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Evaluation Of The Use of Monoglycerides In The Manufacture Of Like Margarine

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A B S T R A C T

This study was aimed to manufacture a margarine-like product in which the milk fat was replaced with olive oil at a rate of 25 and 50%, with the addition of monoglycerides (M.G.) as an emulsifying agent at a rate of 0.25%. The product was stored for 60 days. at State the temperature for storage. A cow butter sample was manufactured as control sample, and some properties were estimated, including the peroxide value and The acid value spreadability and hardness. Also, Sensory evaluation was carried out, and the research was conducted in the period from 1/10/2022 to 1/2/2023, The results showed that the M.G sample was lower in peroxide number, as the values for the M.G. sample ranged from 3.5 to 11.6), while in the butter sample it was 11 to 13.5 mEq O2/gm fat. The acid for the M.G. sample ranged between 0.84 and 1.4) and for the butter sample, it ranged between 0.84 and 1.6) mg KOH/gm fat. The spreadability was estimated at 20° for the M.G. sample, and it ranged from 3.4-5.15 cm, while in the butter sample it was between 2-3.25 cm. Hardness was also estimated, as it was about 2 cm in the M.G. sample at 20°, and in the butter, it was 0.7–1.15 cm.

Introduction

Butter is considered one of the most important dairy products because it contains a high percentage of fat as well as the fat-soluble vitamins E, D, A, and K. When part of the milk fat is replaced with vegetable oil, such as olive oil or other oil, a product similar to margarine is obtained, characterized by its high nutritional value, reasonable price, and texture and shape. Good due to the presence of various emulsifiers, including monoglycerides (M.G.). Emulsifiers, also known as surfactants, are often added to improve stability, texture, or shelf life. The use of these materials is regulated by multiple bodies and organizations, such as the Food and Drug Administration and Global Health, so that the smallest added quantities produce the desired benefit (Hasenhuettl and Hartel, 2008). Monoglycerides, also called monoacylglycerols, are non-ionic molecules that have hydrophilic and hydrophobic groups. MAG is an anionic emulsifier with excellent emulsifying properties because it contains two hydrophilic (hydroxyl) groups and one hydrophobic group on the fatty acid chain. These emulsifying properties are used in food products, cosmetics, plasticizers (Brei, 2012). It is considered one of the most widely used emulsifiers in the food industry. It is either a yellow liquid or an ivory solid with a mild odor and taste. It is insoluble in water but soluble in alcohol, ethyl acetate, and chloroform. Mono- and diglycerides are added as emulsifiers to many foods. The total number of foods to which they are added is about 18 out of 26 foodstuffs. The most important of these foods are bakery products, toffee, chewing gum, fats, ice cream, peanut butter, etc. Mono- and di-glycerides are considered safe to use, according to American legislation. They are on the international list and bear the international number E471 (Sharma etal., 2017).

MATERIALS AND METHODS

Raw cow's milk from one of the breeders in the city of Mosul was used to manufacture butter, as well as dried skim milk (Rijiya brand) of French origin; monoglycerides of Malaysian origin were used from Oleon, a Natural Chemistry Company; and olive oil of Spanish origin (RS) was used where it was manufactured. Butter was processed according to the method reported by (Al-Hubaiti, 1997). After filtering the raw milk and conducting tests on it

Manufacturing a Margarine-like product: The method of Al-Hubaiti (1997) was followed with manufacture of a margarine-like product, 50% olive oil, in a quantity of 400 grams, which is the minimum quantity for making churning, and the processing steps were as follows:

1 - The skim milk and olive oil were prepared. For every 100 grams, 40 grams of olive oil are weighed. To prepare 400 grams, 160 grams of oil are weighed for a 50% replacement ratio, compared to 40 grams of natural cow butter per 100 grams, in order to obtain a margarine-like product with a fat percentage of 80%, where the percentage is (3:1) i.e. (skimmed milk: olive oil) being (480 ml separated milk: 160 gm olive oil.

