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Ameliorative Effect of Dill and Coriander Oils Addition on Quality Characteristics and Oxidative Stability of Tallaga Cheese Manufactured Using Vegetable Oil

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ABSTRACT

Tallaga cheese produced exploiting milk (4% fat) as control. Sunflower oil was inserted to skim milk as an alternative for milk fat. Dill and coriander oils were included to sunflower oil cheese treatments at a percentage of 0.2%. Chemical structure, oxidative stability, antioxidant activity, microbiological and sensual characteristics of produced Tallaga cheese when fresh and after 15, 30, and 60 days of store at 7ºC were investigated. The existing findings exhibited that dill and coriander oils have high content of phenolic components and presented great antioxidant activity. No significant differences were obtained among resulting sunflower oil cheeses in the chemical structure, but dill and coriander oils supplementation impacted the oxidative stability, antioxidant activity, microbiological and organoleptic properties. An evident decrease in peroxide and acid values of sunflower oil cheese comprising dill and coriander oils through the storage phase than sunflower oil cheese without *tert*- butyl hydroquinone (TBHQ) was detected. As well as yeasts & moulds of cheese samples encompass dill and coriander oils did not discover throughout storage when compared with sunflower oil cheese without (TBHQ). Likewise, our outcomes demonstrated that that the organoleptic properties of all cheese treatments improved throughout the storage period progressed. Sunflower oil cheese containing dill and coriander oils showed better flavor intensity and body characteristics than other cheese treatments.

Keywords: Tallaga Cheese, Coriander oil, Dill oil, Sunflower oil

INTRODUCTION

Fat consumption is associated with an increased risk of obesity, elevated blood pressure, tissue injury diseases and coronary heart disease, associated with lipid oxidation (Katsiari *et al.*, 2002). However, fat content is responsible for many desirable functional, textural and sensory characteristics in produced cheese (Sheehan and Guinee, 2004).

Cheese analogs are cheese-like products with different compositions and functional characteristics produced by whole or partial replacement of milk components, particularly milk fat, substituted by non-milk-based components (Al-Ismail *et al.,* 2015). In addition, recent researches have explored the possible total replacement of milk-fat by polyunsaturated edible vegetable oils to produce functional products with healthier unsaturated/saturated fatty acids balance that may improve consumer's health (Yu and Hammond, 2000).

In the Middle East countries, especially Egypt, Tallaga cheese is one of the most popular soft white cheeses. According to the Egyptian standards (ES, 2005a) Vegetable oil soft cheeses are defined as white fresh or ripened soft cheeses obtained after coagulation of fresh or concentrated milk or a mixture of its fresh products, total or partial fat replacement with the addition of vegetable oils.

Sunflower seeds oil is the 5th in production among edible vegetable oils in the world. World edible oil production had been increased in the last few years, with estimated total seed production of about 400 million metric tons in 2014. The total world sunflower oil production in 2001 about 8.91 million tons. Moreover, about 13.2 million tons in 2011, in the season of 2014, is currently forecast at about 21 million metric tons. This was set considering the accepted approach that 42 g sunflower oil can be obtained from 100 g sunflower seed. (Sánchez-Muniz e*t al.,* 2016)

In order to overcome the stability problems of fats and oils, synthetic antioxidants, such as butylated hydroxy-toluene (BHT), butylated hydroxyanisole (BHA), *tert*-butyl hydroquinone (TBHQ) have been used as food additives. However, recent reports reveal that these compounds may be implicated in many health risks, including cancer and carcinogenesis (Prior, 2004). Therefore, the most potent synthetic antioxidant (TBHQ) is not allowed for food application in some countries such as Japan, Canada, and Europe. Similarly, BHA has also been removed from the generally recognized as safe (GRAS) list of compounds (Goli *et al.*, 2005). Due to these safety concerns, there is an urgent need to replace these synthetic antioxidants with natural other ones, which in general, are supposed to be safer (Yanishlieva and Marinova, 2001). Phenol compounds are one of the most important groups of natural antioxidants (Artajo *et al.,* 2006).

