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Research Article
The Effect of Substituting Milk Fat by Peanut Oil on the Quality of White Soft Cheese

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Abstract

Objective: This study was carried out to investigate the effect of using peanut oil extract from peanut seeds (*Arachis hypogea* L.) variety NC7on the properties of the white soft cheese. **Methodology:** Quality properties of peanut oil including oxidative stability, characterize and quantitative of tocopherol isomers, antioxidants and the content of free fatty acids was examined before white soft cheese was made by using of fresh skim milk and butter oil 4% (control, C), peanut oil 4% (T1) and addition of two commercial stabilizers to peanut oil cheese, S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1). The S1 and S2 stabilizers were added at a ratio of 1% to white soft cheese made by peanut oil as T2 and T3, respectively. Produced cheeses were stored at 5±2°C for three months and examined for chemical analysis, ripening indices, oxidative stability and organoleptic properties. **Results:** The results showed that using of S1 and S2 as cheese stabilizers decreased the loss of oil in cheese whey comparing with the control treatment as well as the treatment without stabilizer (T1). The fatty acids content of cheeses were varied and the most abundant fatty acids were palmitic acid, stearic acid and myristic acid, which was 35.41, 16.02 and 8.24 %, respectively in control cheese samples (C). These values were higher than the values in treatments T1, T2 and T3, which ranged 10.35-10.56, 4.45-4.98 and 1.16-1.82%, respectively. **Conclusion:** There were high concentrations of unsaturated fatty acids compared with saturated fatty acids. Oleic acid had a high percentage in cheese containing peanut oil (T1, T2 and T3), which made it more stable for oxidation and recorded high scores for sensory evaluation compared to the control. The use of peanut oil with S1, which containing whey protein powder improved oxidative stability and organoleptic properties of the produced cheese.

Key words: HPLC, gas chromatographic, tocophorol, stabilizer, antioxidants, sensory evaluation, fatty acids

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

White soft cheese is one of the most popular soft cheeses in Egypt and many other countries especially in Middle East. Tallaga cheese is defined according to the Egyptian Standards[1] as a white fresh or ripened soft cheese obtained by coagulation of fresh concentrated milk or mixture of its fresh products with partial or total fat substitution with vegetable oils. Milk fat is a major component in most cheese varieties and many consumers limit their consumption of cheese because milk fat has high saturated fatty acids and cholesterol content. Milk fat contains over 70% saturated acyl groups and of these, laurate, myristate and palmitate are considered particularly atherogenic[2]. Reduced fat products have been available in the market place for several decades and continuously new products emerge that allow consumers to limit their fat intake within recommended levels[3,4]. The amount of fat intake is considered equally important to the balance between saturated and unsaturated fatty acids so that diets abundant in mono and polyunsaturated fats are considered healthy[5]. Researchers have explored the possible total substitution of milk-fat by polyunsaturated vegetable oils to achieve functional products with healthier saturated/unsaturated fatty acid balance that may contribute to improve consumers acceptance[6]. The substitution of milk fat by polyunsaturated vegetable oils in a 1:1 ratio resulted in cheeses with lower mechanical characteristics than those exhibited by the full-milk fat cheese, probably due to part of the liquid state and lower melting point of the vegetable oils[7]. Replacement of milk fat with vegetable oils in making soft cheese had been studied[8,9]. One of the main problems related to the use of vegetable oils in dairy products is the possible decrease of their textural properties, rapid oxidation of fat and formation of undesirable compounds, such as peroxides and aldehydes[10-12].

Peanut oil is pale yellow oil with a distinctive nutty taste and odor obtained from the processing of peanut kernel[13]. There are many health benefits associated with consumption of peanuts including weight gain control[14], prevention against cardiovascular diseases[15], protection against alzheimer disease[16] and cancer inhibition[17]. These benefits are mainly attributed to the fact that peanuts do not contain trans-fatty acids[18]. Refined peanut oil is not allergenic to people with peanut allergy since oil should not contain any protein[19]. The oil content in peanut seeds generally ranges from 42-52%, which is relatively high compared with most other oilseed crops[20].

A wide variety of plant and animal derived hydro colloids are added to the milk prior (e.g., cream cheese and fresh cheese products) to immobilize water and reduce syneresis[21]. The stabilizers that give the product more homogeneity and improves the consistency of the cheese, increases the yield of the produced cheese. Furthermore, reduces losing in weight during storage and increases the release of compounds responsible for the distinguished flavor[22]. The aim of this work was to manufacture and investigate the quality of white soft cheese in which milk fat was substituted by peanut oil. Also, study the effect of adding stabilizers to peanut oil cheese. Chemical analysis, oxidative stability and organoleptic properties of the produced cheeses were studied.

MATERIALS AND METHODS

Materials: Fresh skim buffalo's and cow's milk (1:1) were obtained from Dairy Technology Unit, Department of Food Science, Faculty of Agriculture, Zagazig University. Peanut oil was extracted by steeping crushed, seeds of peanut (*Arachis hypogea* L.) overnight in n-hexane as a solvent. The solvent was then distilled off under vacuum at 45°C in a rotary evaporator (Buchi Rotavapor R-124, Switzerland, Sigma-Aldrich) commercial stabilizers: S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1) were obtained from EGY DAIRY (10th of Ramadan city, Egypt).

Methods

Starter culture: Freeze dried FD-DVS R-704 pHage control™ containing *Lactococcus lactis* subsp. *lactis* and *Lactococcus lactis* subsp. *cremoris* and microbial rennet powder (granulate NB) were obtained from Christian Hansen Inc. Laboratories, Denmark, by Misr Food Additives, Egypt. It was diluted with distilled water to a standard rennet solution before using.

Making white soft cheese: White soft cheese treatments were made from all milk treatments by the conventional method of making domiati cheese[23]. Fresh skim buffalo's and cow's milk (1:1) contains 0.2% fat was divided into two parts, the first part was mixed with butter oil at a ratio of 4% (control cheese, C) and the second one was mixed with 4% of peanut oil. The cheese milk with 4% peanut oil was divided into three portions: T1, without stabilizers; T2, containing stabilizer S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and T3, containing stabilizer S2 (mono and

diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1). Each stabilizer S1 or S2 was added to cheese milk at 1%. The NaCl was added at 4% to the cheese milk of all treatments then homogenized at 60°C, 400 kPa. Pasteurized at 72°C for 15 sec, cooled to 40°C and then 0.02% of $CaCl_2$ was added. Starter culture was added to each treatment at a ratio of 0.003%. Temperature was adjusted in each treatment to 40°C and renneted with microbial rennet and incubated until coagulation. Produced cheeses were packaged in plastic bags containing pasteurized whey (4% salt) and stored at the refrigerator (5±2°C) for three months. Three replicates were carried out from each treatment. Cheese samples were chemically analyzed, oxidative stability (peroxide and acid values) and sensory evaluated when fresh and after 3, 60 and 90 days of storage.

