

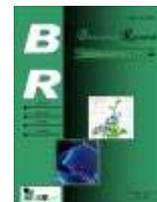


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## Effect of replacing milk fat with oil replacers on the quality of processed cheese

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The research aimed to know the effect of substituting fat milk by vegetarian oils (canola oil, sesame oil, flax Oil) on the features of processed cheese during storage. Factors are divided into four factors which are (M, M1, M2, M3) where the results refer that there are no significant differences are noticed on the chemical composition of the processed cheese in relation to humidity and fat percentage. Whereas there was a simple significant difference for protein. Concerning cholesterol a clear significant differences were noticed between comparison sample which was 33.3 mg / 100 g of cheese. The other three samples in which the fat has been substituted by vegetarian oils (canola oil, sesame oil, flax Oil) which reached (4.9, 4.9, 4.7) mg /100 g respectively. In relation to the peroxide no. and free fatty acid percentage, simple significant differences are found between the four factors. In relation to the saturated fatty acids, the percentage in the comparison sample was high, it was 70.01, the percentage of the three factors (M1, M2, M3) went down, it became (29.43, 29.95, 24.93) respectively. Finally, in relation to the cheese sensitive features, there were no significant differences among the factors concerning the cheese color, while little significant differences are noted concerning the cheese flavor and substratum.

**Keywords:** processed cheese , white cheese , fatty acids , canola oil, sesame oil, flax Oil

### INTRODUCTION

The healthy products are recently demanded, which led to develop a number of fat free or low-fat products, where now a days studies are interesting in substituting highly saturated milk fats by vegetarian oils in producing diaries like cheese which may give chances to low level of cholesterol in blood, which is regarded one of the most important and dangerous factors which cause heart diseases and Arteriosclerosis Karvonen et al.,(2002)

The studies refer that 80% of coronary heart diseases and 90% of Diabetes type 2 can be avoided by changing the life style including the food system and avoiding high percentage fats WHO (2011).using phytosterol and omega 3 fatty acid widely in a group of foods are related with reducing cholesterol Chan et al., (2003). Quilez et al., (2003), Delzenne et al., (2002).

The processed cheeses are regarded among high nutritional value and widely spread and consumption In daily meals for different social classes Caric, M. (1993)., on the other hand found that single and multiple unsaturated fatty acids lead to reduce cholesterol level in blood Lobato-Calleros et al.,(2002).

Processed cheeses differ from ordinary cheeses as they are not made of milk directly, but are made of a mixture of natural dry cheeses, half dry and mature ones in different degrees Klostermeyer, H. (1989). ,mentioned that reducing saturated fatty acids level in processed cheese by using vegetarian oils results a cheese balanced in its content of saturated and unsaturated fatty acids Lobato- Calleros. et al., (2007).

While mentioned that using vegetarian oils instead of milk fat can improve favor features and produced cheese strength, they also mentioned that the

substitution is useful because vegetarian oils are empty of cholesterol and usually are cheaper and more stable for seasonal changes in comparison with milk fat Liangping Y. and Hammond E. G.,(2000).

Lipids play vital functional and sensory roles in food products, they carry enhance and release the flavors of other ingredients lipids also interact with other ingredients to develop and mold texture, flavor perception, flavor stability, flavor generation and overall sensation of foods Giese, I. (1996). De-Roose, K.B. (1997). Over the past decade, there has been substantial interest in the development of anew range of dairy products which and similar to the existing products but in which the fat content is substituted reduced to avoid the health problems associated with increased fat composition Giese, I. (1996)., In addition reducing cow's milk fat with oil from same seeds plants will improve the appearance of the resultant processed cheese or processed cream cheese. One of the most rapidly growing segments of the food industry is the production of reduced calorie foods and in particular low-fat dairy products. This trend is affected by the consumer's awareness about the link between diet and health, which has encouraged research on low-fat processed cheese Duxbury, D.D. (1989). To improve the quality of fat free cheese using oil substitutes to replace fat in food while keeping the same functional and sensory properties of high fat products has attracted great attention in past few years. Processed cheese is a semi-hard cheese manufactured from full fat old new cheeses. However no research has been under taken faculty of Agriculture, Mosul, University.

The objective of this study were to evaluate the possibility of manufacturing low fat processed cheese using different ail substitutes.

## MATERIALS AND METHODS

### Materials

Cow's milk 3% fat obtained from local Mosul market.

Vegetable oil (canola oil, flax oil and sesame oil) obtained from local Mosul market.