Dill (*Anethum graveolens* L.) is a member of Apiaceae. It is one of the most popular culinary herbs in the world. Dill has been cultivated since ancient times, and the use of this plant for consumption purposes and medicinal has been recorded dating back to Egyptian and Greek

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civilizations. Widely use of dill is giving flavor to food (Ramadan *et al.*, 2013). Dill oil is extracted from the leaves, seeds, and stems of the plant and is an essential oil used as a flavoring in the food industry (Jana and Shekhawat, 2010). Moreover, it exhibits intense antioxidant activity (Ramadan *et al.,* 2013).

Coriander (*C. sativum* L.) is a member of the Apiaceae family commonly used for medicinal purposes due to its antioxidant activity (Demir and Korukluoglu, 2020). In addition, the Coriander essential oil and extracts possess promising antifungal, anti-oxidative and antibacterial activities as various chemical components in different parts of the plant, which thus play a significant role in preventing foods spoilage and that maintain the shelf-life of different foods (Khan *et al.,* 2017).

The major problem related to using vegetable oils in dairy products is that they are easily oxidized, giving rise to undesirable compounds such as aldehydes and peroxides (During *et al.,* 2000). Therefore, the present investigation aimed to study the effects of milk fat replacement with sunflower oil and the extent to which dill and coriander oils contributes to improving the quality characteristics and the oxidative stability of resultant cheeses.

MATERIALS AND METHODS

Materials

Dill and Coriander oils were purchased from EL-Captain Company, Egypt. Distilled monoglyceride (DMG) was obtained from Al-Iman Company, imported from Turkey. Raw cow milk was collected from a private farm located in Sharqia Governorate (Egypt) and handled within 1 h after milking. Fresh cow milk (4.8% fat) was obtained from the Dairy unit, Department of Food Science, Agriculture Faculty, Zagazig University, Egypt. Milk was standardized to 4% fat using a person square and milk separator. Fresh skim milk (0.2% fat) was produced by a mechanical separator. Sunflower oil and TBHQ (E319) were obtained from SAVCO Vegetable oils Company, 10^{th} of Ramadan City, Egypt. Freeze-dried starter culture: FD-DVS R-704 containing (*Lactococcus lactis subsp. lactis* and *Lactococcus lactis subsp. cremoris*) and rennet (HANNHLASE® TL2300 Granulato NB microbial coagulate granulate) were obtained from Christian Hansen Inc. Laboratories, Denmark, by Misr Food Additives Company, Egypt. Rennet was diluted with distilled water to a standard rennet solution before use. Calcium chloride ($CaCl_2$) was obtained from El-Gomhoria Company, Cairo, Egypt. Commercial fine grade salt obtained from the Egyptian Salt & Minerals Company (EMISAL), Egypt was used.

Tallaga cheese manufacture

Cow milk was divided into two batches. The first batch was served as control: whole milk (standardized 4% fat), the second batch fresh raw skim milk (0.2% fat) divided into four batches T1: 4% Sunflower oil without (TBHQ), T2: 4% Sunflower oil with (TBHQ), T3: 4% Sunflower oil+0.2% dill oil and T4: 4% Sunflower oil +0.2 coriander oil. Tallaga cheese treatments were made from all milk treatments by the conventional method of making Domiati cheese (Fahmi and Sharara, 1950). With some modification as following: fresh raw skim milk (0.2% fat) was mixed with 4% of sunflower oil, and then the mixtures were salted by 4% NaCl, stabilizer DMG was added to cheese milk at 1%, the cheese milk of all treatments then homogenized at 60 ºC, 400 kPa. Pasteurization was carried out at 72 ºC for 15 min and then cooled to 40ºC. After this, 0.02% of $CaCl_2$ was added. Next, 0.003% of the starter was added. Cheese milk of each treatment was adjusted to 40º C and renneted with microbial rennet and incubated until coagulation, and then the curd was filtered and collected the whey of each treatment. Resultant cheeses were packaged in plastic bags containing pasteurized saline solution (10%) and stored at 7±1ºC in the refrigerator for 60 days of storage. Samples were analyzed for physicochemical sensory properties, total bacterial count , and moulds & yeasts when fresh and after 15, 30, and 60 days of storage.

