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CHEMICAL AND PHYSICAL CHARACTERISTICS OF MILK FAT AND PALM STEARIN BLENDS

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ABSTRACT: ***Milk fat was blended with palm stearin in various ratios (ranged from 5 to 95 %) .All blends were determined for their physical and chemicals characteristics, i.e., refractive index, melting point, slip melting point, iodine number, acid value, peroxide value, oxidative stability, fatty acid composition and solid fat content by Nuclear Magnetic Resonance (NMR). Results obtained indicated that melting point, slip melting point, iodine value, oxidative stability and solid fat content were found to decrease as ratios of milk fat increase .The obtained results compared with that similar product locally produced under the locally name (Samna EL-Hanna).***

Key words*: Palm stearin, blends, solid fat cotent, milk fat, melting point.*

INTRODUCTION

Milk fat has a unique composition, consisting of 98 % (w/w) triglycerids with fatty acids length ranging from C4 to C18 (Jensen *et al.,* 1991). From the nutritional, technical and economical points of view, milk fat can be blended with some vegetable fats to produce new edible products.

Milk fat fractions may be used as ingredients in wide different products for improving the spreadability of some products such as butter (Koylegian *et al.,* 1993).

The blending of milk fat with vegetable oils has been used to increase the butter flavor of vegetable fats and also to change the physical and chemical properties of milk fat, for example, milk fat alone does not have the appropriate plasticity and hardness for use in pastries (Dimick *et al.,* 1996), but blending milk fat with vegetable fats results in a significant alteration of the physical and chemical properties of milk fat, So that the produced fat blends can be used in the processing of confectionery , pastry ,baking and other applications (Shen *et al .,* 2001) .

Palm stearin (PS), the more solid fraction obtained by fractionation of palm oil after crystallization at a controlled temperature, is a great source of fully natural hard component for many different products such as shortening, pastry, margarine and other edible fats (Patience *et al.,* 1999). PS consists of a high proportion of palmitic acid (47 – 74 %) and oleic acid (16 –

37%), with a slip melting point ranging between 44 – 56 C (Pantzaris. 1987).The objective of the present study was to determine the physical and chemical properties, stability, solid fat content and fatty acid composition of milk fat and palm stearin blends.

MATERILS AND METHODS:

Materials:

-Source of fats:

Palm stearin (RBD) was obtained from Alexandria Oil and Soap Company, Alexandria, Egypt, while anhydrous milk fat was obtained from the pilot plant unit, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt. Anhydrous Milk fat was processed by according to (Walstra *et al.,* 2006).

-Blending treatments:

Both milk fat and palm stearin were individually melted, filtered before blending treatments. Palm stearin and milk fat were blended in different ratios as indicated in Table (1):

Methods:

-Physico-chemical properties of milk fat,palm stearin and their blends:

Refractive index at 25ºC, melting point, slip melting point, acid value, peroxide value and iodine number were determined according to A .O .A .C. (2000).

-Fatty acids composition.

The fatty acids were analyzed by gas chromatography according to Neff *et al.,* (1992) using a Shimadzu 12 A GS equipped with FID detector and 3.2 × 4 mm glass column packed with 10 % - SP - 2330 on 100 / 120 chromosorb WAW (Supelco, USA).

-Solid fat contents:

Solid fat contents were measured by low resolution pulsed Nuclear Magnetic Resonance using Brauker PC / 20 (p NMR) analyzer according to IUPAC method (1987). Measurements were made at 10,20,30 and 40ºC.

-Oxidative stability by Rancimat method:

Rancimat 679 (Metrohm Ltd.,CH 9100 Herisau, Swizerland)was used for the determination of oxidative stabilities of milk fat ,palm stearin and their prepared blends .The induction time was automatically determined i.e., the time from the start of the experiment to the intersection point (Mendez *et al.,* 1996).

Table (1): Relative ratio of milk fat and palm stearin blends.

