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Chemical Properties and Oxidative Stability of Modified of Table Margarine from Buffalo Fat Fractions with Vegetable Oil Oleogels

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ABSTRACT

In the present work, using oleogels (OGS) ofolive sesame and flaxseed oils with beeswax at 6:3:1:1.78 ratio. Substitute oleogels with buffalo milk fat fractions (Mffs) at two levels 60:40 and 50:50 (w/w) to produce table margarine (TM) .It compared with breakfast margarine (BM) as control All samples were stored at 5 °C in the refrigerator for 3 months. Fatty acids composition, peroxide value (PV),), firmness and stickiness and sensory attribute were investigated. The fatty acids composition revealed that incorporation OGs into two blends significant increased the mono-unsaturated fatty acid(MUFA) polyunsaturated fatty acid, (PUFA) and ɯ 6:ɯ3 ratio in TM compared with BM, whereas the significantly lowest in AI and TI when blending with 50:50 (w/w) g were observed. There was a significant increase ($p<0.05$) in PV of all samples during storage at 5◦C.The substitute OGs with Mffs improved flavor in all samples, while the highest spreadability score in both samples OG4 and OG5 compared with other treatments. It can be concluded that OGs can be used successfully OGs to produce of the table margarine (TM)

***Keywords*: Table margarine Oleogels, Beeswax, Buffalo milk fat fractions.**

INTRODUCTION

Recently a new a approach of beeswax (BW) oleogel has been successfully produce with different types of oils and applied for production of breakfast margarine (BM) (Öğütcü et al. 2015). Oleogels have some advantages such as not changing the fatty acid composition and trans and saturated fatty acids (SFA) are decreased (Toro-Vazquez et al. 2007; Marangoni, and Garti, 2018; Marangoni, 2011). Beeswax consists of long chain monohydric alcohol compounds and a mixture of esters of fatty acids and fatty alcohols which able to act an edible gelator with different oils (Öğütcü et al. 2015; Marangoni, 2011; Marangoni et al., 2012). Oleogels can be formed from a wide range of structuring agents that will lead to different gelation mechanisms (Mertil et al., 2018). Technological approaches to enhance replacement of animal fat in a product with a fat having a healthier fatty acid profile. This includes lesser amount of SFA and TFA and a greater level of MUFA and PUFA). Moreover a healthier omega-6/omega-3 and PUFA/SFA ratios and reduced cholesterol are desirable. Food manufacturers must take into consideration the use of oleogelation, a recent technique of converting liquid vegetable oil to create novel food ingredients, which may have the functionality of fats and the nutritional profile of liquid oils (Hughes et al., .2009, and Patel et al., 2016).Also, prepare the healthier products for lowering the saturated and trans-fat content in food (Marangoni et al., 2012; Yılmaz, and Öğütcü, 2014; Marangoni, 2011). The oleogelation subject is of high interest worldwide .(Andreea et al.,2020)

Oleogels are gel-like materials incorporating liquid oil within a three-dimensional structured network. The liquid oil is converted into solid-like systems using an oleogelator, during which the chemical characteristics of the oil are not changed .For the preparation of oleogels, two important materials are required; an organic solvent which is to be entrapped and an oleogelator, which entraps the organic solvent. Only edible oil is employed to prepare oleogels when it comes to the food industry among the numerous organic solvents.

oleogelation is the process of physically entrapping an organic solvent (oil) into a 3D-gel network with the aid of an oleogelator through a variety of interactions to create oleogels with an oil content in the range of 90-99% (w/w). These oleogels have similar technological capabilities as solid fat but contain less *trans* and saturated fat (Gravelle and Marangoni, 2018). Reduction of saturated and trans- fat by oleogelation approach is receiving widespread attention from researchers (Shao et al., 2020,) to several advantages conferred by them like safe usage in food products. (Zhao et al., 2021).

Different edible oleogels are being formulated by various techniques and used in spreads, bakeries, confectioneries, and dairy an meat products.(Andeera et al., 2020).The dietary intake of trans-and saturated fat has been with an increase in serum of low- density lipoprotein (LDL) cholesterol also called "bad cholesterol". At the same time, unlike the effect caused by the consumption of saturated fat, trans –fat has been associated with a decrease of blood levels of high –density lipoprotein (HDL), known as : good cholesterol". (WHO, 2018). Both effects are responsible for increasing the risk of coronary heart disease (Rogers 2009). Food manufacturers must take into consideration the use of oleogelation, a recent technique(Patel and Dewettinck ,2016)

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Fats in dairy products play roles in flavoring the final products in a unique and specific manner, but they are also important for texture and structure formation. Milk fat is composed of numerous triacylglycerol and their ability to crystalize make them indispensable for some applications (Martini and Marangoni 2007)

In previous works various have been focused on formation of organogold, including beeswax and sunflower was in olive oil (Marangoni, et al. 2012) carnauba wax in canola oil or beeswax in grapseed oil (Mozaffarian et al. 2007).

Thus, in our study, the blending of different oils at ratio (olive oil: sesame oil: flaxseed oil –BW 6:3:1:1:1.76) replacement of the three mixture of buffalo milk fat fractions (Mffs) at 60:40 and 50:50 (w/w) to improvement in nutritional profile of TM.