Oil content of peanut seeds: The oil content of unroasted peanut seeds was determined as described by AOAC method[24].

Analysis of peanut oil: Acid and peroxide values of the oil samples were determined by AOCS[25] official methods Cd 3d-63 and Cd 8-53, respectively. To study the oxidative stability of unroasted peanut oils, 50 g of oil were transferred, in duplicate to a 100 mL capacity glass beaker. The samples were stored in a forced-draft air oven at 60°C for 18 days. The oxidative stabilities of oils were studied by measuring Peroxide Value (PV). Iodine Value (IV) was calculated from fatty acid composition[26] using the following formula:

$$IV = (\%\ Oleic\times 0.8601)+(\%\ Linoleic\times 1.7321)+(\%\ Eicosenoic\times 0.7854)$$

DPPH radical scavenging method: The antioxidant activity was evaluated of oil by using the stable 1, 1-diphenyl-2-picryl-hydrazyl radical (DPPH) according to modified method of Bandoniene *et al.*[27]. The radical scavenging activities of the tested samples, expressed as percentage inhibition of DPPH, according to Yen and Duht[28].

High-performance liquid chromatography (HPLC): HPLC separation, identification and quantification of tocopherols was selected to avoid extra sample treatment (e.g., saponi cation) according to Ramadana *et al.*[29].

Cheese analysis: The cheese samples of all treatments were analyzed for moisture, fat, titratable acidity, Total Nitrogen (TN), non-protein nitrogen (NPN), Soluble Nitrogen (SN) according to AOAC[24]. Fat in treatments with peanut oil and fat loss in whey was determined according to Hefnawy[30]. The pH value was determined in homogenized cheese samples using HNNA Digital Hi 8014 pH meter according to AOAC[24]. Fat loss in whey of control cheese after manufacturing and during storage was determined according to Gerber method as described by Ling[31]. Actual cheese yield was determined by the following equation:

$$\text{Actual yield} = \frac{\text{Weight of cheese}}{\text{Weight of milk used to make cheese}}\times 100$$

To determine oxidative stability, cheese samples were dried at 40°C for 12 h in hot air oven, ground and mixed with n-hexane as a solvent for extraction of oil. The solvent was evaporated in dry air oven and the extracted oils were analyzed for Peroxide Value (PV) and Acid Value (AV) according to the method described in AOAC[24].

Total phenolic content and antioxidant activity: To assay the total phenolic content and antioxidant activity, water of soft cheese extract was prepared as follows: Cheese sample (10 g) was mixed with 2.5 mL distilled water and the pH was adjusted to 4.0 using HCl (1 M). The cheese was then incubated in water bath at 45°C for 10 min and the precipitated proteins were removed by centrifugation (10,000 rpm, 10 min, 4°C). The supernatant pH was adjusted to 7.0 using NaOH (0.5 M) followed by centrifugation (10,000 rpm, 10 min, 4°C) to remove residual precipitated proteins and salts. The supernatant was collected, kept refrigerated and used for subsequent analysis within 24 h. Total phenolic content and antioxidant activity by 1.1-diphenyl-2-picryl-hydrazyl radical (DPPH) inhibition assay were determined as described by Shetty *et al.*[32].

Gas Chromatographic (GC) analysis of Free Fatty Acids (FFAs) of peanut oil and cheese: Free Fatty Acids (FFAs) were extracted according to AOAC[24]. Fatty acids were esterified into methyl esters by heating in borontrifluoride (10% solution in methanol, Merck, Darmstadt, Germany) according to the procedure reported by Ramadan and Moersel[33]. Results were expressed as percent of relative area as described by Dabbou *et al.*[34].

Organoleptic properties: Organoleptic properties of cheese samples were assessed by the staff members Department of Food Science, Faculty of Agriculture, Zagazig University. The panel scores for appearance (score 1-10), body and texture (score 1-40) and flavor (score 1-50) as reported by Scott[35].

Statistical analysis: The collected data were statistically analyzed using IBM[36]. Analysis of variance (ANOVA), the multiple range tests using the Least Significant Difference (LSD) test and Duncan's multiple range test was used to determine the differences among the cheese samples. Significant differences were determined at $p \leq 0.05$.

RESULTS AND DISCUSSION

Proximate composition of peanut oil: The oil content of peanut seeds 48.87% and chemical properties of peanut oil such as: acid (mg KOH g^{-1}), peroxide (mill equivalents/kg) and iodine values of oil were 0.044, 7.2 and 90.40, respectively.

The acid value of peanut oil are far below the toxic level[37]. Peanut oil is one of the major oils in the human diet[38]. Peanut seeds contain 40-50% oil and 27-29% protein[39]. Peanut oil generally contains 55-65% monounsaturated fatty acids, 26-28% polyunsaturated fatty acids and 17-18% saturated fatty acids[40].

Tocopherol isomers are presented in Fig. 1. The α-tocopherol (α-t and α-t3) constituted ca 1050 mg 100 g^{-1} oil and β-tocopherol (β-t and β-t3) constituted ca. 250 mg 100 g^{-1} oil of the total analysts, the rest being δ-tocopherol (δ-t and δ-t3) ca. 530 mg 100 g^{-1} oil and γ-tocopherol (γ-t and γ-t3) ca. 2200 mg100 g^{-1} oil. The α-tocopherol is the most efficient antioxidant of the tocopherol isomers, while β-tocopherol has 25-50% of the antioxidative activity of α-tocopherol and the γ-isomer 10-35%[41]. Despite of general agreement that α-tocopherol is the most efficient antioxidant and vitamin E homologue *in vivo*, other studies indicate a considerable discrepancy in its absolute and relative antioxidant effectiveness *in vitro*, especially when compared to γ-tocopherol[42]. Levels of tocopherols detected in peanut oil may contribute to protect oil against oxidation. The nutritionally important components, such as tocopherols (vitamin E), improve stability of the oil. Tocopherols are the major lipid-soluble, membrane-localised antioxidants in humans. Deficiency of these compounds affects many tissues in mammalian and bird models[43]. Vitamin E deficiency in man causes defects in the developing nervous system of children and hemolysis in man[44]. Epidemiologic studies suggest that people with lower vitamin E and other antioxidant intakes and plasma levels may be at increased risk for certain types of cancer and for atherosclerosis[45,46]. It is also suggested that supplementation with antioxidants may decrease the risk of other degenerative processes[41]. Tocopherols in vegetable oils, moreover, are believed to protect polyunsaturated fatty acids (PUFA) from peroxidation[47].