Used the microbial rennet processed from the company (Meto senygo co. LTD ) Japanese originator their source is mold *Mucor miehei* (1gm / 25 litter milk ) obtained from the local market of Mosul .

Cheddar cheese and salts obtained from the local market of Mosul.

Emulsifiers (sodium diphosphate , multiple sodium phosphate ) from Euro-phose company of the Belgian.

Packaging materials (poly ethylene) company of the Turkey.

Starters (*Streptococcus lactic* and *Streptococcus cremoris* ) obtained Hans-Danish.

### Search plan

The transactions were divided in to four sections:-  
M: processed cheese as compared.

M1: processed cheese with canola oil.

M2: processed cheese with sesame oil.

M3: processed cheese with flax oil.

### The method

#### Manufacture of white cheese

White cheese making as the method described by Ricki Carrol, (2003).

Sorting of milk.

Milk pasteurizer on 72°C for period 15 seconds.

Cool the milk for 37°C.

Add starters with ratio of (1%) .

Leave milk for 30 minutes of 37°C to develop acidity.

Cut the curd and leave for 10 minutes to get rid of whey.

Move the curd in to the molds.

The same type of cheese was made from milk with a fat value 3%.

#### Manufacturing of processed cheese

Manufacturing of processed cheese according to the method described by Caric, M. (1993). with some modulations:-

Weight of the basic components and as is shown in the table (1) and mix it with some and place it in a cooking pot , steam was processed with continuous stirring at 90°C with period of 10 minutes , the mixture was then naturalized by naturalization of a kind (Silverson Machines Ltd, London, UK) . They are then packaged and packed with polyethylene paper and stored in the refrigerator at 3-5 °C.

#### Chemical estimate

Protein, fat and moisture were estimated according to the method described in A.O.A.C.(2010). , extract fat was ran by Folch, et al., (1957):

#### Estimate cholesterol

Fat was pushed by away of Sander et al.,(1988) , the sterolse derived was used to use

the gas chromatography column by the injection 1  $\mu$ l in to the column of the device . The injection temperature was 280°C , the field of the 290°C and the rate of 0.8 ml/min. flow rate and the 20% split .

The cholesterol value and their standards are selected with standard solution tops.

**Table (1) Ingredients of processed cheese for all transactions**

Ingredients	Treatment			
	M	M1	M2	M3
Cheese cow milk whole fat (g)	500	-	-	-
Cheese cow's skim milk (g)	-	500	500	500
Cheddar cheese (g)	50	50	50	50
Oil (g)	-	100	100	100
Salt (g)	10	10	10	10
Emulsifier (g)	25	25	25	25
Water (ml)	70	70	70	70

#### Estimate of the peroxide number and free fatty acid .

Peroxide number were estimated as mille equivalent Peroxide / Kg fat, and the free fatty acid content expressed oleic was determined according to the method of <sup>16</sup> .

#### Determination of fatty acids

Esters of fatty acid for fat and oils extracted from cheese samples were prepared according to the method described by Chritopherson S. and Glass R., (1969). The methyl ester prepared using the chromatography column were then analyzed directly after the ester by injecting 1  $\mu$ l of the hexane layer through the column after which the fatty acid methyl esters were injected at 70°C oven temperature increasing to 165°C for 10 min. then still at 185°C for 1 min. and increased to 220°C for 15 min. the flow rate was 0.8 ml/min. and the split ratio was 80 . As the peaks of fatty acid were determined and compared with the standard.

#### Organoleptic properties

The organoleptic properties of the resultant was carried out Arbuckle, W. S. (1986) by panelists from staff members of Dairy Dept. . .

#### Statistical analysis

The statistical analysis for the obtained data were done according to the SAS Version Statistical Analysis System (2001). , Differences were considered significant at  $P \leq 0.05$ . Significant variations were determined by Duncan's multiple range test Duncan, D.B. (1955).

## RESULTS

#### Chemical composition of process cheese:

Showed in table (2) varied due to the different treatments the fat and moisture content were non-significant from the beginning and the end of storage after 60 days. Between control & the three treatments of replacement of fat with oils. Protein content same table showed there were lower significant between beginning and end of storage. Which were 24.6, 28.6, 23.6 and 23.3% in the beginning of storage and lowest to 22.5, 20.3, 20.1 and 20.1% in the end of storage in (M, M<sub>1</sub>, M<sub>2</sub> and M<sub>3</sub>) respectively. The lowest protein may be due to the hydrolysis of protein or activity of starter bacteria Abd El-Salam et al., (1994) there was significant difference in cholesterol in the comparison sample and other coefficients, where the ratio was 33.3 mg/100mg in comparison sample and became 4.9, 4.9, 4.7 mg/100mg in the treatment M<sub>1</sub>, M<sub>2</sub> and M<sub>3</sub> respectively in the beginning of storage , The indicates that the replacement of fat with vegetable oils led to the reduction cholesterol by 85-86% due to the reduction of vegetable oils to saturated fatty acids.