MATERIALS AND METHODS

Materials

Fresh Butter and vegetable oil

Raw buffalo butter (~82 % fat) was obtained from Faculty of Agriculture, Cairo University then stored at -18OCuntil used for 3 month

Olive, sesame and flaxseed oils got from the local oil extraction place at Fath oil press machine Company Cairo.

Beewax obtained from El Gomhouria Co. for trading in Drugs, Chemicals and Medical requirements El Sawash Cairo

Butter Milk Powder

Butter milk powder, was purchased from Bob's Red Mill Natural Foods, Milwaouke, Oregon 97222, USA. The analytical data was taken from printed packaging material of buttermilk material of buttermilk powder were (Total fat 1g ,saturated fat 0.5g ,Trans fat 0g Cholesterol 10 mg , sodium 85 mg ,Total carbohydrate 7g,Protein 5 g)

Skim Milk Powder

Low heat spray dried skim milk powder was obtained from Dairy America, California-USA. The analytical data of skim milk powder were (Protein –SNFBasis 34%, Moisture 4%, Fat 1.25% Titratable acidity 0.15%and Solubility Index 1.2ml)

Emulsion mixture

Soy lecithin Adlec for Food Use (E322) was purchased from ADM, Hamburg – Germany. Mono-diglycerides, Grindsted®, for Food Use was purchased from DuPont, NHIB, ApS Langebrogade 1-Denmark.

Preparation of butter oil:

Preparing butter oil (BO) by the method of Amer *et al.*, (1985). BO was prepared from fresh butter by melting the butter at 60^{O}C for 2h without agitation, then removing the top oil layer by filtering the oil by (Whatman No.1 paper) and drying over anhydrous sodium sulfate under vacuum in a Buchner funnel to remove ingredient of aqueous phase material. The collected oil was then stored at -18^{O}C until dry fractionation .BO crystallization was carried out by stepwise and successive cooling procedure described by van Aken *et al.*, (1999) to obtained liquid fraction (L15 ,L25and L35)and solid fraction (S15,S25and S35).

Preparation of mix vegetable oil

Mix vegetable oil containing 60% olive oil, 30%sesame oil and 10% Flaxseed oil were heated at 60 C until melted ,then taken 85part from vegetable oil

Preparation of oil oleogels

Blended vegetable 85 part were melted with 15 part of beeswax at 70◦C

Preparation of modified healthy butter (table margarine)_

The formulation and the production procedure of OGs and margarine are showed in Figure 1.The water content in watery formulations was 16%,

Different milk fat fractions, three vegetable oil and bee wax used to prepare samples.

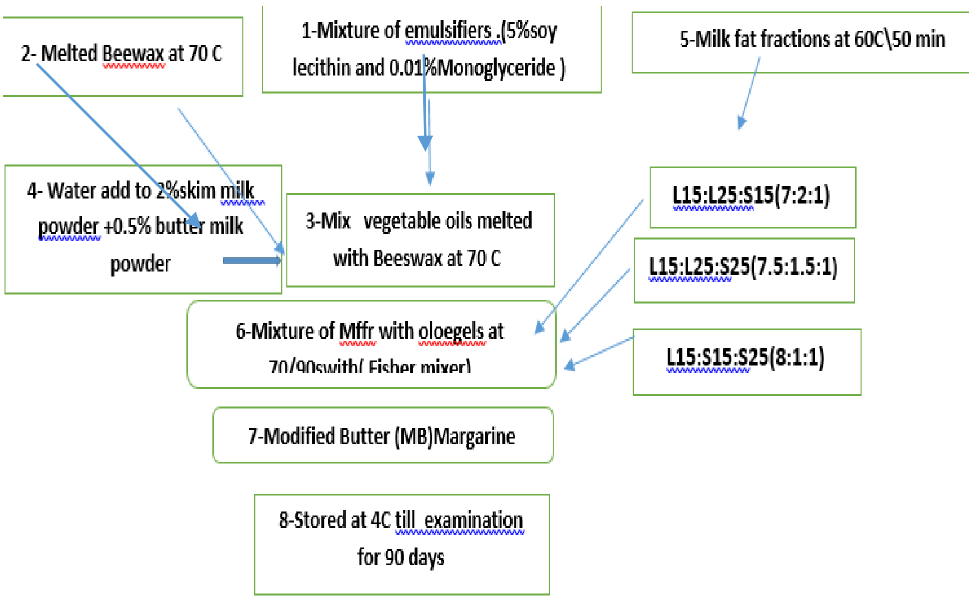

Fig. 1. Technological flow chart for table margarine (TM)

Methods

Statistical analysis

The level of statistical significance taken as $P < 0.05$, using SAS (version 9.4 TS Level 1M3, SAS Institute Inc., Cary, NC, USA). Least squares mean was calculated and presented throughout (Snedecore and Cochran 1994)

Methods

Determination of Fatty acid composition and Atherogenicity index (AI)

Atherogenicity index (AI) resulted from modified calculation of hyper-cholesterolemic fatty acids, was calculated by the following equation according to (Van Aken et al. 1999 and Ulbricht and Southgate, 1991).

AI = [C12:0 (W/w, %) + 4 × C14:0 (W/w, %) + C16:0 (w/w, %)]/USFA (w/w, %)

Peroxide value

Peroxide value was estimated according to Edwin and Frankel (2012) A blank was also performed at the same time.

Texture Profile analysis (TPA)

The TPA systems comprising TMS-Pro equipment, with TL-Pro™ software, provide precise force, speed and position for rigorous food texture analysis (Food Technology Corporation, USA) was employed for determination of hardness and adhesiveness of Fat samples at temperatures of 5OC according to (AOAC, 2006).