Methods of analysis

Total phenolic content (TPC) determination: TPC concentration in oil and cheese was determined according to (Hassanien *et al.,* 2013) for oil and Reis *et al.,* (2012) for Tallaga cheese by using reagent of Folin-Ciocalteu and expressed as mg GAE /100g.

Radical scavenging activity (RSA%) determination:

According to (Brand-Williams *et al.,* 1995), RSA of oil and Tallaga cheese were measured by bleaching of the purple-colored solution of 2,2-diphenyl-1-picrylhydrazyl (DPPH)· Antioxidant activity of DPPH percent was calculated as follows:

$$\mathbf{RSA\ (\%) = [(A0- A1)/A0] \times 100}$$

Where A0: is the absorbance of the control reaction, and A1: is the absorbance in the extract.

Chemical analysis

Cheeses were analyzed in duplicate for moisture, fat, fat in whey, titratable acidity, and pH values were determined in homogenized cheese samples using HNNA Digital Hi 8014 pH meter using the methods of AOAC (2000). The modifications suggested by Hefnawy (1988) were applied to determine fat in cheese made using vegetable oils. Total nitrogen (TN) and soluble nitrogen (SN) content were determined by the Kjeldahl method. Total volatile fatty acids (TVFA) were estimated according to Kosikowski (1978).

Oxidative stability tests

To determine oxidative stability, cheese samples were dried at 40ºC for 12 hrs in a hot air oven, grounded, and mixed with n-hexane as a solvent for oil extraction. Then, the solvent was evaporated in a hot air oven, and the extracted oils were analyzed for peroxide and acid values according to the method described in AOAC (2000).

Microbiological examination

The total bacterial count was determined using plate count agar (Houghtby *et al.,* 1992). Bacterial count plates were incubated at 37ºC for 48 h. According to Marshall (1992) moulds and yeasts counts were enumerated. The plates were incubated at 25ºC for 5 days.

Organoleptic properties

The cheese was organoleptically evaluated when fresh and after 0, 15, 30, and 60 days of storage at the refrigerator temperature 7±1ºC by the staff members of the Food Science Department, Faculty of Agriculture, Zagazig University. As a result, the panel scores for appearance (10), body and texture (40), and flavor (50), as described by Scott (1981).

Statistical analysis

The experiment was carried out in triplicate, and the data were transferred to the SPSS (2007) version 16 program, and data were statistically analyzed using one-way ANOVA.

RESULTS AND DISCUSSION

TPC and RSA of dill and coriander oils

Phenolic acids are the most prominent class of bioactive chemicals grouped under phenolic compounds present in various plant sources such as spices, beverages, grains, vegetables, and fruits (Stuper-Szablewska and Perkowski, 2019); which are distributed in different parts of plants. They are the secondary aromatic metabolites flavor, color, astringency, harshness, and imparting, which contribute to the typical sensory characteristics of the foods. Phenolic acids have gained momentum owing to their immense dietary health benefits and functionalities like antioxidant, immune regulatory, anti-allergenic, anti-inflammatory, anti-microbial, anti-atherogenic, anti-thrombotic, anti-cancer activities, cardioprotective and anti-diabetic properties (Kumar and Goel, 2019)

Dill and coriander oils were investigated for (TPC). The results showed that total phenolic content of dill oil was 1862 mg/100g. The radical scavenging activity (RSA%) of dill oil was 72.8%. These results are in harmony with those found by (Ramadan *et al*., 2013), who studied the antioxidant activity of dill oil. The results revealed that TPC and RSA of coriander oil were 2590 mg/100g and 77.6%, respectively. Similar results were reported by (Khan *et al*., 2017).

The yield and chemical analysis of Tallaga cheese

The results tabulated in Table 1 clear that the average yield of fresh cheese from milk was 26.56 -30.16 kg/100 kg. The obtained results indicated that Tallaga cheese made using sunflower oil scored the lowest cheese yield.