#### Free fatty acids content:-

Free fatty acids indicate the degree of hydrolysis of fat in doing products Kesenkas et al., (2009) table (3) showed the effect of replacing of fat with oils through the storage period on the free fatty acids & peroxide number. There were nonsignificant in fatty acids between treatments in the beginning of storage but they increased though the storage periods. Which reach to 1.13, 1.09, 0.95 and 0.90% in the treatment of M, M<sub>1</sub>, M<sub>2</sub> and M<sub>3</sub> respectively. This results was similar with Kavas et al., (2004) who reported that the duration of fatty acid degradation increases during storage.

**Peroxide number:-**

Peroxide value indicate that oxidation occurs during the storage of fats, oils or foods that contain them. Table (3) shows the peroxide values of all transactions were of the beginning of. Manufacturing of there was no significant difference and less than 1 meqO<sub>2</sub>/kg. This indicates

the high quality of the oil used in the study, while the values of peroxide often the end of storage period where the values 0.61, 1.75,1.22 and 0.72 transactions M,M<sub>1</sub>,M<sub>2</sub> and M<sub>3</sub> respectively, and this corresponds to what he found Fedele E, and Bergamo P.,( 2006)

**Table (2) Effect of vegetable oils on the chemical composition of processed cheese.**

storage time (Day)	Transactions			
	M	M1	M2	M3
<b>Moisture (%)</b>				
0	41.8 <sup>a</sup>	40.4 <sup>a</sup>	40.5 <sup>a</sup>	40.9 <sup>a</sup>
60	41.3 <sup>a</sup>	40.1 <sup>a</sup>	40.4 <sup>a</sup>	40.6 <sup>a</sup>
<b>Fat (%)</b>				
0	29.7 <sup>a</sup>	28.6 <sup>a</sup>	28.7 <sup>a</sup>	28.6 <sup>a</sup>
60	29.5 <sup>a</sup>	28.9 <sup>a</sup>	28.6 <sup>a</sup>	28.3 <sup>a</sup>
<b>Protein (%)</b>				
0	24.6 <sup>a</sup>	23.6 <sup>a</sup>	23.6 <sup>a</sup>	23.3 <sup>a</sup>
60	22.5 <sup>a</sup>	20.3 <sup>b</sup>	20.1 <sup>b</sup>	20.1 <sup>b</sup>
<b>Cholesterol (mg/ 100g cheese)</b>				
0	33.3 <sup>a</sup>	4.9 <sup>b</sup>	4.9 <sup>b</sup>	4.7 <sup>b</sup>
60	31.9 <sup>a</sup>	4.8 <sup>b</sup>	4.8 <sup>b</sup>	4.8 <sup>b</sup>

The different letters within the row indicate significant differences between the coefficients (P <0.05). "M: Sample processed cheese compared (milk 3% fat), M1: Sample cheese processed with canola oil, M2: Sample cheese processed with sesame oil, M3 : Sample processed cheese with flax oil"

**Table 3 Effect of vegetable oils on the ratio of free fatty acids and the number of peroxide of cheese processed during storage.**

Characteristic	storage time (Day)	M	M1	M2	M3
Free Fat acidity %	0	0.54 <sup>a</sup>	0.62 <sup>a</sup>	0.60 <sup>a</sup>	0.50 <sup>a</sup>
	60	1.13 <sup>a</sup>	1.09 <sup>a</sup>	0.95 <sup>b</sup>	0.90 <sup>c</sup>
Peroxide value (meq. O <sub>2</sub> / Kg)	0	0.56 <sup>a</sup>	0.60 <sup>a</sup>	0.52 <sup>a</sup>	0.60 <sup>a</sup>
	60	0.61 <sup>c</sup>	1.75 <sup>a</sup>	1.22 <sup>b</sup>	0.72 <sup>c</sup>

The different letters within the row indicate significant differences between the coefficients (P <0.05). "M: Sample processed cheese compared (milk 3% fat), M1: Sample cheese processed with canola oil, M2: Sample cheese processed with sesame oil, M3 : Sample processed cheese with flax oil"