2 - Heat the mixture to 120 °C for two minutes with continuous stirring, then cool and stir it from time to time during the first 4-5 hours in order to form artificial fatty granules, then leave it in the refrigerator until the next day/

3 - A skimming process was performed to remove the fatty layer, then the churned milk was added at a rate of 1/2 the amount of added oil, i.e. 80 ml, for a 50% replacement rate, mixed well, the emulsifier was added at a rate of 0.25%, and left for 3-4 hours to age

4 - The churning process was carried out using a small manual churner at a temperature of 8-9°C for 10-15 minutes, then a margarine-like form was obtained, then it was washed with cold water, squeezed, shaped into 50-gram containers, and stored in the freezer to be tested every 1, 30, or 60 days

* The previous processing steps were repeated again with manufacture of similar margarine with 25% oil as substituted material

Chemical properties of margarine-like product

The following properties were estimated in the margarine- like products

Peroxide value: it was estimated according to method of A.O.A.C. (2008)

Acid value: it was estimated according to the method of A.O.C.S. (2009)

Physical properties of margarine-like materials:

Spreadability characteristic: where numbers are specified that indicate the spread of a sample of butter or margarine on a specific surface by the effect of a certain force on the butter, according to Al-Hubaiti (1997).

The characteristic of hardness: or the speed of cutting, by designing a simple tool that contains a scale pan and moves within a groove inside a wooden frame, where the butter block is placed on the pan at the level of the knife blade, and a specific weight is placed so that the knife can cut a specific distance from the butter in a certain time, according to the method followed by Al-Hubaiti (1997) .

Sensory Evaluation: This evaluation was obtained by a number of specialists in the Department of Food Sciences, College of Agriculture and Forestry,

University of Mosul. The evaluation scores were given according to a special form and according to by Saleem (1986)

Statistical Analysis:

The data were analyzed according to the factorial experimental system using a completely randomized design (C.R.D). As reported by Al-Rawi and Khalaf Allah (1980), the means were tested by Duncan's multiple procedure at a probability level of 0.05% using the SAS program (2001) to conduct statistical analyses of the data.

Results and Discussion

It is noted that from Table (1) the peroxide number values for a product similar to margarine and butter during the storage periods, where it becomes clear to us that the peroxide number for the samples on 1 day after manufacturing was 3.5, 5.5, and 11 mEq O2/g fat for the M.G. 50 % and M.G. 25% samples, respectively. After a month, the peroxide number was 5.6, 7, and 12.5 mEq O2/g fat for M.G. 25%, M.G. 50%, and butter, respectively. After 60 days of freeze storage, it increased significantly to become 11.6, 12.2, and 13.5 mM O2 equivalent/g fat for M.G. 25%, M.G. 50%, and butter, respectively. From the results, it is clear that the M.G. sample in both replacement ratios had the lowest values for the peroxide number. Especially at 1 and 30 days of storage compared to butter, in which peroxide values increased during all storage periods. The reason is that monoglycerides work to slow down the oxidation process due to the presence of antioxidants as well as the good texture, which weakens the diffusion of oxygen and the formation of free radicals in the product. Barden and Decker (2013), and the results were consistent with what was found by Yatsenko et al. (2020) when manufacturing butter with the addition of emulsifiers and storing the product for a period of 45 days, as the peroxide number increased as the storage period increased. I also agreed with El-Aidie (2018) in his research on estimating the peroxide values in cow butter

Table (1) Peroxide values (mEq O2/g) of a margarine-like product during storage periods

Sample type		Acid number mg KOH/g fat		
		1day	30 day	60 day
butter		0.84 cd	1.12 b c d	1.96 a b
M.G	%25	0.84 cd	0.84 cd	1.4 a - d
	%50	0.56 d	0.84 cd	0.84 cd

*Similar letters indicate that there are no significant differences at the 0.05% significantly level.
*The numbers are an average of three replicate

It is from Table (2) the acid number of a product similar to margarine and butter during storage periods, as it appears that after 1 day of manufacturing the acid number was 0.84, 0.56, 0.84 mg KOH/g fat, and after 30 days it was 0.84, 0.84, 1.12 mg KOH/ gm fat, after 60 days of freeze storage, it was 1.4, 0.84, 1.96 mg KOH/gm fat for the M.G 25%, M.G50%, and butter samples, respectively. From the results, it is clear that the M.G sample had lower values for the acid number compared to the butter that rose Significantly, the reason is due to the presence of monoglycerides as emulsifiers with fat, which leads to raising pH values and lowering acidity. These results are consistent found by Abdel-Rahman (2003).