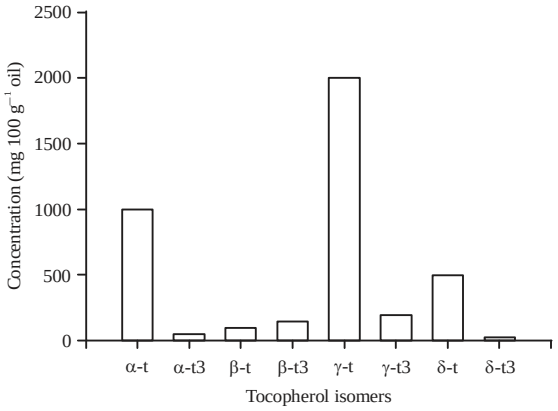

Fig. 1: Tocopherol isomers in peanut oil determined by using HPLC

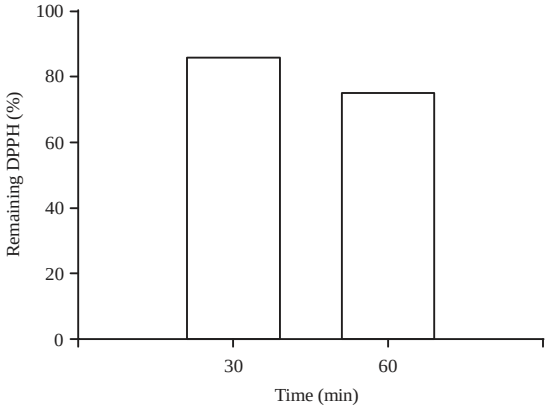

Fig. 2: Antioxidant activity of peanut oil

Antiradical properties of the oil under study were compared using stable antioxidant activity of DPPH radical. Figure 2 shows that peanut oil had the strongest Radical Scavenging Activity (RSA), after 60 min incubation, 75% of DPPH radical. It could be said that the RSA of oil can be interpreted as the combined action of different endogenous antioxidants. However, when unsaponifiables and polar fractions containing high levels of polar lipids and low levels of phenolic compounds, strong RSA of these components can be expected as well as synergistic activity with primary antioxidants[48]. The stronger antiradical action of oil may be due to: (1) The differences in content and composition of polar lipids and unsaponifiables, (2) The diversity in structural characteristics of potential phenolic antioxidants present, (3) A synergism of polar lipids with other components present and (4) Different kinetic behaviors of potential antioxidants. All these factors may contribute to the radical quenching efficiency of oil[49].

Table 1: GC profile of fatty acids as a percentage of total fatty acids of peanut oil extracted from peanut seeds variety NC7

Fatty acids	Percentage (%)
$C_{16:0}$ (palmitic)	9.35
$C_{16:1}$ (palmitoleic)	0.05
$C_{18:0}$ (stearic)	4.85
$C_{18:1}$ (oleic)	53.95
$C_{18:2}$ (linoleic)	25.40
$C_{18:3}$ (α-linolenic acid)	1.10
$C_{20:0}$ (arachidic acid)	1.90
$C_{20:1}$ (eicosenoic acid)	Trace
$C_{20:2}$ (eicosadienoic)	Trace
$C_{22:0}$ (behenic acid)	3.20
$C_{22:1}$ (erucic)	Trace
$C_{24:0}$ (lignoceric acid)	Trace
$C_{24:1}$ (nervonic)	0.20
$C_{26:0}$ (cerotic)	Trace
Oleic/linoleic ratio (O/L)	2.12
Saturated	4.18
Unsaturated	80.70
Saturated/unsaturated ratio (S/U)	0.24
Unsaturated/saturated ratio (U/S)	4.18
MUFA	54.20
PUFA	26.50
MUFA/ PUFA ratio	2.05

The GC profile of fatty acids in peanut oil is presented in Table 1. Palmitic ($C_{16:0}$), stearic ($C_{18:0}$), oleic ($C_{18:1}$), linoleic ($C_{18:2}$) and linolenic ($C_{18:3}$) acids were identified in peanut oil with high percent. The results revealed that the peanut oil contained relatively high percentage of Unsaturated Fatty Acids (UFAs) as compared to Saturated Fatty Acids (SFAs) (Table 1). Among UFAs, high monounsaturated fatty acids MUFAs/PUFAs and oleic/linoleic (O/L) ratios were observed in peanut oil. The oleic acid, a MUFA, as the major UFAs was presented highest by 53.95%. Linoleic acid, a PUFA, was presented secondly as major UFA in peanut oil. Diets enriched with MUFA, such as oleic acid may protect against atherosclerosis, lower serum cholesterol levels by diminishing oxidative stress and inflammatory mediator, while promoting antioxidant defense[50]. A significant decrease in the total plasma cholesterol and LDL-cholesterol by the use of diets rich in MUFAs has been reported[51]. The low-fat diets and the diets containing high levels of MUFAs are equally effective in lowering serum cholesterol levels[52]. The MUFAs, relative to carbohydrate, increase HDL cholesterol levels and decrease plasma triglyceride levels. Thus, the cardiovascular disease (CVD) risk can be managed with reference to the diets higher in MUFA keeping in the limits of SFA recommendation and compromise weight control[53]. A number of human studies showed that MUFAs rich diets may decrease the plasma LDL cholesterol level when compared to PUFAs or carbohydrate-rich diets[54-56]. However, the studies on rats showed that diets containing high UFAs/SFA and PUFAs/MUFAs ratio increases the level of very low density lipoprotein in plasma but reduces the effect of dietary cholesterol in elevating the triglycerides level in liver[57]. The presence of high amounts of UFAs as compared to SFAs, make peanut suitable for nutritional application. Peanut oil is high in oleic acid compared to linoleic acid content, showed high O/L ratio and was found to be promising regarding the protection against CVD risk. Linoleic acid having two double bonds is more susceptible to oxidative rancidity than oleic acid and the saturated fatty acids[58]. The rancidity of oil is due to the reaction of oxygen with the double bonds of UFAs resulting in the products having unpleasant odor and flavor. Hence, the oil containing higher MUFAs/PUFAs ratio may be recommended in nutritional supplements for better health. It has also been reported that higher O/L ratio and lower Iodine Value (IV) indicate the better oil stability, longer shelf life and good quality of oil[59]. Asibuo *et al.*[60] reported that the oil content of peanut seeds (*Arachis hypogaea*) 49.7%. The major fatty acids were oleic and linoleic, which accounted for 77.89% of the total fatty acids. The subspecies *hypogaea* had content of oleic acid (55.9%). The sum of three fatty acids oleic, linoleic and palmitic acid constitute 89.35% of the total fatty acids. The mean O/L for subspecies *hypogaea* was 2.59. The iodine value ranged from 85.77-93.67%.