Blended NO.	Blending ratio %	
	Milk fat	Palm stearin
Milk fat	100.00	00.00
Palm stearin	00.0	100.00
1	5.00	95.00
2	10.00	90.00
3	15.00	85.00
4	20.00	80.00
5	25.00	75.00
6	30.00	70.00
7	35.00	65.00
8	40.00	60.00
9	45.00	55.00
10	50.00	50.00
11	55.00	45.00
12	60.00	40.00
13	65.00	35.00
14	70.00	30.00
15	75.00	25.00
16	80.00	20.00
17	85.00	15.00
18	90.00	10.00
19	95.00	5.00

Statical analysis:

Statical analysis involved used of the statical analysis systems(SAS, 1985) software package. Analysis of variance performed by ANOVA procedures. Significant differences between means were determined by duncan's multiple range testes.

RESULTS AND DISCUSSION

-Physical and chemical properties of milk fat, palm stearin and their blends:

Results in Table (2) and Figure (1) illustrate some of the physical and chemical properties of milk fat, palm stearin and their blends. Analysis included refractive index, melting point, slip melting point, iodine number, peroxide value, acid value and oxidative stability.

Palm stearin was characterized with the highest values of melting point, slip melting point iodine value and oxidative stability than those of the milk fat. Blending of milk fat with palm stearin at ratios of 5 to 95 % (w/w) resulted in decrease of melting point, slip melting point, iodine number and oxidative stability. The above mentioned characteristics decreased in all blend in parallel with the increasing milk fat and its values ranged from 43.50ºC to 36.50ºC, 37.10ºC to 33.90ºC, 52.88 to 30.21 and 42.00 to 20.00hr, respectively. Physical and chemical properties of Samna EL-Hanna are represented in Table (2). Results reveled that produced similar to the blend (1) which consists of 5% milk fat and 95% palm stearin.

-Fatty acid composition:

Data in Table (3) and Figure (2) show the major fatty acid composition of the milk fat, palm stearin and their blends used in this work. Milk fat and palm stearin constituted about 75% and 65% of saturated fatty acids. Blending of milk fat with palm stearin resulted in gradual increase in short chain fatty acids (C4:0 - C8:0) because milk fat had a broad range of short chain fatty acid. These data agreed with those reported by Neff *et al.,* (1992) and Dimick *et al.,* (1996). Fatty acid compositions of Samna EL-Hanna are presented in Table (3). The results showed that Samna EL-Hanna similar as that of blend (1) which contained 5% milk fat and 95% palm stearin. The fatty acid results confirmed the physical and chemical characteristics.

-Solid fat content:

Functional properties of fats are largely determined by their solid fat content at a specific temperature or a series temperatures .A major portion of the structure of the food may depend on the solids contributed by the fat (de Man *et al.,* 1991). With regard to the solid fat contents, the results in Table (4) and Figure (3) indicated that there were remarkable differences among the studied milk fat, palm stearin and other blends. It cane be noticed that the solid fat content of milk fat was higher than of the palm stearin. This increase in the solid fat content was mainly due to the higher content of saturated fatty acids in milk fat (about 75%). Blending of milk fat with palm stearin at concentrations from 5 % to 95 % (w/w) caused a decrease of solid fat content at all temperature (10, 20, 30 and 40ºC). Results in Table (4) indicated that Samna EL-Hanna similar as that of formula (1) which contained 5% milk fat and 95%palm stearin.

Table (2): physical and chemical properties of milk fat ,palm stearin and their prepared blends used .