Table (2) Acid value (mg KOH/g) of a margarine-like product during storage periods

Sample type		Peroxide number mEq O_2/g fat		
		1day	30 day	60 day
butter		11 d - g	12.5 dh	13.5 b c d
M.G	%25	5.5 i – l	5.6 i - l	11.6 d e f
	%50	3.5 klm	7 h i y	12.5 dh

*Similar letters indicate that there are no significant differences at the 0.05% probability level.

Table (3) Measurement of spreadability (cm) of a margarine-like product during storage periods

Sample type		Spreadability/cm								
		1day			30day			60day		
		0°	10°	20°	0°	10°	20°	0°	10°	20°
butter		2.1 b c d	2.5 a z	3.25 twh	1.2 k	2.1 b c d	3.1 Th-th-th	1.5 O-K	1.85 C - H	2 cdh
M.G	%25	2.8 y z	4.1 ps	5.15 g-j	1.25 YK	3.1 HT	4.65 lmn	1.65 h Y	3.15 w x y	3.4 sh- f
	%50	2.6 a z	4.85 h - m	5.1 g-k	1.35 t y k	4.5 m-f	5.1 g-k	1.4 T y k	3.4 sh- f	4.65 lmn

*Similar letters indicate that there are no significant differences at the 0.05% probability level.
*The numbers are an average of three replicates

As can be seen from Table 3, the spreadability characteristics of semi-margarine and butter were measured during storage periods, which were estimated at a temperature of 0, 10, and 20°C. It is clear that as the temperature increases, the spreadability character increases, especially at a temperature of 20°C, where it was 1 day after manufacturing. The spreadability is 5.15, 5.1, and 3.25 cm, and after a month of storage, it was 4.65, 5.1, and 3.1 cm. After 60 days, the spreadability was 3.4, 4.65, and 2 cm for the samples M.G25%, M.G50%, and butter, respectively. From the results, it is clear that the sample Butter is less diffusive because it contains saturated fatty acids, which have a lower melting point than unsaturated fatty acids, while the spreadability increased in the M.G. samples because they contain olive oil, which is known to contain unsaturated acids in high proportions. It is also noted that spreadability decreased significantly during storage periods in

monoglyceride samples due to its role in the process of emulsifying the oil with the rest of the components, which gives better cohesion and consistency to the sample. The results agreed with Al-Hubaiti's (1997) study and also with Mallia's (2008) study of butter fortified with unsaturated fatty acids as an acid. Linoleic acid, as the results showed a decrease in the hardness of the butter and an increase in spreadability. I also agreed with Al-Hayali (2018) when the butter was fortified with vegetable oils, it led to an increase in the softness of the butter and thus an increase in spreadability It is noted that from Table 4 that the hardness or cutting speed of semi-margarine and butter was measured during storage periods, as it was estimated at a temperature of 10 and 20 degrees. It is noted that the cutting speed or distance increased with increasing temperature. At 1 day after manufacturing and at a temperature of 20 degrees, the hardness was approximately 2.1, 2.1, 1.15 cm; after a month of storage, it was 1.9, 2, 2 cm; and after 60 days, it was 0.7, 2, 2 cm. Within 5 seconds, the samples M.G. were 25%, 50%, and butter, respectively. It is clear from the results that the butter was lower in cutting distance or hardness. Due to the nature of its ingredients and its content of short-chain saturated fatty acids, it has a higher hardness than a margarine-like sample containing olive oil and monoglycerides, which give the product a good consistency. This is due to the increase in the replacement rate with olive oil containing unsaturated fatty acids, which have a higher melting point than saturated fatty acids and a lower hardness. This is consistent with what Bobe et al. (2007) mentioned: butter produced from cow's milk fed with fish oil and soybeans, which are rich in unsaturated fatty acids. It gave softer butter and a higher nutritional value, and it also agreed with Al-Hubaiti (1997) and Al-Hayali (2018) who they fortified the butter with vegetable oils.

Table (4): Measurement of hardness (cm) of a margarine-like product during storage periods

Sample type		Hardness/cm within 3-5 seconds with a dead weight of 20-50 g					
		1day		30day		60day	
		10°	20°	10°	20°	10°	20°
butter		0.45 JKL	1.15 g h	1.35 fh	1.9 a b c	0.45 JKL	0.7 t j
M.G	25 %	1.45 dw	2.1 a	0.4 JKL	2 a b	1.55 d e f	2 a b
	50 %	1.55 d e f	2.1 a	0.6 JK	2 a b	2 a b	2 a b

*Similar letters indicate that there are no significant differences at the 0.05% probability level.