Chemical analysis was assessed by determining moisture, fat, fat in whey, total protein, pH, acidity, and ripening indices.

Table 1 showed that the control Tallaga cheese (4% fat) had the lowest moisture content compared to sunflower oil cheeses treatments. The moisture content of all samples decreased during the storage period progressed up to 60 days of storage. The decrease in moisture content of cheese samples during the storage period may be due to the penetration of salt into the cheese and syneresis, which occurred as a result of decreasing pH. (Abd El-Salam, 2015; El-Sheikh *et al.*, 2001).

Concerning fat content in manufactured Tallaga cheese made using skim milk affected by sunflower oil treatments Table 1. It could be observed that the fat content of experimental cheese samples increased significantly (P≤ 0.05) up to 60 days of storage, depending on the loss of moisture. Control cheese showed the highest fat content compared with other treatments. The increase in fat content might decrease moisture content and, consequently, increase total solids. The results agree with those reported by (Javidipour and Tuncturk, 2007; Mahgoub *et al.,* 2013). Table 1 also shows increasing in fat % in whey of Tallaga cheese manufactured with vegetable oils compared with control cheese. And in all cheese samples the fat % in whey was increased during storage period progressed up to 60 days of storage.

Table 1 shows that the TP% content of cheese samples slightly decreased up to the end of the storage period. However, the slightly decreasing in TP% during the storage period. This may be due to lower proteolysis and high protein content in all treatments. Similar results were stated by (Abd El-Galeel and El-Zahar, 2018; Salem *et al*., 2010).

Table 1. Chemical analysis and ripen indices of Tallaga cheese during storage at 7ºC

Storage period (day)	Treatment					
	C	**T1**	**T2**	**T3**	**T4**	**LSD**
Yield (%)						
Fresh	30.16^{a}	27.18^{b}	27.00^{b}	26.56^{b}	26.77^{c}	0.19
Moisture (%)						
Fresh	62.50^{b}	62.97^{a}	62.94^{a}	62.90^{a}	62.92^{a}	0.33
15	60. 62^{b}	58.67^{a}	58.62^{a}	58.60^{a}	58.55^{a}	0.18
30	58.04^{b}	56.28^{a}	56.24^{a}	56.22^{a}	56.18^{a}	0.14
60	56.90^{b}	55.08^{a}	55.02^{a}	55.04^{a}	54.98^{a}	0.24
Fat (%)						
Fresh	17.22^{a}	15.52^{b}	15.58^{b}	15.62^{b}	15.66^{b}	0.63
15	18.62^{a}	16.24^{b}	16.32^{b}	16.34^{b}	16.40^{b}	0.55
30	20.17^{a}	17.67^{b}	17.74^{b}	17.78^{b}	17.86^{b}	0.52
60	20.58^{a}	19.02^{b}	18.86^{b}	18.82^{b}	18.84^{b}	0.60
Fat in whey (%)						
Fresh	0.30^{d}	0.80^{a}	0.70^{b}	0.64^{c}	0.60^{c}	0.04
15	0.47^{e}	0.73^{a}	0.66^{b}	0.63^{c}	0.60^{cd}	0.02
30	0.62^{d}	0.95^{a}	0.90^{b}	0.87^{c}	0.85^{c}	0.02
60	0.78^{e}	1.12^{a}	1.02^{b}	0.96^{c}	0.92^{d}	0.01
Total protein (%)						
Fresh	15.98^{a}	15.60^{b}	15.56^{b}	15.52^{b}	15.58^{b}	0.12
15	14.58^{a}	14.07^{b}	14.02^{b}	14.00^{b}	13.96^{b}	0.14
30	13.15^{a}	12.77^{b}	12.74^{b}	12.72^{b}	12.68^{b}	0.12
60	11.94^{a}	11.66^{b}	11.62^{b}	11.60^{b}	11.54^{b}	0.18
pH						
Fresh	5.42^{c}	5.48^{b}	5.54^{ab}	5.56^{ab}	5.59^{a}	0.04
15	5.22^{c}	5.30^{b}	5.36^{ab}	5.40^{a}	5.42^{a}	0.06
30	5.19^{c}	5.22^{b}	5.26^{ab}	5.28^{a}	5.32^{a}	0.05
60	5.08^{c}	5.14^{b}	5.18^{ab}	5.22^{a}	5.26^{a}	0.04
Acidity (as lactic acid %)						
Fresh	0.35^{a}	0.32^{b}	0.30^{bc}	0.28^{d}	0.25^{e}	0.02
15	0.63^{a}	0.60^{b}	0.56^{c}	0.52^{d}	0.50^{e}	0.01
30	0.83^{a}	0.78^{b}	0.74^{c}	0.70^{d}	0.68^{e}	0.01
60	0.98^{a}	0.84^{b}	0.80^{c}	0.76^{d}	0.72^{e}	0.02
SN/TN %						
Fresh	9.97^{a}	8.94^{b}	8.9^{b}	8.84^{c}	8.80^{c}	0.16
15	10.26^{a}	9.50^{b}	9.44^{b}	9.30^{c}	9.18^{c}	0.12
30	11.53^{a}	9.60^{b}	9.56^{b}	9.50^{c}	9.42^{c}	0.10
60	13.15^{a}	10.94^{b}	10.60^{b}	10.10^{c}	10.05^{c}	0.124
Total Volatile Fatty Acids (TVFA)(ml NaOH 0.1N/100gm)						
Fresh	19.40^{a}	16.80^{b}	16.92^{b}	15.40^{d}	15.70^{c}	0.18
15	23.67^{a}	21.55^{b}	21.64 ^{b}	20.37^{d}	20.64^{c}	0.22
30	25.33^{a}	23.62^{b}	23.78^{b}	22.47^{d}	22.88^{c}	0. 24
60	27.14^{a}	24.80^{b}	24.98^{b}	23.30^{d}	23.76^{c}	0.28