Sensory evaluation

The sensory analyses of theTM obtained by trained panelists. Parameters such as color, spreadability, texture, flavor, and overall acceptance were evaluated as described by Kramer and Twigg, (1973) with little modification sensory analyses were carried out at room temperature (25^{O}C). The samples were provided in transparent glass cups along with bread slices.. The 7 hedonic scales were used to categories the sample. The scale 1 shows extremely dislike, and 7 shows extremely like on the hedonic scale.

RESULTS AND DISSCUSION

Fatty acids profile

vegetable oils

The main fatty acids profiles of olive oil, sesame oil, flaxseed oil and its mixed oil with beeswax(BW) (olive oil: sesame oil: flaxseed oil: BW oloegel) at ratio 6:3:1:1.78. are presented in table (1). Results show that olive oil had the highest content of oleic acid ($C_{18:1}$) being 55.92 (mg/100g) as compared with other oil (Musazadeh et al. 2021; Nadeem et al. 2013)The linolenic acids ($C_{18:3}$) were higher in flaxseed oil approximately 50 times (fold)than olive oil and sesame oil which is very important from nutritional prospective, while sesame oil had higher content of linoleic acid (Nadeem et al. 2013) the oleic acids (C18:1) was 40.18, 68.25, 20.66 and 55.22mg/100g whereas, unsaturated fatty acids were 84.44, 82.31, 90.85 and 84.38mg/100g in sesame, olive , flaxseed oils and oleogels respectively. USFA in olive oils have been considered as healthy lipids because they incidence of cardiovascular disease (CVD) (Fatma et al. 2015; Rogers 2009).Flaxseeds oil had the highest content of(PUSFA),whereas the lowest content of both the SFA and MUSFA with compared other oils.

MUSFA have been recognized as beneficial as PUSFA for human health because of their effect in lowering blood cholesterol, in particular the DHA (Barzi et al. 2003) The ratio of unsaturated: saturated fatty acids (USFA: SFA) in olive oil was lower than those sesame oil and flaxseed oil. All vegetable oil used in in this study is free from Tran's fatty acids(TFA). The ratio of ɯ6:ɯ3 in olive ,sesame ,flaxseed oil and oil oloegels were 43.88:1,100:1,0.32:1 and3.82.:1 respectively, which is important from technological and improved nutritional view. (Nadeem et al. 2013).

Fatty acids of table margarine (TM*)*

Blending three vegetable oil used in these study is good outcome to improve their functional characteristics and increase their application in food industry (Nadeem et al. 2013) Using, the ratio of olive, sesame, flaxseed and beeswax its was blending 6:3:1:1.78 in preparation of TM as replacing of Mffr at 40 and 50%.

The fatty acids profile of TM made with blending vegetable oil oloegel and breakfast margarine BM as control are shown in Table (1B). The usage of blending Mffr - vegetable – oil oloegel was pronounced significant decrease the trans oleic acid ($C_{18:1}$trans) with increasing percentage of oloegel in TM as compared with controls. In regards, MUSFA and PUSFA were significantly increased in all sample which made with Mffr: oil oloegels at ratio 50:50, while the saturated fatty acid (SFA) was significantly decreased. The increment of USFA with incorporate of oloegels at 40% in experimental samples was 59.32,53.54 and 51.01% for OG1, OG2 and OG3 respectively as compared with RB as control sample, while its in blending at 50%was reached 67.16,68.83and 66.11% for OG4, OG5, and OG6 respectively. The SFA_S were decreased in all samples. These results correspond with Hassan et al. (2015) who reported that increasing the level of Palme oil in butter oil, the SFA decreased while oleic and linoleic acid were increased. (Manuela et al. 2011) recommend reducing SFA with replacing USFA in the diet.

Table 1A. Fatty Acids Profile of vegetable oil g/100g.

Nomination	Sesame Oil	Olive Oil	Flaxseed Oil	Oleogel
C14:0	--	0.15804	0.04756	0.038
C16:0	10.37	12.23	5.98797	10.91
C17:0	0.05766	0.09463	0.05976	0.07
C18:0	4.62	4.46223	2.74	4.51
C20:0	0.25553	0.36944	0.20106	0.07
C22:0	0.27820	0.40528	0.14729	0.03
Saturated Fatty acids (SFA)	15.56	16.69	9.15	15.62
C16:1ɯ9	0.13086	0.11748	0.08114	0.086
C17:1	0.02983	0.04700	0.03329	0.050
C18:1Cis	40.18	68.25	20.66	55.22
C18:1Trans	--	--	--	…
C20:1	0.20073	0.26812	0.14106	0.04
Mono Unsaturated Fatty Acids(MUSFA)	40.54142	68.6826	20.91549	55.396
C18:2 Trans	--	--	--	--
C18:2 Cis	42.98	11.65	12.32	21.65
C18:3Cis	0.93	1.58	57.41	7.32
C18:3n6	--	0.42861	0.21087	0.02
C18:4	--	--	--	---
Poly Unsaturated Fatty Acids (PUSFA)	43.91	13.65861	69.94087	28.99
TotalUnsaturated Fatty Acids (TUSFA)	84.44	82.41	90.85	84.38
Omega 6	42.98	11.65	12.32	21.65
Omega 3	0.93	1.58	57.41	7.32
Omega 6/ Omega 3	46.21	7.37	0.21	2.96

Table 1B. Fatty acid profile of modified butter by partial replacement of milk fractions with oleogels of different kinds vegetable oils- beeswax blends (g/100g).