**Fatty acids profile**

Table (4) shown the composition of fatty acids in cheese. There was showed that there was a significant between control and other treatments note that there was a significant decrease in the concentration of short- chain fatty acids (C<sub>4</sub>-C<sub>10</sub>) and saturated fatty acids (C<sub>12</sub>-C<sub>18</sub>) in cheese substitutes with vegetable oil M<sub>1</sub>,M<sub>2</sub> and M<sub>3</sub> compared to a comparative sample this may reduce cholesterol and the risk of heart disease Williams ( 2000). On the contrary, oleic and linoleic acid was higher than the comparison sample, with the percentage of oleic acid 63.62, 39.14 and 25.99 % to the treatments M<sub>1</sub>,M<sub>2</sub> and M<sub>3</sub> respectively while in the comparison sample M (21.76%) , while the ratio of linoleic acid 5.22 , 35.92 and 43.70% for

the treatments M<sub>1</sub>,M<sub>2</sub> and M<sub>3</sub> respectively while the comparison sample M (2.89%) this result was due to the was of vegetable oils that have high levels of unsaturated fatty acids we also note the table that the sample of cheese containing flax oil has the highest percentage of the linoleic acid compared to other transactions The reason for the rise of flax oil is from the linoleic acid compared to the oleic acid, the replacement of milk fat was plant in a rather potential oil in the proportion of saturated and unsaturated fatty acids where the ratio of fatty acids was in the treatment of 68.16% compared to the cheese used by vegetable oils where the ratio was reached 29.43, 29.95 and 24.93% in the treatment M<sub>1</sub>,M<sub>2</sub> and M<sub>3</sub> respectively this means that adding oils process cheese improved from their food value as a result of its highly infected with

unsaturated fatty acids. Which increase the prevention of heart disease Calvo et al.,(2007).

#### Sensory evaluation:-

Scores of sensory properties (flavor, texture, color and appearance) followed similar trends

(table 5) although many cheese treatments were accepted by the panelists, the most acceptable treatment was M<sub>3</sub> which was not significantly different from full fat M. there were slight differences in scores many all treatment.

**Table (4) Effect of vegetable oils on the composition of fatty acids (gm / 100 g fatty acids) for processed cheese.**

Fatty acid	Storage Period (Day)	M	M1	M2	M3
C4:0	0	1.42 <sup>a</sup>	0.27 <sup>c</sup>	0.25 <sup>c</sup>	0.52 <sup>b</sup>
	60	1.41 <sup>a</sup>	0.29 <sup>c</sup>	0.27 <sup>c</sup>	0.58 <sup>b</sup>
C6:0	0	1.78 <sup>a</sup>	0.25 <sup>c</sup>	0.19 <sup>c</sup>	0.41 <sup>b</sup>
	60	1.70 <sup>a</sup>	0.28 <sup>c</sup>	0.21 <sup>c</sup>	0.39 <sup>b</sup>
C8:0	0	1.09 <sup>a</sup>	0.30 <sup>b</sup>	0.24 <sup>c</sup>	0.31 <sup>b</sup>
	60	1.04 <sup>a</sup>	0.39 <sup>b</sup>	0.22 <sup>c</sup>	0.27 <sup>c</sup>
C10:0	0	2.37 <sup>a</sup>	0.44 <sup>c</sup>	0.48 <sup>c</sup>	0.84 <sup>b</sup>
	60	2.39 <sup>a</sup>	0.49 <sup>c</sup>	0.46 <sup>c</sup>	0.81 <sup>b</sup>
C12:0	0	3.72 <sup>a</sup>	0.71 <sup>b</sup>	0.76 <sup>b</sup>	0.89 <sup>b</sup>
	60	3.60 <sup>a</sup>	0.81 <sup>b</sup>	0.80 <sup>b</sup>	0.86 <sup>b</sup>
C14:0	0	12.11 <sup>a</sup>	2.42 <sup>bc</sup>	1.98 <sup>c</sup>	2.47 <sup>b</sup>
	60	12.08 <sup>a</sup>	2.51 <sup>bc</sup>	1.96 <sup>c</sup>	2.08 <sup>c</sup>
C16:0	0	39.13 <sup>a</sup>	20.17 <sup>b</sup>	14.82 <sup>d</sup>	15.12 <sup>c</sup>
	60	39.21 <sup>a</sup>	20.20 <sup>b</sup>	15.73 <sup>d</sup>	15.18 <sup>c</sup>
C16:1	0	2.35 <sup>a</sup>	0.96 <sup>b</sup>	0.48 <sup>c</sup>	0.53 <sup>c</sup>
	60	2.38 <sup>a</sup>	0.96 <sup>b</sup>	0.46 <sup>c</sup>	0.45 <sup>c</sup>
C18:0	0	9.76 <sup>a</sup>	6.10 <sup>b</sup>	6.85 <sup>b</sup>	4.08 <sup>c</sup>
	60	10.12 <sup>a</sup>	5.98 <sup>b</sup>	6.81 <sup>b</sup>	4.13 <sup>c</sup>
C18:1	0	21.76 <sup>d</sup>	63.62 <sup>a</sup>	39.14 <sup>b</sup>	25.99 <sup>c</sup>
	60	21.92 <sup>d</sup>	63.22 <sup>a</sup>	39.02 <sup>b</sup>	25.64 <sup>c</sup>
C18:2	0	3.39 <sup>d</sup>	5.22 <sup>c</sup>	36.13 <sup>b</sup>	45.10 <sup>a</sup>
	60	3.45 <sup>d</sup>	5.28 <sup>c</sup>	36.09 <sup>b</sup>	45.14 <sup>a</sup>
SFA	0	68.16 <sup>a</sup>	29.43 <sup>b</sup>	29.95 <sup>b</sup>	24.93 <sup>c</sup>
	60	68.21 <sup>a</sup>	30.24 <sup>b</sup>	30.23 <sup>b</sup>	24.89 <sup>c</sup>
MUFA	0	27.86 <sup>c</sup>	65.11 <sup>a</sup>	39.09 <sup>b</sup>	26.46 <sup>b</sup>
	60	27.78 <sup>c</sup>	64.62 <sup>a</sup>	39.20 <sup>b</sup>	26.08 <sup>b</sup>
PUFA	0	3.39 <sup>d</sup>	5.22 <sup>b</sup>	6.13 <sup>b</sup>	45.10 <sup>a</sup>
	60	3.45 <sup>d</sup>	5.28 <sup>b</sup>	6.09 <sup>b</sup>	45.14 <sup>a</sup>