*The numbers are an average of three replicates

Table (5): Sensory evaluation of a margarine-like product during storage periods

Samples	Storage /day	Taste (45)	Texture and composition (30)	color (15)	Appearance (10)	Total scores (100)
butter	1	49	29	14	10	98
	30	48	29	14	10	96
	60	48	28	14	10	95
M.G %25	1	42	27	14	10	93
	30	38.75	27.25	14	9.25	89.25
	60	39	27	14	9	89
M.G %50	1	43	28	14	10	95
	30	38.5	28.5	14	9	90
	60	37	25	13	9	84

It is noted from Table (5) that the sensory evaluation of a product similar to margarine and butter during storage periods The evaluation was conducted by professors and graduate students according to a special form. The butter sample obtained the highest evaluation scores, the highest being 98 at 1 day of storage and the lowest being 95 at 60 days of storage. Storage, while the M.G 25% sample obtained 93 at 1 day and 89 at 60 days of storage, while the M.G 50% sample obtained 95 at 1 day and 84 at 60 days of freeze storage. The
monoglyceride samples were admired by the residents in terms of color. The good appearance and consistent texture are close to natural butter due to the role of emulsifiers, which gave the product good qualities (Hasenhuettl and Hartel, 2019).

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CONFLICT OF INTEREST

The authors state that there are no conflicts of interest with the publication of this work.

REFERENCES

[1] A.O.A.C. Assocation of official Analytical Chemists (2008).Offical methods of Analysis 16 th ed. international Arliny ton,Virginia,U.S.A.

[2] A.O.C.S. American Oil Chemists' Society. (2009). Official Methods and Recommended Practices of the American Oil Chemists' Society. 6 th ed, Champaign,IL

[3] Abdel-Rahman , H.A. (2003). Dairy ice cream containing concentrated soybean proteins. Egy. J.Dairy Sci. 31:41-419.

[4] Al-Hayali, Sh. J. M. (2018). The effect of fortification with fatty acids (omeca) on the physical, chemical and sensory properties of cream and butter made from them. Doctoral thesis - Department of Food Sciences - College of Agriculture and Forestry - University of Mosul.

[4] Al-Hubaiti, A. Q. H. (1997). Production of low-fat butter with partial replacement with vegetable oils. Doctoral thesis - Department of Food Sciences - College of Agriculture and Forestry - University of Mosul.

[5] Al-Rawi, K. M. and Khalaf Allah, A. M. (1980). Design and analysis of agricultural experiments, Mosul University Press.

[6] Barden, L., & Decker, E. A. (2013). Crit Rev Food Sci Nutr.

[7] Bobe, G., Zimmerman, S., Hammond, E. G., Freeman, A. E., Porter, P. A., Luhman, C. M., & [8] Beitz, D. C. (2007). Butter composition and texture from cows with different milk fatty acid compositions fed fish oil or roasted soybeans. Journal of dairy science, 90(6), 2596-2603.

[9]Brei, V., Starukh, G., Levytska, S., & Shistka, D. (2012). Study of a continuous process of glycerolysis of rapeseed oil with the solid base catalysts. Chemistry and Chemical Technology, 6(1), 89-94 .

[10] El-Aidie, S. A. (2018). The Healthiness of Commercial Butter in Malaysia: Evaluation of the Physicochemical and Microbial Quality. International Journal of Advancement in Life Sciences Research, 1-7.

[11] Hasenhuettl, G. L., & Hartel, R. W. (Eds.). (2008). Food emulsifiers and their applications (Vol. 19). New York: Springer.

[12] Mallia, S. (2008). Oxidative stability and aroma of UFA/CLA (unsaturated fatty acids/conjugated linoleic acid) enriched butter (Doctoral dissertation, ETH Zurich).

[13] Sharma, K., Negi, S., Thakur, N., & Kishore, K. (2017). Partial glycerides-an important nonionic surfactant for industrial applications: an overview. J. Biol. Chem. Chron, 3(1), 10-19.

[14] Yatsenko, O., Yushchenko, N., Kuzmyk, U., Pasichnyi, V., Kochubei-Lytvynenko, O., Frolova, N., ... & Voitsekhivskyi, V. (2020). Research of milk fat oxidation processes during storage of butter pastes. Slovak Journal of Food Sciences, 14.