Fatty acids	BM	RB	Mffr :OOSFOW Ratio						*SE±	**LSD
			60:40			50:50				
			OG1	OG2	OG3	OG4	OG5	OG6		
C4:0	0.73^{E}	3.43^{A}	1.34^{C}	1.65^{B}	1.73^{B}	1.77^{B}	1.09^{D}	0.65^{E}	0.08	0.246
C6:0	0.87^{C}	1.82^{A}	0.86^{C}	0.87^{C}	1.40^{B}	0.75^{DC}	0.51^{E}	0.68^{D}	0.05	0.169
C8:0	0.60^{B}	0.81^{A}	0.42^{DC}	0.51^{BC}	0.50^{BC}	0.49^{BCD}	0.36^{D}	0.46^{DC}	0.04	0.125
C10:0	1.38^{B}	1.61^{A}	0.95^{DCE}	0.98^{DC}	1.08^{C}	0.80^{FE}	0.84^{DFE}	0.67^{F}	0.06	0.182
SCFA	3.58^{D}	7.67^{A}	3.57^{D}	4.01^{C}	4.71^{B}	3.81^{DC}	2.80^{E}	2.46^{E}	0.115	0.346
C12:0	1.48^{B}	2.13^{A}	0.96^{E}	1.25^{C}	1.01^{DE}	1.07^{DCE}	1.16^{DC}	1.03^{DE}	0.06	0.192
C15:0	0.66^{BC}	1.54^{A}	0.71^{BC}	0.4^{B}	0.47^{CD}	0.69^{BC}	0.59^{BCD}	0.38^{D}	0.090	0.272
MCFA	2.14^{B}	3.67^{A}	1.67^{C}	1.65^{C}	1.48^{F}	1.76^{BC}	1.75^{BC}	1.41^{E}	0.15	0.464
C16:0	22.23^{D}	29.78^{A}	23.47^{C}	23.68^{C}	24.22^{B}	21.73^{E}	21.32^{F}	22.09^{D}	0.083	0.247
C17:0	0.40^{D}	0.99^{A}	0.66^{B}	0.61^{BC}	0.56^{C}	0.59^{BC}	0.43^{D}	0.54^{C}	0.024	0.074
C18:0	6.06^{E}	10.24^{A}	7.62^{BC}	7.69^{C}	8.04^{C}	6.08^{E}	7.21^{D}	7.21^{D}	0.100	0.301
C20:0	0.27^{D}	0.28^{D}	0.41^{BA}	0.44^{A}	0.34^{BDC}	0.40^{BAC}	0.32^{DC}	0.42^{BA}	0.030	0.092
LCSFA	29.13^{E}	41.46^{A}	32.34^{C}	32.61^{C}	33.36^{B}	28.96^{F}	29.40^{E}	30.42^{D}	0.129	0.378
C22:0	0.16^{A}	0.13^{AB}	0.01^{C}	0.14^{A}	0.13^{A}	0.13^{A}	0.08^{B}	0.14^{A}	0.016	0.049
C24:0	0.01^{B}	0.02^{B}	0.01^{B}	0.03^{BA}	0.04^{B}	0.01^{B}	0.02^{B}	0.02^{BA}	0.008	0.024
SFA	40.42^{E}	62.6^{A}	42.89^{D}	43.68^{C}	44.82^{B}	39.68^{F}	38.11^{G}	39.41^{F}	0.154	0.462
C14:1ω5	0.55^{A}	0.51^{AB}	0.42^{BCD}	0.46^{ABC}	0.29^{E}	0.38^{CDE}	0.36^{DE}	0.37^{CDE}	0.03	0.100
C16:1ω9	0.96^{E}	1.61^{A}	1.35^{BC}	1.39^{B}	1.37^{B}	1.19^{BCD}	1.15^{CDE}	1.07^{DE}	0.073	0.219
C17:1	0.19^{B}	0.38^{A}	0.39^{A}	0.29^{AB}	0.20^{B}	0.42^{A}	0.16^{B}	0.27^{AB}	0.054	0.164
C18:1Cis	40.96^{D}	24.71^{F}	39.38^{E}	39.59^{E}	39.39^{E}	42.70^{C}	43.81^{A}	43.33^{B}	0.111	0.335
C20:1	0.76^{A}	0.28^{D}	0.43^{B}	0.45^{BC}	0.36^{DC}	0.49^{BC}	0.47^{BC}	0.41^{BDC}	0.046	0.138
C22:1	0.02^{B}	0.02^{B}	0.01^{B}	0.02^{B}	0.01^{B}	0.13^{A}	0.01^{B}	0.03^{B}	0.007	0.022
(MUFA)	43.94^{C}	32.03^{F}	43.41^{D}	43.56^{DC}	42.81^{E}	46.35^{B}	47.08^{A}	46.54^{B}	0.127	0.383
C18:2 Cis	10.47^{C}	2.34^{F}	9.95^{D}	9.42^{E}	9.47^{E}	11.19^{B}	11.40^{A}	11.06^{B}	0.057	0.170
C20:2	0.05^{C}	0.02^{C}	0.04^{C}	0.03^{C}	0.29^{B}	0.02^{C}	0.46^{A}	0.03^{C}	0.017	0.052
C18:3Cis	4.34^{A}	1.33^{C}	2.63^{B}	2.55^{B}	2.15^{C}	2.05^{C}	2.11^{C}	2.06^{C}	0.032	0.098
C20:4	0.05^{BC}	0.06^{B}	0.12^{A}	0.05^{BC}	0.03^{BCD}	0.04^{BCD}	0.01^{D}	0.02^{DC}	0.011	0.035
(PUFA)	15.44^{A}	4.31^{F}	12.98^{D}	12.31^{E}	12.13^{E}	14.51^{C}	14.32^{B}	13.50^{C}	0.066	0.200
C18:1Trans	0.48^{E}	4.49^{A}	1.30^{B}	1.34^{B}	1.17^{C}	1.02^{D}	1.16^{C}	1.06^{DC}	0.039	0.117
C18:2 T	0.50^{A}	0.54^{A}	0.22^{DC}	0.24^{DC}	0.18^{D}	0.20^{D}	0.31^{BC}	0.33^{B}	0.026	0.080
TFA	0.98^{F}	5.03^{A}	1.52^{B}	1.58^{B}	1.35^{D}	1.23^{E}	1.47^{BC}	1.39^{CD}	0.038	0.197
ND	0.53^{D}	0.19^{BA}	0.71^{A}	0.44^{BCD}	0.22^{CD}	0.45^{BA}	0.49BA	0.51^{BA}	0.085	0.256
(USFA)	59.38^{C}	36.34^{G}	56.39^{D}	55.87^{E}	54.95^{F}	59.86^{B}	61.40^{A}	60.07^{B}	0.141	0.424
PUFA:SFA	0.38^{A}	0.06^{F}	0.30^{C}	0.28^{D}	0.27^{E}	0.34^{B}	0.37^{A}	0.34^{B}	0.002	0.007
$\omega_6:\omega_3$	$2.41:1^{D}$	$1.76:1^{E}$	$3.77:1^{C}$	$3.69:1^{C}$	$4.41:1^{B}$	$5.45:1^{A}$	$5.38:1^{A}$	$5.35:1^{A}$	0.070	0.210
AI	0.78^{D}	2.13^{A}	0.83^{C}	0.83^{C}	0.86^{B}	0.74^{E}	0.65^{F}	0.74^{E}	0.006	0.019
TI	2.48^{G}	6.50^{A}	3.08^{C}	3.13^{C}	3.37^{B}	2.80^{E}	2.70^{F}	2.86^{D}	0.019	0.057