Means followed by different small letters in the same column are significantly different ($p \leq 0.05$). L.S.D: Least significant difference
Control (C): milk (standardized 4% fat) T1: 4% Sunflower oil without (TBHQ), T2: 4% Sunflower oil with (TBHQ), T3: 4% Sunflower oil+0.2% dill oil T4: 4% Sunflower oil +0.2 coriander oil

A significant increasing trend (P≤ 0.05) in the acidity for all cheese treatments during storage. Tallaga cheese manufactured with vegetable oils showed the lowest acidity than control cheese. Also, cheese-containing vegetable oils with dill and coriander oils decreased cheese acidity than vegetable oils control cheese. This may be due to the antimicrobial activity of dill oil (Ramadan *et al.*, 2013) and coriander oil (Khan *et al.*, 2017). The acidity of all cheese treatments increased gradually with the progress in the storage period. These results are in line with those stated by (Abd El-Salam, 2015; Abd El-Galeel and El-Zahar, 2018). The trend of the changes in pH values of all treatments was opposite to that of acidity Table 1.

Ripening indices of Tallaga cheese during storage at 7ºC

The rate of proteolysis

Soluble nitrogen content as a percentage of total nitrogen (SN/TN%) of Tallaga cheese samples during storage is presented in Table 1. The control cheese had the highest SN/TN% compared with other treatments. SN/TN% content in cheese samples had significant differences between control and other treatment along the storage period due to the differences in moisture content. The increase in soluble nitrogen content in all cheese samples throughout the storage period may be due to proteolysis breakdown. These results are following those results reported by (Salem *et al.*, 2010). Increasing in ripening indices of cheeses throughout the ripening period reported by (Arslan *et al.*, 2012).

Total Volatile Fatty Acids

Results under discussion in Table 1 also show the changes in total volatile fatty acids TVFA of Tallaga cheese samples made using sunflower oil treatments. There were significant differences in TVFA content of cheese as compared with control when fresh and during the storage period. Moreover, TVFA content of all cheese samples showed a significant gradual increasing during the storage period, which could be attributed to lipolysis of fat and the higher rate of proteolysis and formation of free amino acids, which could be converted to volatile fatty acids through a specific metabolic pathway (Nakae and Elliott, 1965). Control cheese had the highest TVFA content (27.14) after 60 days of storage. Similar results were reported by (Salem *et al.*, 2010; Abd El-Galeel and El-Zahar, 2018).