Sample	Refractive index at 25ºC	Melting point (ºC)	Slip melting Point (ºC)	Iodine number (Hanus)	Acid value (as oleic acid)	Peroxide Value (meq./kg oil)	Oxidative stability (hrs)
Milk fat	1.4618	36.00	34.00	30.50	0.18	2.76	19.00
Palm stearin	1.4675	44.00	37.00	55.17	0.17	1.50	45.50
Blend 1 1	1.4670	43.50	37.10	52.88	0.17	2.04	44.30
Blend 2	1.4671	42.00	36.80	51.50	0.18	1.07	42.10
Blend 3	1.4647	41.00	36.10	50.76	0.21	2.24	39.00
Blend 4	1.4644	40.60	35.50	50.83	0.20	2.10	39.00
Blend 5	1.4677	40.20	35.30	50.20	0.17	1.38	37.30
Blend 6	1.4646	40.10	35.20	50.00	0.21	1.45	36.00
Blend 7	1.4675	40.00	35.10	49.85	0.25	1.20	35.20
Blend 8	1.4665	39.80	35.00	49.45	0.23	1.48	34.90
Blend 9	1.4630	39.50	35.00	49.31	0.26	1.39	34.50
Blend 10	1.4648	39.20	34.90	47.59	0.25	1.34	32.50
Blend 11	1.4638	39.00	34.70	43.89	0.24	1.08	30.00
Blend 12	1.4632	38.50	34.70	43.26	0.58	1.72	28.50
Blend 13	1.4642	38.00	34.60	39.05	0.36	1.47	28.10
Blend 14	1.4627	37.40	34.50	40.07	0.34	1.42	26.20
Blend 15	1.4633	37.20	34.20	40.61	0.38	1.40	26.00
Blend 16	1.4628	37.00	34.10	40.15	0.30	1.22	25.00
Blend 17	1.4621	36.90	34.10	40.07	0.39	1.61	23.30
Blend 18	1.4624	36.00	34.00	37.32	0.26	1.77	20.00
Blend 19	1.4680	36.00	33.90	30.21	0.40	1.29	20.00
Samna EL-Hanna	1.4670	43.50	37.10	52.80	0.16	2.00	44.30
LSD	0.0003	0.50	0.50	1.00	0.05	0.05	2.00

LSD demonstrates to least significant difference test .

Table (3): Fatty acid composition of milk fat, palm stearin and their prepared blends used.

Samples	C4:O	C6:0	C8:0	C10:0	C12:0	C14:0	C16:0	C18:0	C18:1	C18:2	T.S F.A*	T.US F.A**
Milk fat	3.39	2.11	1.28	2.85	3.20	10.43	30.70	11.50	23.54	11.00	65.46	34.54
Palm stearin	0.45	0.22	0.20	0.70	1.23	6.37	25.30	17.30	33.00	15.23	51.77	48.23
Blend 1 1	0.43	0.20	0.23	0.69	1.30	6.50	25.60	17.35	33.01	15.02	51.77	48.23
Blend 2	0.46	0.21	0.19	0.72	1.32	6.49	25.57	17.37	33.20	14.80	52.30	47.70
Blend 3	0.50	0.31	0.23	0.74	1.35	6.50	25.60	16.30	32.11	14.57	52.33	47.67
Blend 4	0.53	0.37	0.30	0.75	1.40	6.55	25.63	16.20	32.00	15.27	51.53	48.47
Blend 5	0.59	0.45	0.37	0.89	1.49	6.60	25.70	16.11	31.80	16.00	51.73	48.27
Blend 6	0.63	0.53	0.49	0.94	1.53	6.72	25.73	15.50	31.50	15.80	52.20	47.80
Blend 7	0.67	0.67	0.52	0.99	1.60	6.81	25.79	15.30	31.23	14.28	52.07	47.93
Blend 8	0.90	0.81	0.67	1.11	1.82	7.13	25.83	15.21	31.01	17.01	53.35	47.65
Blend 9	1.13	0.96	0.73	1.43	2.30	7.50	25.90	14.90	30.13	15.49	54.46	46.54
Blend 10	1.72	1.15	0.90	1.73	2.75	8.90	26.50	14.00	28.50	14.95	54.85	45.15
Blend 11	1.80	1.30	0.95	1.85	2.80	8.95	26.55	1398	28.20	14.35	57.65	42.35
Blend 12	2.10	1.37	0.96	1.92	2.85	8.97	26.67	13.90	28.00	13.52	58.18	41.82
Blend 13	2.19	1.48	1.00	1.99	2.91	9.00	26.80	13.50	27.50	13.16	58.75	41.25
Blend 14	2.45	1.55	1.13	2.11	3.01	9.11	26.95	13.20	27.30	13.01	58.87	41.13
Blend 15	2.70	1.71	1.19	2.20	3.19	9.15	27.01	12.90	26.53	13.16	59.51	40.49
Blend 16	2.95	1.89	1.25	2.45	3.20	9.41	27.15	12.55	26.13	13.02	60.85	39.15
Blend 17	3.11	1.98	1.27	2.60	3.23	9.50	27.30	12.20	25.07	13.74	61.19	38.81
Blend 18	3.31	2.00	1.30	2.67	3.25	9.72	29.13	12.00	24.13	12.49	63.38	36.62
Blend 19	3.40	2.19	1.30	2.70	3.28	10.40	30.69	11.55	23.30	11.13	65.57	34.43
Samna EL-Hanna	0.40	0.20	0.18	0.70	1.32	6.55	25.70	18.00	33.00	13.95	53.05	46.95
LSD	0.11	0.10	0.10	0.20	0.20	0.30	0.20	0.20	0.20	0.20		