Significantly at a level of 5% of probability ($p < .05$), Means in rows with the same letter are not significantly different. BM = Breakfast Margarine, Control=RB=Recombined butter made with whole butter oil SCFA (C4-C10) = Short chain Fatty acids, MCFA (C12-C15) = Medium Chain Fatty Acids, LCSFA (C16-C20) = Long chain saturated fatty acids, LCUSFA (C16:1-C18:3),Long chain unsaturated fatty acids.Saturated fatty acid (SFA) ,Medium unsaturated fatty acids(MUFA), Polyunsatured fatty acids(PUFA) ,Unsatured fatty acids(USFA) ,ω6: ω3 = (Omega 6: Omega 3 Ratio), TFA = Trans Fatty acid, Atherogenic Index = AI, Thrombogenic Index = TI, hypocholesterolemic: hypercholesterolemic ratio = HH, Calculation of Mffr in T1andT4 =L15: S15:S25 (7: 2: 1) ratio, Mffr in T2andT5 =L15: L25:S25 (7.5: 1.5:1) ratio, Mffs in T3andT6 =L15: S15:S25 (8: 1: 1) ratio, Olive oil: Sesame oil: Flaxseed oil: Bee wax = O: S: F: W (6: 3: 1: 1.76) ratio. * (SE) = Standard Error ** (LSD) = Least Significant Difference.

The essential fatty acid and bioactive compounds are important in health, thus food products that enriched and fortified essential fatty acid and bioactive compounds content (Nadeem et al. 2013). From the same table (1B) the ratio of $\omega_6:\omega_3$ of all organogel sample are enriched to suitable optimal level .It has been changed in fatty acid composition in all treatment .The balanced ratio of essential fatty acids have important health effect, therefor ,should be considered in our daily diet. The optimal ratio $\omega_6:\omega_3$ fatty acids the cure or prevention of diseases was defined as 1:1 to 4:1 (FAO 2010) blending of OGs at 50% level caused significantly increase the ratio of $\omega_6:\omega_3$ to reach a healthy levels.

The altherogentic index (AI), thromhogenic index (TI) PUFA:SFA and $\omega_6:\omega_3$ evaluated by blending organogel sample which indicated that nutritional quality of foods based on the fatty acid composition .These indexes should be kept at low level s in healthy daily diet (Guimares et al. 2013; Nadeem et al. 2013) AI and TI can be used as predicators or risk factors for cardiovascular diseases . The lowest of both AI and TI level in OG5 sample as compared the rest sample and control due to their higher content of PUFA.

The lower of PUFA:SFA ratio was found to be ranged from 0.225 to 0.302 in all treatment than BM and RB sample which due to their higher content in PUFA and lower content of SFA with increasing oil oloegel.