Chemical composition of white soft cheese: The moisture contents for cheese samples were significantly ($p \leq 0.05$) decreased at the first 30 days and decreased slowly after 30-90 days of storage (Table 2). The decrease in moisture contents of all cheeses during the first period of ripening may be due to cheese synersis, which occurred as a result of decreasing pH. The higher moisture content of cheeses in this study could be attributed to application of homogenization and stabilizers. In homogenization the para-casein network, causing interference to casein micelle aggregation and fusion to form a compact structure and thereby leading to lower synersis and increasing moisture[61]. Results showed that cheeses containing stabilizers and peanut oils (T2 and T3) had higher moisture content compared with control and T1 cheeses. This might be due to the addition of cheese stabilizers decreased the moisture loss and increased the water holding capacity.

Fat and oil contents of cheese samples increased significantly ($p \leq 0.05$) during storage depending on the loss of moisture (Table 2). Similar results were obtained by El-Sheikh *et al.*[62]. The addition of stabilizers to cheese increased fat content in cheese as a result of decreasing the loss of fat in whey.

Table 2: Chemical composition and actual yield of white soft cheeses as affected by substituting milk fat by peanut oil during storage period

		Cheese samples					
Parameters	Storage period (days)	C	T1	T2	T3	Total means	LSD
Moisture (%)	3	60.57±3.57^{a}	59.68±1.78^{b}	61.92±1.83^{a}	62.17±0.83^{a}	61.09±2.18^{A}	4.20
	30	60.24±4.31^{b}	59.45±2.71^{b}	61.46±2.44^{a}	61.85±1.12^{a}	60.75±2.57^{AB}	4.21
	60	59.13±0.87^{b}	58.85±1.87^{b}	60.65±2.66^{a}	61.05±1.95^{a}	59.94±1.92^{AB}	3.65
	90	58.64±2.46^{ab}	57.06±1.46^{b}	59.85±1.15^{a}	60.72±1.75^{a}	59.10±2.11^{B}	3.44
Total means		59.64±2.77^{BC}	58.76±1.94^{C}	60.97±2.01^{A}	61.45±1.63^{A}	60.21±2.28	1.71
Fat/DM (%)	3	45.35±2.35^{a}	44.85±2.89^{a}	43.76±0.25^{a}	43.15±1.19^{b}	44.28±1.89^{B}	1.62
	30	46.65±1.77^{a}	45.63±1.58^{a}	44.85±2.85^{b}	44.76±3.78^{b}	45.47±2.38^{AB}	2.94
	60	47.11±1.29^{a}	46.58±0.46^{a}	45.72±1.77^{b}	45.43±2.54^{b}	46.22±1.45^{A}	1.02
	90	46.65±1.65^{a}	45.73±1.82^{a}	44.84±1.91^{b}	45.65±1.15^{ab}	44.97±1.75^{AB}	2.45
Total means		46.69±1.73^{A}	45.70±1.71^{AB}	44.79±1.81^{B}	44.75±2.27^{B}	45.49±1.99	1.62
Fat in whey (%)	3	0.43±0.08^{ab}	0.51±0.10^{a}	0.33±0.01^{bc}	0.23±0.04^{c}	0.38±0.13^{C}	0.16
	30	0.53±0.09^{a}	0.63±0.12^{a}	0.35±0.0^{6b}	0.26±0.06^{b}	0.44±0.17^{C}	0.15
	60	0.83±0.06^{ab}	0.97±0.41^{a}	0.47±0.04^{bc}	0.37±0.02^{c}	0.66±0.31^{B}	0.39
	90	1.15±0.10^{ab}	1.54±0.50^{a}	0.63±0.21^{bc}	0.51±0.06^{c}	0.96±0.50^{A}	0.52
Total means		0.74±0.30^{B}	0.91±0.50^{A}	0.45±0.15^{C}	0.34±0.12^{C}	0.61±0.38	0.15
TN (%)	3	2.44±0.41^{a}	2.52±0.22^{a}	2.53±0.02^{a}	2.37±0.14^{a}	2.47±0.21^{A}	0.44
	30	2.51±0.32^{a}	2.57±0.09^{a}	2.59±0.05^{a}	2.46±0.11^{a}	2.53±0.16^{A}	0.33
	60	2.55±0.18^{ab}	2.60±0.01^{a}	2.64±0.25^{a}	2.50±0.14^{b}	2.57±0.15^{A}	0.31
	90	2.45±0.09^{b}	2.52±0.19^{a}	2.58±0.02^{a}	2.41±0.11^{b}	2.49±0.12^{A}	0.22
Total means		2.49±1.17^{B}	2.55±1.23^{A}	2.59±1.15^{A}	2.44±1.11^{B}	2.51±1.13	0.15
Acidity (%)	3	0.26±0.05^{a}	0.27±0.03^{a}	0.28±0.03^{a}	0.26±0.04^{a}	0.27±0.03^{D}	0.07
	30	0.39±0.02^{a}	0.37±0.01^{a}	0.37±0.02^{a}	0.36±0.02^{a}	0.39±0.02^{C}	0.03
	60	0.52±0.01^{a}	0.47±0.02^{b}	0.48±0.03^{ab}	0.47±0.05^{b}	0.51±0.29^{B}	0.04
	90	0.59±0.01^{a}	0.55±0.03^{b}	0.56±0.01^{ab}	0.51±0.02^{c}	0.55±0.03^{A}	0.03
Total means		0.44±0.13^{A}	0.41±0.11^{B}	0.42±0.12^{AB}	0.40±0.10^{B}	0.42±0.11	0.02
pH	3	5.51±0.15^{a}	5.46±0.17^{a}	5.43±0.08^{a}	5.55±0.21^{a}	5.49±0.14^{A}	0.29
	30	5.25±2.04^{a}	5.29±0.02^{a}	5.31±0.13^{a}	5.32±0.02^{a}	5.29±0.87^{B}	0.14
	60	5.11±0.10^{b}	5.21±0.04^{a}	5.17±0.06^{ab}	5.24±0.17^{a}	5.18±0.11^{C}	0.19
	90	5.04±0.15^{c}	5.16±0.10^{ab}	5.12±0.15^{ab}	5.19±0.07^{a}	5.13±0.12^{D}	0.23
Total means		5.23±0.89^{B}	5.29±0.14^{A}	5.25±0.16^{AB}	5.32±0.19^{A}	5.27±0.46	0.43
Actual yield (%)	Fresh	21.31±1.69^{AB}	20.65±3.35^{B}	23.72±2.28^{AB}	24.07±0.93^{A}	22.44±2.47	3.40