LSD demonstrates to least significant difference test .
*** T.S. Total saturated fatty Acids.**
****T. U.S. Total unsaturated fatty Acids.**

Table (4): Solid fat content of milk fat, palm stearin and their prepared blends used.

Sample	Solid fat content			
	10ºC	20ºC	30ºC	40ºC
Milk fat	49.50	29.03	11.90	3.70
Palm stearin	47.20	27.50	11.05	3.60
Blend 1	47.00	27.06	11.00	3.56
Blend 2	46.15	25.79	10.90	3.34
Blend 3	45.00	25.30	10.37	2.50
Blend 4	43.00	25.00	10.33	2.10
Blend 5	43.00	24.33	9.70	1.90
Blend 6	42.90	23.90	9.63	1.54
Blend 7	42.30	23.51	9.30	1.33
Blend 8	42.00	23.00	8.85	1.18
Blend 9	41.00	22.20	8.21	0.95
Blend 10	40.80	22.11	8.00	0.93
Blend 11	40.10	21.00	7.90	0.82
Blend 12	39.00	20.20	7.78	0.79
Blend 13	38.50	20.13	7.72	0.37
Blend 14	38.30	19.50	7.33	0.30
Blend 15	38.00	19.20	7.15	0.24
Blend 16	37.10	18.90	7.00	0.19
Blend 17	37.90	18.22	6.80	0.15
Blend 18	36.00	18.16	6.70	0.09
Blend 19	34.80	17.90	6.56	0.07
Samna EL-Hanna	47.00	27.00	11.00	3.56
LSD	2.00	1.00	0.50	0.50

LSD demonstrates to least significant difference test .

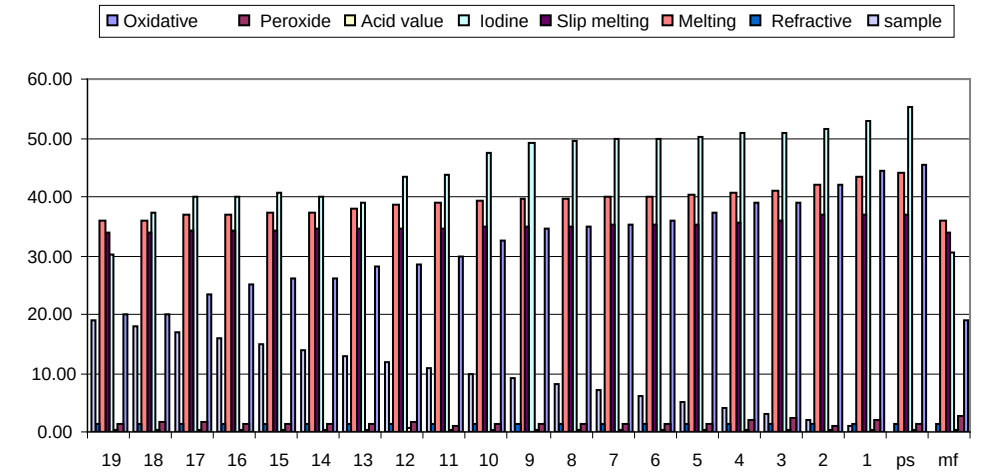

Fig. (1): Physical and chemical properties of milk fat, palm stearin and their Prepared blends used.