Peroxide Value (meq O_2/kg oil)

Peroxides generated by the oxidation of fatty acids can affect the quality of oils and also food containing them. Oxidation can be promoted by per oxidant metals

such as iron and copper, temperature, light, sensitizers such as chlorophyll The peroxide value is a measure of the concentration of peroxides and hydroperoxides formed in the initial stages of lipid oxidation so that it is one of the most widely used tests for the measurement of oxidative status in seed and nut products (Muresan el al ., 2015) .

Olive oils had higher PV than sesame and flaxseed oils which its values reached 15mg/O $_2$/Kg oil (Codex Alimentarius Commission. Codex Stan 33)(1981). On the other hand, flaxseed can also oxidize very fast and can have very high PV because they contain high amount of poly unsaturated fatty acids (PUSFA).

Data presented in table (2) show that fresh RB had lower PV than those all oloegel treatment whereas, BM (control) had higher PV. As expected, as increased the blend with oil oloegel in sample increasing the PV was observed that reached from 0.55 to 0.84 and from 0.51 to 0.65 (meq O_2/Kg) in 60:50 blend and 50:50 blend respectively. In all sample PV gradually significant increased along storage period to reach between 1.25 to 2.13 meq O_2/Kg at the end of cold storage. This finding confirmed with (Hashempour-Baltork et al. 2017 and Hassan et al. 2015).

Table 2. Peroxide Value (PV) of modified d butter by partial replacement of milk fractions with oleogels of different kinds vegetable oils- bee Wax blends during storage periods at ~5˚C.

Storage (days)	Breakfast margarine	Control	MFr : OOSFOW Ratio						**LSD
			60:40			50:50			
			OG1	OG2	OG3	OG4	OG5	OG6	
Fresh	1.46^{E}	0.24^{T}	0.84^{L}	0.62^{O}	0.55^{P}	0.65^{O}	0.78^{M}	0.51^{P}	0.70^{D}
30	1.63^{D}	0.30^{S}	1.23^{H}	0.72^{N}	0.65^{O}	1.15^{I}	1.23^{H}	0.61^{O}	0.94^{C}
60	1.86^{B}	0.38^{R}	1.74^{C}	1.14^{I}	0.91^{K}	1.29^{FG}	1.74^{C}	1.05^{J}	1.26^{B}
90	2.13^{A}	0.43^{Q}	1.83^{B}	1.43^{E}	1.33^{F}	1.61^{D}	1.85^{B}	1.25^{GH}	1.48^{A}
Means	1.77^{A}	0.34^{F}	1.41^{B}	0.98^{D}	0.86^{E}	1.17^{C}	1.40^{B}	0.85^{E}	

Significantly at a level of 5% of probability (p < .05), Means with the same letter are not significantly different. Least Significant Difference (LSD) for Treatments = 0.025 LSD for Storage = 0.018 LSD for interaction = 0.0511 Control=Recombined butter made with whole butter oil, MFr in T1andT4 =L15: S15:S25 (7: 2: 1) ratio, MFr in T2andT5 T2andT5 =L15: L25:S25 (7.5: 1.5:1) ratio, MFr in T3andT6 TS15:S25 (8: 1: 1) ratio, Olive oil: Sesame oil: Flaxseed oil: Bee wax = O:S:F : W (6 : 3: 1: 1.76)ratio.

Firmness and stickiness of TM.

Firmness and sickness of TM ,BM and RB are shown in Table (3) .RB was a much higher firmness and stickiness than those of BM and oloegel butter TM due to the higher of SFC and SFA level led to harder networks .It might be considered together estimation of spear ability. Hardness is the force required to create a deformation to a simple, while stickiness is a force required to pull back the probe from the sample. Consequently spread ability can be estimated from both parameters ,and it is defined as the easiness of a sample to be applied as a thin layer onto a surface by a knife .Moderate levels of firmness and stickiness indicate good spreadability as reported by (Brighentiet al.,.2008)although the best estimate would be by sensory attribute (Glibowski et al. 2008) found that high correlations exit between firmness and spread ability and stickiness. It was also reported that spread ability is the best estimate to evaluate butter consistency who, studied that good butter should have a firmness and waxy body and be sufficiently plastic to be spreadable at lower temperature. It is also clear that both firmness and sickness values of TM were lower than BM when made with 60:40 blends or 50:50 blends .Firmness and stickiness values of all samples were measured each month during 90 days of storage there was no important change during cold storage. These results are similar to those of (Queirós et al. 2016). All the OGs margarine ,firmness and stickiness had lower than that BM (control).

These results indicated that butter made with both different ratio of Mffr and oil oloegel is potentially more spreadable with confirmed by (Wright et al. 2001).They reported the hardness has been correlated with spreadabillity in butter.

Table 3. Firmness and stickiness (N/mm)of healthy modified butter made with different buffalo milk fat fractions and different kinds vegetable oils- bee Wax blends during storage periods at ~5˚C.