The different letters within the row indicate significant differences between the coefficients (P <0.05).

"M: Sample processed cheese compared (milk 3% fat), M1: Sample cheese processed with canola oil, M2: Sample cheese processed with sesame oil, M3 : Sample processed cheese with flax oil" SFA: saturated fatty acids, MUFA: monounsaturated fatty acids, PUFA: polyunsaturated fatty acids

**Table (5) shows the effect of replacing vegetable oil with milk fat on the sensory characteristics of processed cheese.**

Characteristics	Time of storage (Day)	M	M1	M2	M3
Color	0	8.5 <sup>a</sup>	8.7 <sup>a</sup>	8.3 <sup>a</sup>	8.5 <sup>a</sup>
	60	8.6 <sup>a</sup>	8.6 <sup>a</sup>	8.4 <sup>a</sup>	8.4 <sup>a</sup>
Flavor	0	9.5 <sup>a</sup>	7.5 <sup>bc</sup>	7.0 <sup>c</sup>	8.3 <sup>b</sup>
	60	9.4 <sup>a</sup>	7.6 <sup>bc</sup>	7.1 <sup>c</sup>	8.1 <sup>b</sup>
Textures	0	8.5 <sup>a</sup>	7.6 <sup>c</sup>	7.6 <sup>c</sup>	8.0 <sup>b</sup>
	60	8.6 <sup>a</sup>	7.3 <sup>c</sup>	7.8 <sup>b</sup>	7.9 <sup>b</sup>
Appearance	0	8.5 <sup>a</sup>	8.3 <sup>a</sup>	8.0 <sup>ab</sup>	7.7 <sup>b</sup>
	60	8.6 <sup>a</sup>	8.7 <sup>a</sup>	8.2 <sup>ab</sup>	7.9 <sup>b</sup>

The different letters within the row indicate significant differences between the coefficients (P <0.05).

"M: Sample processed cheese compared (milk 3% fat), M1: Sample cheese processed with canola oil, M2: Sample cheese processed with sesame oil, M3 : Sample processed cheese with flax oil"

## CONCLUSION

From the obtained results it can be concluded; We find that the use of flax oil was better than who else the oils used to maintain cheese from oxidation, the replacement of milk fat with vegetable oils has reduced the proportion of saturated fatty acids harmful to health and increase unsaturated fatty acids that have a positive effect on consumer health

## CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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## AUTHOR CONTRIBUTIONS

I have contributed to collecting and getting results, writing every part of the article, I agree to the final version.

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