C: Control cheese with 4% butter oil, T1: Cheese with 4% peanut oil, T2: Cheese with 4% peanut oil+S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and T3: Cheese with 4% peanut oil+S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1), TN: Total nitrogen, Mean±SE, values with the same small and capital letters in the same column and same raw are not signi cantly ($p \leq 0.05$), LSD: Least significant difference at ($p \leq 0.05$)

Data showed that there were significant differences in fat content of whey. Whey of control cheese and treatment (T1) had higher fat content, while the addition of stabilizers to cheese (T2 and T3) decreased the loss of fat in whey (Table 2).

Total Nitrogen (TN) content of all cheeses increased gradually up to 60 days of the storage period (Table 2). There were no significant differences between treatments. Treatment (T2) had the highest TN content at the end of storage period compared with the other treatments. Acidity increased gradually with the progress of storage period in all the cheese treatments (Table 2). An important observation was noticed that the control cheeses had higher acidity than other treatments. These results were agreed with those given by El-Sheikh *et al.*[62]. The trend of the changes in pH values of all treatments was opposite to that of acidity (Table 2).

Actual yield of cheese: Cheese yield is of basic interest to cheese manufacturers as small differences in yield translate to large sums of profit, especially for the cheese makers with vegetable oils. Results of cheese yield are listed in Table 2. Peanut oil cheese T1 had no significant difference at $p \leq 0.05$ compared with control cheese but peanut oil+S2 (T3) cheese scored the highest actual yield. However, there were high significant differences ($p \leq 0.05$) in the yield of cheese made by using stabilizer S2 and other treatments and this may be due to its high content of moisture, which led to high ability to water holding capacity. The addition of cheese stabilizers decreased the loss of fat in whey compare with other cheese[22].

Ripening indices: All ripening indices including Soluble Nitrogen (SN), non-protein nitrogen (NPN) and Total Volatile

Table 3: Proteolysis and lipolysis (ripening indices) of white soft cheeses as affected by substituting milk fat by peanut oil during storage period

		Cheese samples					
Parameters	Storage period (days)	C	T1	T2	T3	Total means	LSD
SN/TN (%)	3	10.15±0.50^{a}	10.23±0.11^{a}	10.65±0.14^{a}	9.48±0.20^{b}	10.13±0.50^{D}	0.53
	30	10.91±0.76^{a}	11.25±0.69^{a}	11.55±0.71^{a}	10.94±0.56^{a}	11.16±0.64^{C}	1.07
	60	11.54±0.27^{b}	11.96±0.35^{a}	12.17±0.28^{a}	11.52±0.14^{b}	11.79±0.37^{B}	0.41
	90	12.76±0.83^{ab}	13.01±0.66^{ab}	13.23±0.94^{a}	11.98±0.41^{b}	12.74±0.79^{A}	1.09
Total means		11.34±1.13^{BC}	11.61±1.17^{AB}	11.90±1.10^{A}	10.98±1.03^{C}	11.46±1.13	0.36
NPN/TN (%)	3	6.38±0.37^{a}	6.54±0.30^{a}	6.44±0.58^{a}	6.34±0.55^{a}	6.43±0.40^{D}	0.70
	30	7.04±0.07^{b}	7.37±0.32^{a}	7.53±0.09^{a}	6.93±0.15^{b}	7.22±0.30^{C}	0.28
	60	7.46±0.05^{b}	7.54±0.11^{b}	8.09±0.61^{a}	7.13±0.15^{b}	7.55±0.45^{B}	0.49
	90	8.33±0.01^{a}	8.36±0.09^{a}	8.38±0.26^{a}	7.67±0.39^{b}	8.19±0.37^{A}	0.36
Total means		7.30±0.76^{B}	7.45±0.70^{AB}	7.62±0.86^{A}	7.02±0.58^{C}	7.35±0.74	0.22
TVFA (mL NaOH	3	20.27±1.73^{a}	19.87±0.68^{a}	20.33±1.67^{a}	18.93±0.07^{a}	19.85±1.22^{D}	1.89
0.1 N100 g^{-1})	30	26.33±3.67^{a}	22.47±5.53^{ab}	23.73±2.27^{ab}	20.31±3.73^{b}	23.20±4.09^{C}	6.03
	60	28.67±0.98^{a}	25.47±0.15^{b}	26.73±0.27^{b}	22.27±1.84^{c}	25.79±2.59^{B}	1.60
	90	32.52±0.48^{a}	27.55±3.70^{bc}	28.64±1.65^{b}	23.85±3.15^{c}	28.14±3.88^{A}	3.85
Total means		26.95±4.98^{A}	23.84±4.17^{B}	24.86±3.55^{B}	21.33±2.97^{B}	24.23±4.36	1.72

C: Control cheese with 4% butter oil, T1: Cheese with 4% peanut oil, T2: Cheese with 4% peanut oil+S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and T3: Cheese with 4% peanut oil+S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1). SN: Soluble nitrogen, TN: Total nitrogen, NPN: Non-protein nitrogen, TVFA: Total volatile fatty acids, Mean±SE values with the same small and capital letters in the same column and same raw are not signi cantly ($p \leq 0.05$). LSD: Least significant difference at ($p \leq 0.05$)

Fatty Acids (TVFA) for all cheese samples were gradually increased as the ripening period progressed (Table 3). The increased proteolysis in cheeses during storage may be attributed mainly to the residual rennet retained in cheese curd. Treatments (T2) had higher levels of SN (Table 3). Abdel-Bakey *et al.*[63] reported that the addition of whey protein carboxymethyl callulose complex (WPC) in soft cheese manufacture increased SN and TN contents.

