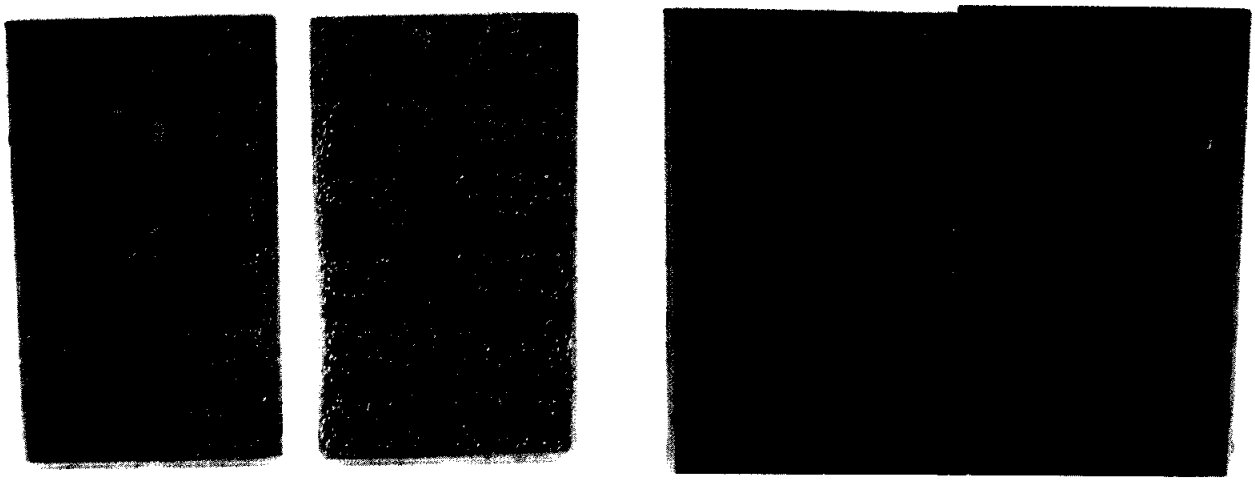


Figure 3. Appearance on CBS Plain Chocolate with a) 1%, b) 1.5% and c) 2% Polyglycerol Esters Stored at 20°C and 30°C for 9 Months.



(a) (b)

Figure 4. Appearance of CBS Plain Chocolate with a) Control and b) 1.5% Polyglycerol Ester, Stored at Cyclic 10/20°C for 5 months.

ACKNOWLEDGEMENTS

The authors wish to thank Tomen Corporation and Olinco (M) Sdn. Bhd., for the supply of polyglycerol ester and hydrogenated palm kernel stearin sample. Thanks are also due to the Director-General of PORIM for his permission to publish this paper.

REFERENCES

MINIFIE, B W (1980). *Bloom, Microbiological and other Spoilage Problems.* Cocoa, Chocolate and Confectionery: Science and Technology. AVI Publishing Company, Inc. Westport, Connecticut. p. 495.

KLEINETT, J (1966). Absorption Cooling and Fat Bloom. *Rev. Int. Choc. 21(9)*:410.

LAUTSEN, K (1991). The Nature of Fat Bloom in Molded Compound Coatings. *The Manufacturing*

Trans Free Formulation: A Short Review

Mohd Suria Affandi Yusoff and Noor Lida Habi Mat Dian

INTRODUCTION

Trans fatty acids produced during hydrogenation of vegetable oils are currently the subject of controversy. In the hydrogenation process positional and trans isomers are formed (Sahasrabudhe and Kurian, 1979; Carpenter and Slover, 1976; Nazir *et al.*, 1976). Formation of trans isomers influences the chemical and physical characteristics of the final product because trans isomers have higher melting points than the corresponding *cis* fatty acid (Lo and Handel, 1983). Consumption of trans fatty acid may have an adverse effect on health (Mensink and Katan, 1990), hence one of the alternatives for the production of trans free plastic fats is interesterification.

Interesterification involves rearrangement of the fatty acids within and between the triglycerides. The fatty acids on the glycerol molecules are rearranged in a random or directed manner. This results in the formation of new triglycerides which do not exist in the original fat. In random interesterification the fatty acids are distributed in a statistically random manner. Directed interesterification is carried out at low temperatures forming high melting glycerides which crystallise from reaction mixture.

This article reviews some of the food formulations which are free from trans acids.