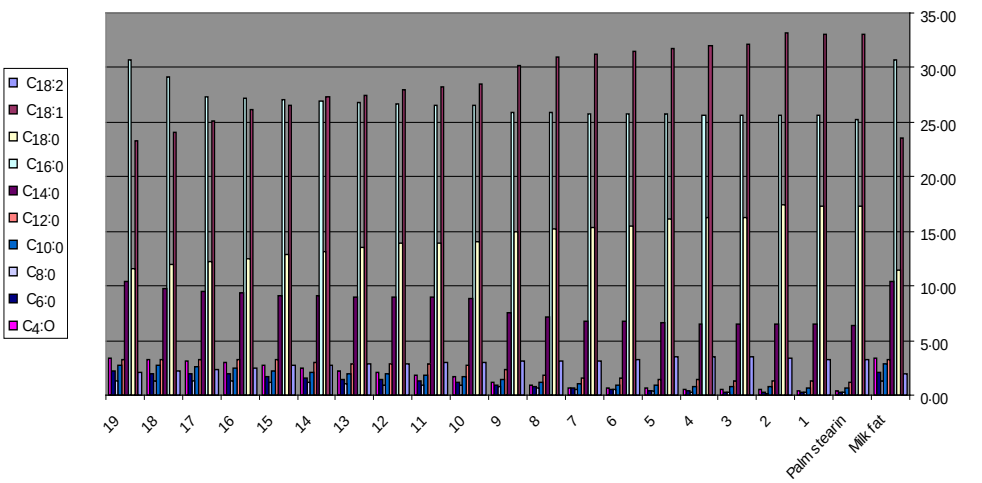

Fig. (2): Fatty acid composition of milk fat, palm stearin and their Prepared blends used.

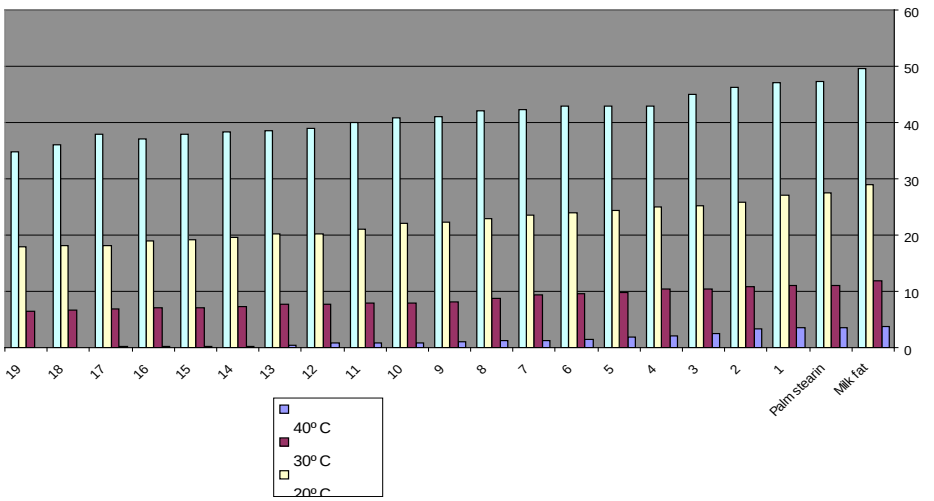

Fig. (3): Solid fat content of milk fat, palm stearin and their prepared blends used.