FIRMNESS						
		Storage (days)				
Mffr:OSF-BW blends		**Fresh**	**30**	**60**	**90**	**TS**
BM		11.91	11.03	11.18	11.58	11.42
RB		52.75	53.24	53.48	53.56	53.26
	OG1	8.00	7.6	7.74	7.84	7.79
60:40	OG2	7.90	7.88	7.89	7.90	7.89
	OG3	7.84	7.45	7.64	7.75	7.76
	OG4	4.30	3.86	3.95	4.03	4.03
50:50	OG5	4.12	3.83	3.94	4.02	3.98
	OG6	6.80	6.38	6.51	6.73	6.60
ST		12.95	12.66	12.79	12.93	SE0.058
LSD				0.232		
STICKINESS						
Mffr:OSF-BW blends		Fresh	30	60	90	TS
BM		-4.21	-4.12	-3.91	-3.82	-4.02
RB		-12.11	-11.95	-11.44	-11.04	-11.63
	OG1	-3.12	-2.93	-2.84	-2.79	--2.92
60:40	OG2	-3.92	-3.82	- 3.72	-3.66	-3.78
	OG3	3.75	-3.23	-3.03	2.94	-3.24
	OG4	-1.78	-1.45	-1.25	-1.01	-1.37
50:50	OG5	-1.54	-1.43	-1.38	-1.14	-1.37
	OG6	-1.64	-1.43	-1.37	-1.14	-1.39
ST		-4.01	-3.79	3.62	3.44	SE0.063
LSD				0.251		

Sensory evaluation

As shown in Table (4) illustrate the effect of using Mffr: oil oloegel at 60:40 and 50:50 (w/w) blend on the sensory evaluation as compared with RB and BM served as control samples . The results indicated that BM had the lowest score for flavor, color and acceptability as compared with the oloegel butter (OG). The use of blend Mffr:oil oloegel at ratio 50:50 (w/w) for OG4,OG5 and OG6 had significantly improved the sensory characteristics (flavor ,texture spread ability and acceptability. As for, OG5 had gained the highest scores followed by OG4 and lastly OG6 either when fresh and the end storage periods.

The incorporated of oil oloegel in TM was improved of acceptability due to greenish color of the olive oil (Hashempour-Baltork et al. 2017).

From these results concluded that the substituted of mixture of three vegetable oil- beeswax oloegel with Mffs were improved the nutritionally beneficial unsaturated fatty acids, firmness, stickiness, spread ability of table margarine TM products

Table 4. Sensory evaluation of healthy modified butter by partial replacement of milk fractions with oleogels of different kinds vegetable oils- bee Wax blends during storage periods at ~5°C.

Sensory evaluation	Storage period (days)	Breakfast margarine	Control	M Fr :OOSFOW Ratio						Means	**LSD
				60:40			50:50				
				OG1	OG2	OG3	OG4	OG5	OG6		
Flavor (7)	Fresh	3.70^{L}	5.10^{DEFGH}	5.90^{A}	5.60^{ABC}	5.50^{ABCD}	5.80^{AB}	5.80^{AB}	5.50^{ABCD}	5.36^{A}	$^{ST}0.143$
	30	3.40^{LM}	4.96^{FGHI}	5.48^{BCD}	5.18^{DEFG}	5.04^{EFGHI}	5.62^{ABC}	5.40^{BCDE}	5.28^{CDEF}	5.05^{B}	
	60	3.26^{M}	4.66^{IJK}	4.94^{FGHIJ}	5.00^{EFGHI}	5.06^{EFGHI}	4.82^{GHIJK}	5.18^{DEFG}	4.86^{GHIJK}	4.72^{C}	
	90	3.44^{LM}	3.76^{L}	4.82^{GHIJK}	5.54^{JK}	4.74^{HIJK}	4.52^{K}	5.02^{EFGHI}	4.74^{HIJK}	4.45^{D}	
	Means	3.45^{E}	4.62^{D}	5.28^{AB}	5.08^{BC}	5.08^{BC}	5.19^{ABC}	5.35^{A}	5.10^{BC}	$^{IA}0.406$	$^{TS}0.203$
Texture (7)	Fresh	5.90^{DEF}	3.60^{OP}	5.50^{GHI}	5.30^{HIJ}	3.70^{O}	6.40^{BC}	6.90^{A}	5.76^{EFG}	5.38^{A}	$^{ST}0.114$
	30	5.26^{IJ}	3.18^{Q}	5.42^{HI}	4.88^{KL}	3.28^{PQ}	6.18^{BCD}	6.46^{B}	5.26^{IJ}	4.99^{B}	
	60	4.66^{LM}	2.82^{RS}	5.22^{IJ}	4.40^{MN}	3.10^{QR}	6.02^{DE}	6.08^{CDE}	5.04^{JK}	4.66^{C}	
	90	4.36^{MN}	2.66^{S}	5.00^{JK}	4.16^{N}	3.02^{QR}	5.30^{HIJ}	5.62^{FGH}	4.78^{KL}	4.36^{D}	
	Means	5.05^{D}	3.07^{G}	5.29^{C}	4.69^{E}	3.28^{F}	5.98^{B}	6.27^{A}	5.21^{C}	$^{IA}0.324$	$^{TS}0.162$
Color (7)	Fresh	4.30^{O}	5.40^{CDEF}	5.60^{CD}	5.60^{CD}	4.90^{IJKLM}	5.30^{DEFG}	6.60^{A}	5.30^{DEFG}	5.38^{A}	$^{ST}0.124$
	30	4.28^{OP}	5.10^{FGHIJ}	5.28^{DEFGH}	5.28^{DEFGH}	4.36^{NO}	5.22^{EFGHIJ}	6.20^{B}	5.04^{GHIJ}	5.10^{B}	
	60	3.92^{Q}	5.00^{GHIJK}	5.18^{EFGHI}	4.98^{GHIJK}	3.90^{PQ}	4.94^{HIJKL}	5.70^{C}	4.82^{JKLM}	4.81^{C}	
	90	3.56^{R}	4.66^{KLMN}	4.78^{JKLM}	4.62^{LMNO}	3.94^{QR}	4.68^{KLMN}	5.46^{CDE}	4.56^{MNO}	4.53^{D}	
	Means	4.02^{E}	5.04^{BC}	5.21^{B}	5.12^{B}	4.28^{D}	5.04^{BC}	5.99^{A}	4.93^{C}	$^{IA}0.125$	$^{TS}0.175$
Spreadability (7)	Fresh	6.20^{BC}	2.80^{N}	5.70^{DEF}	4.50^{LM}	2.30^{P}	6.40^{B}	6.90^{A}	5.90^{CDE}	5.09^{A}	$^{ST}0.133$
	30	6.10^{BC}	2.70^{NO}	5.48^{FGHI}	4.30^{M}	2.28^{P}	5.96^{CD}	6.42^{B}	5.28^{GHI}	4.82^{B}	
	60	5.86^{CDE}	2.60^{NOP}	5.18^{HIJ}	4.28^{M}	2.26^{P}	5.54^{EFGH}	5.64^{DEFG}	5.16^{IJ}	4.57^{C}	
	90	5.60^{DEFG}	2.48^{NOP}	4.90^{JK}	4.28^{M}	2.42^{OP}	5.14^{IJ}	5.18^{HIJ}	4.68^{KL}	4.34^{D}	
	Means	5.94^{AB}	2.65^{E}	5.32^{C}	4.34^{D}	2.32^{F}	5.76^{B}	6.04^{A}	5.26^{C}	$^{IA}0.145$	$^{TS}0.189$
Overall Acceptability(7)	Fresh	4.70^{JKL}	4.90^{IJK}	5.40^{EFG}	5.60^{DEF}	5.20^{GHI}	6.00^{B}	6.80^{A}	5.50^{EFG}	5.51^{A}	$^{ST}0.112$
	30	4.48^{LM}	4.76^{JKL}	5.22^{GH}	5.30^{FGH}	4.82^{JK}	5.98^{BC}	6.50^{A}	5.20^{GHI}	5.28^{B}	
	60	4.18^{MNO}	4.36^{M}	4.72^{JKL}	5.00^{HIJ}	4.30^{MN}	5.68^{CDF}	6.14^{B}	5.00^{HIJ}	4.92^{C}	
	90	3.96^{O}	4.00^{NO}	4.70^{JKL}	4.68^{kl}	4.22^{MNO}	5.24^{GH}	5.90^{BCD}	4.78^{JKL}	4.69^{D}	
	Means	4.33^{E}	4.50^{D}	5.01^{C}	5.15^{C}	4.64^{D}	5.73^{B}	6.34^{A}	5.12^{C}	$^{IA}0.378$	$^{TS}0.159$