There were significant differences in TVFAs content of cheeses as compared with control during the storage period. Moreover, TVFAs content of all cheese samples showed significant gradual increase during the storage period, which could be attributed to lipolysis of fat and the higher rate of proteolysis and formation free amino acids, which could be converted to volatile fatty acids through a specific metabolic pathway[64]. Control cheese (C) and treatment (T2) recorded higher values for TVFA values during storage period (Table 3). Similar results were reported by Salem *et al.*[65].

Patterns of free fatty acids in ripened white soft cheese: Lipids in foods may undergo hydrolytic or oxidative degradation. However, in cheese, oxidative changes are very limited due to the low oxidation/reduction potential[66,67] (about-250 mV). However, triglycerides in all cheese varieties undergo hydrolysis by the action of endogenous and/or exogenous lipases, which resulted in the liberation of fatty acids in cheese during ripening. The triglycerides of ruminant milk fat are rich in short-chain fatty acids that, when liberated, have low flavor thresholds that contribute significantly to the flavor of many cheese varieties. Lipolytic agents in cheese generally originate from the milk, the coagulant (in the case of rennet paste) and the cheese microflora (starter, nonstarter and adjunct microorganisms).

The acceptability of cheese depends largely on the flavor formed during ripening. Two important classes of compounds contribute to flavor are volatile sulphur compounds and fatty acids. Free fatty acids more than likely contribute to flavor and odor of cheese[68]. Table 4 shows the profile fatty acids composition (as relative area percentage) of cheese samples. Volatile fatty acids, impart flavor substances to many cheeses, as a result of hydrolysis of fatty acids (butyric) or bacterial growth. The resulting acidity prevents the development of starter culture and improving the flavor of cheese. Total volatile fatty acids in control cheese (C) had higher value followed by treatments T2, T1 and T3 (Table 4). The nonvolatile fatty acids content varied and the most abundant fatty acid were palmitic acid ($C_{16:0}$), stearic acid ($C_{18:0}$) and myristic acid ($C_{14:0}$), which were 35.41, 16.02 and 8.24%, respectively in the control samples (C). These fatty acids were in the control cheese higher than all treatments containing peanut oil, which ranged 10.35-10.56, 4.45-4.98 and 1.16-1.82%, respectively. There were high concentrations of unsaturated fatty acids in all peanut oil treatments compared with saturated fatty acids, which were the opposite in the control cheese (Table 4). Oleic acid was found in higher concentration (52.75-53.42%) in all cheese samples containing peanut oil. However, control cheese (C) samples contained low content of some unsaturated fatty acid.

The fatty acid percentages, oleic/linoleic ratio (O/L) and saturated/unsaturated ratio (S/U) of refined vegetable oils:

Table 4: Free fatty acids composition (FFA% as relative area percentage) of white soft cheeses as affected by substituting milk fat by peanut oil after three months of storage

	Cheese samples			
Fatty acid	C	T1	T2	T3
Saturated fatty acid				
Butyric ($C_{4:0}$)	0.61	0.24	0.32	0.18
Valeric ($C_{5:0}$)	0.12	0.10	0.12	0.10
Caproic ($C_{6:0}$)	0.87	0.25	0.41	0.18
Volatile fatty acids				
Caprylic ($C_{8:0}$)	0.66	0.33	0.38	0.28
Capric ($C_{10:0}$)	4.21	3.01	3.15	2.21
Total volatile fatty acids	6.47	3.93	4.38	2.95
Lauric ($C_{12:0}$)	3.33	1.66	1.69	1.29
Non volatile fatty acid				
Myristic ($C_{14:0}$)	8.24	1.71	1.82	1.16
Pentadecanoic ($C_{15:0}$)	3.40	1.31	1.62	2.11
Palmitic ($C_{16:0}$)	35.41	10.56	10.38	10.35
Margaric ($C_1T1_{7:0}$)	1.62	1.02	1.26	1.15
Stearic ($C_{18:0}$)	16.02	4.45	4.98	4.85
Arachidic ($C_{20:0}$)	0.55	1.66	1.51	1.90
Behenic ($C_{22:0}$)	0.10	2.65	2.87	3.02
Lignoceric ($C_{24:0}$)	0.13	0.18	0.34	0.25
Total non-volatile fatty acids	68.80	25.20	26.47	26.08
Total saturated fatty acids	75.27	29.13	30.85	29.03
(MUFA) palmitoleic ($C_{16:1}$)	1.15	1.01	1.08	1.04
Oleic ($C_{18:1}$)	20.14	53.04	53.42	52.75
Erucic acid ($C_{22:1}$)	0.07	0.09	0.14	0.08
(PUFA) linoleic ($C_{18:2}$)	2.34	16.16	14.14	16.03
Unsaturated fatty acid				
Linolenic ($C_{18:3}$)	0.91	0.43	0.26	0.98
Arachidonic ($C_{20:4}$)	0.12	0.14	0.11	0.09
Total unsaturated fatty acids	24.73	70.87	69.15	70.97
Oleic/linoleic ratio (O/L)	8.61	3.28	3.78	3.29
Saturated/unsaturated ratio (S/U)	3.04	0.42	0.45	0.41

C: Control cheese with 4% butter oil, T1: Cheese with 4% peanut oil, T2: Cheese with 4% peanut oil+S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and T3: Cheese with 4% peanut oil+S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1), MUFA: Mono unsaturated fatty acid, PUFA: Poly unsaturated fatty acid

Peanut oil presented in Table 1 and 4. Peanut oil had oleic acid as the major fatty acid[69]. Thus, treatments with peanut oil resulted in higher O/L and lower S/U ratio than in the control cheese sample (C). Peanut oil has high nutritional value, it has high concentrations of unsaturated fatty acids[70] (UFAs, approximately 80%), much of which (approximately 45%) is oleic acid, a desirable and healthy type of FA. Oleic acid has been implicated in cardiovascular and cerebrovascular health[71].

Oxidative stability of cheese fat: Table 5 shows the oxidative stability of cheese fat samples. The PV increased in different peanut oil cheeses treatments as well as control cheese with extended of storage period, but this increase within the legal standard specification for peanut oils[72]. Control cheese (C) had higher PV than other treatments, while peanut oil cheeses containing Whey Protein (WP) (T2) had lower PV than other cheeses. Obtained results are in agreement with those reported by Anwar *et al.*[73].