CONCLUSION

Results in this study indicated that the milk fat content in Samna EL-Hanna found in local market was very low compared with prepared blends. It is similar as that of blend (1) which contained 5% milk fat and 95% palm stearin.

REFERENCES

A.O.A.C.(2000). Official Methods of Analysis of the Association of Official Analytical Chemists. 15 ed., published by the Association of Official Analytical Chemists, Arlington, Virginia, USA.

De Man, L.; C.F. Shen and J.M. de Man (1991). Composition, physical and textural characteristics of soft (Tub) margarines. J. Amer. Oil. Chem. Soc. 68(2): 70-73.

Dimick, P.S.; S. Yella Reddy and G.R. Ziegler (1996). Chemical and thermal characteristics of milk fat fractions isolated by a melt crystallization, J. Am. Oil chem. Soc. 73: 1647 – 1652.

IUPAC (1987). Standard methods for the analysis of oils, and fats and Derivatives, 7th. edn. Edited by pag pergamon, Oxford, England.

Jensen, R.G.; A.M. Ferris and J. lammi-Keefe (1991). The composition of milk fat, J. Dairy Sci. 74 : 3228 – 3243.

Koylegian, K.E.; R.W. Hartel and R.C. Lindsay (1993). Applications of modified milk fat in food, J. dairy Sci. 76: 1782– 1796.

Mendez, E.; J. Sanhueza; H. Speisky and A. Valenzuela (1996). Validation of the rancimat test for the assessment of the relative stability of fish oils J. Am. Oil. Chem. Soc, 73: 1033 – 1037.

Neff, W.E.; M.A.M. Zeitoun and D. Weislder (1992). Resolution of lipolysis mixtures from soybean oil by solid phase extraction procedure .J. chromatog, 589: 353-357.

Pantzaris, T.P. (1987). Pocketbook of palm oil uses, Palm oil Research Institute of Malaysia Kuala Lumpur, pp. 120.

Patience, D.B.; R.W. Hartel and D. Illing Worth (1999). Crystallization and pressure filtration of anhydrous milk fat: mixing effects, J. Am. Oil Chem. Soc. 76: 585 – 594.

SAS, (1985). SAS, user's guid: Statisties, ver.s.SAS Institute Inc. Gary, N.C.

Shen, Z.; M.A. Biekett; S. Augustin and C. Versteeg (2001). Melting behavior of blends of milk fat with hydrogenated coconut and cottonseed oils, J. Am. oil Chem. Soc. 78: (4) 387 – 394.

Walstra, P.; J.T.M. Wouters and T.J. Geurts (2006). Dairy Science and Technology 2 th ed. Edited by Taylor & Francis Group , LLC, Boca Raton London, pp. 489.

الخصائص الطبيعية والكيماوية لمخاليط دهن اللبن واستيارين النخيل

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الملخص العربى

تم خلط نسب تتراوح من ٥ الى ٩٥ % من دهن اللبن مع إ ستيارين النخيل . تم دراسة الخصائص الطبيعية والكيماوية (معامل الانكسار- نقطة الانصهار- نقطة الانزلاق- الرقم اليودى- رقم الحموضة- رقم البيروكسيد-الثبات الاكسيدى) وتركيب الأحماض الدهنية ومحتوى الدهن الصلب (بواسطة جهاز الرنين المغناطيسى) لكلأ من دهن اللبن وإستيارين النخيل والخلطات الناتجة منها . أشارت النتائج المتحصل عليها الى ان عملية خلط دهن اللبن مع إستيارين النخيل تؤدي الى انخفاض(نقطة الانصهار- نقطة الانزلاق- الرقم اليودى- رقم الحموضة- رقم البيروكسيد- الثبات الاكسيدى -محتوى الدهن الصلب) بزيادة دهن اللبن المضاف .اتضح من النتائج أن نسبة دهن اللبن لا تزيد عن ٥ % عند تحليل سمن الهنا الموجود بالسوق المحلي.