NB: Degree 1:7. Significantly at a level of 5% of probability ($p < .05$), Least Significant Difference (LSD) for interaction between Least Squares Means of Samples and storage, (SE±) = standard Error, Means with the same letter are not significantly different. Lower case letters for storage Upper case letters for samples. TS = Samples, ST = Storage, IA = interaction between Least Squares Means of Samples and storage. Control=Recombined butter made with whole butter oil, MFr in T1andT4 =L15: S15:S25 (7: 2: 1) ratio, MFr in T2andT5=L15: L25:S25 (7.5: 1.5:1) ratio, MFr in T3andT6 =L15: S15:S25 (8:1:1) ratio, Oleogels Olive oil: Sesame oil: Flaxseed oil: Bee wax = O: S: F: W (6: 3: 1: 1.76) ratio.

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الصفات الكيميائية والثبات للاكسدة لمنتج المارجرين المائدة المصنع من مشتقات دهن اللبن الجاموسي مع اورجيل الزيوت النباتية

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الملخص

أستخدم الاوليوجيل المحضرمن الزيوت النباتية وشمع النحل لاستبداله بمشتقات الدهن الجاموسي عند تحضير ماجرين المائدةTM بنسبتين 60 : 40و 50: 50: (وزن/وزن)ومقارنتها بزبد الماجرين السوق ثم خزنت كل المعاملات OGs في الثلاجة علي درجة حرارة 5م لمدة 3 شهور تم قياس محتوي الاحماض الدهنية وقيم البيروكسيد و القوام والتركيب و الخوا ص الحسيه خلال فترات التخزين مع التحليل الإحصائي لكل النتائج المتحصل عليها . وقد أظهرت النتائج ما يلي: حدوث زيادة معنويه في كلا من الاحماض الدهنيه الاحادية الغير مشبعهMUFA والاحماض الدهنية العديدة الغير مشبعة USFA كما حدث إرتفاع معنوي للنسبة ما بين اوميجا 6 والاوميجا 3 .كما حدث انخفاض معنوي في كل قيم TI,AI وخاصة عند الاستبدال بنسه 50:50 (وزن/وزن). تظهر زيادة معنويه في أرقام البيروكسيد PV في كل المعاملات خلال فترات التخزين. كما أظهرت النتائج تحسين في القوام والتركيب والخواص الحسية والقابلية للفرد وخاصه للعينات OG4,OG5بالمقارنه بالعينات الأخرى. وتوصي هذه الدراسة باستخدام الاوليوجيل لإنتاج مارجرين المائدة .

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