As storage period progressed, the Acid Value (AV) increased gradually in all cheese samples. The AV of control cheese was significantly higher than that of experimental cheese and this may be attributes to the extensive fat hydrolysis and liberation of free fatty acids, which cause gradual increase in rancidity during storage. Control cheese (C) had the highest AV followed by T1 then T2 cheese and finally T3 cheese. The presented data are in agreement with Abdel-Fattah[11] who found that cheese made with butter oil had higher AV than cheeses containing sunflower oil. Pervious study has been reported that cheeses made with butter oil had higher PV and AV than cheeses made with mixture of butter oil, sunflower oil and olive oil[13]. Moreover, Ryan *et al.*[74] reported that the peanut oil and virgin olive oil has oleic acid

Table 5: The changes in oxidative stability tests of white soft cheeses as affected by substituting milk fat by peanut oil during the storage period

		Cheese samples					
Parameters	Storage period (days)	C	T1	T2	T3	Total means	LSD
Peroxide value	3	4.94±0.60^{a}	4.21±0.31^{b}	4.03±0.18^{b}	4.12±0.02^{b}	4.33±0.41^{D}	0.28
(meq kg^{-1})	30	5.33±0.37^{a}	4.71±0.46^{b}	4.18±0.33^{c}	4.23±0.12^{bc}	4.61±0.56^{C}	0.51
	60	6.74±0.26^{a}	5.16±0.15^{b}	5.03±0.71^{b}	5.11±0.41^{b}	5.52±0.83^{B}	0.66
	90	7.31±0.45^{a}	5.83±0.38^{b}	5.35±0.37^{b}	5.41±0.51^{b}	5.98±0.89^{A}	0.58
Total means		6.08±1.05^{A}	4.98±0.68^{B}	4.65±0.72^{C}	4.72±0.63^{C}	5.11±0.96	0.24
Acid value	3	0.85±0.05^{a}	0.73±0.08^{b}	0.55±0.09^{c}	0.51±0.02^{c}	0.66±0.15^{D}	0.09
(mg KOH g^{-1} oil)	30	1.28±0.05^{a}	0.87±0.09^{b}	0.64±0.01^{c}	0.62±0.07^{c}	0.85±0.28^{C}	0.09
	60	1.53±0.08^{a}	0.94±0.08^{b}	0.86±0.11^{bc}	0.76±0.07^{c}	1.02±0.32^{B}	0.12
	90	1.71±0.12^{a}	1.13±0.08^{b}	0.93±0.12^{c}	0.95±0.21^{c}	1.18±0.35^{A}	0.14
Total means		1.34±0.41^{A}	0.92±0.18^{B}	0.75±0.16^{C}	0.71±0.21^{C}	0.93±0.37	0.05

C: Control cheese with 4% butter oil, T1: Cheese with 4% peanut oil, T2: Cheese with 4% peanut oil+S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and T3: Cheese with 4% peanut oil+S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1), Mean±SE values with the same small and capital letters in the same column and same raw are not signi cantly ($p \leq 0.05$), LSD: Least significant difference at ($p \leq 0.05$)

Table 6: Total phenolic content and antioxidant activity (inhibition %) of white soft cheeses as affected by substituting milk fat by peanut oil during storage period

		Cheese samples					
Parameters	Storage period (days)	C	T1	T2	T3	Total means	LSD
Total phenolic compounds (g kg^{-1})	3	0.12±0.01^{c}	2.91±0.11^{ab}	3.01±0.10^{a}	2.83±0.01^{b}	2.22±1.27^{C}	0.12
	30	0.19±0.01^{c}	3.01±0.27^{b}	3.26±0.02^{a}	2.91±0.02^{b}	2.34±1.31^{B}	0.20
	60	0.22±0.02^{c}	3.11±0.01^{b}	3.45±0.02^{a}	3.10±0.01^{b}	2.47±1.40^{A}	0.02
	90	0.19±0.02^{c}	3.07±0.03^{ab}	3.13±0.01^{a}	3.01±0.09^{b}	2.35±1.31^{B}	0.08
Total means		0.18±0.04^{C}	3.03±0.15^{B}	3.21±0.18^{A}	2.96±0.12^{B}	2.34±1.27	0.09
Antioxidant activity (inhibition %)	3	31.00±3.00^{b}	43.00±4.00^{a}	45.00±3.00^{a}	42.00±3.00^{a}	40.25±6.34^{B}	4.97
	30	28.00±4.00^{b}	72.00±9.00^{a}	76.00±3.00^{a}	70.00±9.00^{a}	61.50±21.14^{A}	10.38
	60	30.00±1.00^{b}	76.00±5.00^{a}	78.00±4.00^{a}	75.00±2.00^{a}	64.75±21.18^{A}	5.14
	90	28.00±3.00^{b}	73.00±9.00^{a}	75.00±2.00^{a}	71.00±5.00^{a}	61.75±20.93^{A}	8.28
Total means		29.25±2.86^{C}	66.00±15.21^{AB}	68.50±14.46^{A}	64.53±14.51^{B}	57.08±20.48	3.43

C: Control cheese with 4%butter oil, T1: Cheese with 4% peanut oil, T2: Cheese with 4% peanut oil+S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and T3: Cheese with 4% peanut oil+S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1), Mean±SE values with the same small and capital letters in the same column and same raw are not signi cantly ($p \leq 0.05$), LSD: Least significant difference at ($p \leq 0.05$)

as predominant fatty acid (44.8 and 64.2%, respectively), making it more resistant to lipid oxidation at frying temperature than the other refined vegetable oils (sun ower, corn and soybean oils).

Total phenolic content and antioxidant activity of cheese (inhibition %): Total Phenolic Content (TPC) in cheese contained peanut oil was about 2.83-3.45 mg kg^{-1} which is higher than that in the control cheese C (Table 6). The presence of peanut oil elevated the TPC in cheese treatments to similar extent. The total phenolic content in milk may be explained by the formation and/or further degradation of polymeric phenolic compounds during fermentation by the starters culture[75].

Antioxidant activity (inhibition%) in the control cheese was lower than cheeses containing peanut oil (Table 6). The presence of peanut oil in cheese increased the antioxidant activity. The antioxidant activities of treatments cheese T1, T2 and T3 increased up to 78% whereas control cheese decreased to 28% during storage period. These results could be attributed to the ability of peanut oil extracts to scavenge different radicals[48].

In general, peanut oil contain approximately 30-35 and 45-50% of linoleic and oleic acids, respectively, which becomes susceptible to development of rancid and off-flavors through lipid oxidation Angelo[76]. Although, peanut oil is one of the most stable vegetable oils to oxidation in comparison with other vegetable oils like soybean. This is partly because of the fatty acid composition, which is low in 18:3 omega-3[76,77]. The rates of oxidation of C18 unsaturated fatty acids are approximately 1:10:20 for oleic (18:1), linoleic (18:2) and linolenic (18:3), respectively[78]. Fatty acid composition appears to be important in determining oxidative stabilities but other factors are also involved, such as the presence of antioxidant and pro-oxidant compounds. The effect of fatty acids composition on oxidative stability of oil has been studied by a number of investigators[77-80]. Many factors are influence the shelf life of peanuts products. These include variety, maturity at harvest, market grade and seed size, processing methods and storage conditions, such as: Temperature, time, light and exposure to oxygen[74].

Organoleptic properties: It is noticed from data in Table 7 that cheeses containing peanut oil+S1 stabilizer had the highest score of sensory evaluation. As ripening period progressed, all scoring points increased for all treatments. This increase might be due to the improvement in flavor, body and texture as a result of protein degradation and fat lipolysis during the storage period. Cheese with 4% peanut oil without stabilizers (T1) was the least acceptable by panelists due to its oily flavor, therefore it recorded the lowest scores of flavor. Addition of S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) improved cheese properties compared with cheeses S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1), which had high ability to water holding capacity that led to lack of cohesion textures compared between T1 and T2. Throughout the storage period of cheese samples (T1) had an oily flavor compared to T2 and T3, as they had very slight oily off-flavor, which indicated that using mixtures of stabilizers improved cheeses acceptability[22]. These results are in agreement with

Table 7: Organoleptic properties of white soft cheeses as a result to substituting milk fat by peanut oil during the storage period

Parameters	Storage period (days)	Cheese samples C	T1	T2	T3	Total means	LSD
Appearance (10)	3	8.41±0.33^{a}	8.17±0.33^{a}	8.32±0.31^{a}	7.36±0.30^{b}	8.06±0.54^{B}	0.57
	30	8.65±0.35^{a}	8.32±0.22^{a}	8.78±0.24^{a}	7.75±0.46^{b}	8.38±0.59^{AB}	0.48
	60	9.25±0.08^{a}	8.11±1.39^{b}	9.57±0.09^{a}	8.17±0.07^{b}	8.78±0.90^{A}	1.06
	90	8.37±0.63^{ab}	7.56±1.66^{b}	9.47±0.05^{a}	8.45±0.19^{ab}	8.46±1.04^{AB}	1.36
Total means		8.67±0.54^{A}	8.04±0.96^{B}	9.03±0.56^{A}	7.93±0.48^{B}	8.41±0.81	0.43
Body and texture (40)	3	36.23±1.77^{b}	35.43±1.57^{b}	38.27±0.81^{a}	36.13±0.17^{b}	36.52±1.55^{A}	1.88
	30	36.67±1.61^{ab}	36.23±0.34^{b}	37.67±0.33^{a}	36.55±0.45^{ab}	36.78±0.94^{A}	1.35
	60	35.51±1.44^{bc}	35.30±1.28^{c}	38.25±0.78^{a}	37.11±0.58^{ab}	36.54±1.58^{A}	1.66
	90	35.65±1.33^{a}	34.28±0.32^{a}	37.31±1.45^{a}	37.28±3.75^{a}	36.13±2.21^{A}	3.17
Total means		36.02±1.43^{BC}	35.31±1.15^{C}	37.87±0.84^{A}	36.76±1.69^{B}	36.49±1.59	0.97
Flavour (50)	3	41.58±3.33^{a}	35.71±6.29^{b}	40.57±0.76^{ab}	39.67±0.75^{ab}	39.41±3.86^{A}	5.46
	30	42.65±1.33^{a}	36.54±5.46^{b}	41.61±1.72^{a}	40.19±1.26^{ab}	40.25±3.51^{A}	4.53
	60	43.57±1.34^{a}	35.68±6.33^{b}	43.24±1.16^{a}	41.43±1.21^{a}	41.19±4.35^{A}	4.99
	90	42.33±0.67^{a}	34.19±9.92^{b}	44.17±1.52^{a}	42.67±1.17^{a}	40.84±5.96^{A}	7.68
Total means		42.59±1.82^{A}	35.52±6.21^{B}	42.40±1.83^{A}	40.99±1.44^{A}	40.37±4.45	2.64
Total scores (100)	3	86.31±5.69^{ab}	79.31±8.18^{b}	87.16±1.21^{a}	83.16±1.08^{ab}	83.98±5.37^{A}	7.65
	30	87.99±0.11^{a}	81.09±5.45^{b}	88.06±1.18^{a}	84.49±0.73^{ab}	85.41±3.83^{A}	4.22
	60	88.43±2.90^{a}	79.08±6.42^{b}	91.06±1.98^{a}	86.69±1.09^{a}	86.32±5.61^{A}	5.56
	90	86.37±2.63^{a}	76.03±11.30^{b}	90.95±1.12^{a}	88.39±4.70^{a}	85.44±7.97^{A}	9.50
Total means		87.28±3.11^{AB}	78.88±7.20^{C}	89.31±2.10^{A}	85.68±2.92^{B}	85.29±5.75	3.20

C: Control cheese with 4% butter oil, T1: Cheese with 4% peanut oil, T2: Cheese with 4% peanut oil+S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) and T3: Cheese with 4% peanut oil+S2 (mono and diglyceride of fatty acids E471, guar gum E412, sodium carboxymethyl cellulose E466 and xanthan gum E415, 1:1:1:1), Mean±SE values with the same small and capital letters in the same column and same raw are not signi cantly ($p \leq 0.05$), LSD: Least significant difference at ($p \leq 0.05$)

During *et al.*[9] and Abdel-Fattah[11], who reported that cheeses containing vegetable oils had an oily flavor during storage at 7±1°C.

CONCLUSION

In conclusion, it could be recommended that white soft cheese can be made using 4% of peanut oil with the addition of 1% stabilizers S1 (mono and diglyceride of fatty acids E471 and whey protein powder, 1:1) in order to improve the properties of the produced cheeses.

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