Total phenolic content (TPC) and radical scavenging activity (RSA %) of Tallaga cheese during storage at 7ºC

Phenolic contents and radical scavenging activity of Tallaga cheese samples are presented in Table 2. There were significant differences in the samples' phenolic contents and radical scavenging activity (P <0.05). Sunflower oil cheese treatments showed higher phenolic content and radical scavenging activity compared with control cheese. The addition of dill and coriander oils significantly increased phenolic contents and radical scavenging activity of sunflower oil cheese treatments.

Table 2. Total phenolic content and radical scavenging activity of Tallaga cheeses during storage at 7ºC

Storage period (day	C	T1	T2	T3	T4	LSD
	Total phenolic content (TPC) mg/100g					
Fresh	38^{e}	90^{d}	365^{c}	470^{b}	494^{a}	8.22
15	32^{e}	80^{d}	322^{c}	430^{b}	468^{a}	9.14
30	27^{e}	78^{d}	318^{c}	412^{b}	446^{a}	9.60
60	22^{e}	74^{d}	298^{c}	386^{b}	394^{a}	8.55
	Radical scavenging activity (RSA %)					
Fresh	28.0^{e}	45.0^{d}	47.0^{c}	51.0^{b}	55.0^{a}	2.14
15	24.0^{e}	42.0^{d}	44.0^{c}	47.0^{b}	50.0^{a}	3.20
30	23.0^{e}	38.0^{d}	40.0^{c}	45.0^{b}	47.0^{a}	3.42
60	21.0^{e}	36.0^{d}	38.0^{c}	42.0^{b}	44.0^{a}	4.02

Means followed by different small letters in the same column are significantly different ($p \leq 0.05$). L.S.D: Least significant difference
Control (C): milk (standardized 4% fat) T1: 4% Sunflower oil without (TBHQ), T2: 4% Sunflower oil with (TBHQ), T3: 4% Sunflower oil+0.2% dill oil T4: 4% Sunflower oil +0.2 coriander oil

Sunflower oil cheese treatment containing coriander oil had the highest value of phenolic contents and radical scavenging activity with (394 mg/100g and 44.0%) respectively, at the end of the storage period. These may be due to the high concentrations of phenolic contents of coriander oil (Khan *et al.,* 2017).

Phenolic contents and radical scavenging activity of all cheese treatments decreased as the storage period progressed. Similar results were reported by (Omar *et al.*, 2017; Abdel-Ghany *et al.*, 2020).

Oxidative stability

The data presented in Table 3 shows that control cheese had lowest peroxide values than cheeses made with sunflower oil. Sunflower oil cheeses containing coriander oil had lower peroxide values (PV) compared with sunflower cheese without (TBHQ). The addition of dill and coriander oils improved cheeses' stability for oxidation. The peroxide value (PV) increased significantly in different experimental cheeses and control with extended storage period, but this increase within the legal standard specification for sunflower oil (10 meq/kg) (ES, 2005b). The addition of (TBHQ), dill and coriander oils decreased PV in all treatments compared with cheeses without (TBHQ). Similar results were obtained by (Al-Ismail *et al.,* 2015; Abdel-Ghany *et al.,* 2020), who reported that cheese containing vegetable oil had higher PV than control cheese. As the storage period progressed, the acid value (AV) increased gradually in all cheese samples, as shown in Table 3. Control cheese had the lowest AV, followed by sunflower + (TBHQ) cheese, coriander oil cheese, dill oil cheese, and finally, control sunflower oil cheese. Control cheese was recorded (0.92 mg KOH/g) after 60 days of storage. While the cheese made using sunflower without (TBHQ) scored the highest AV (1.20 mg KOH/g). The presented data agree with (Al-Ismail, *et al.,* 2015), who found that cheese made with butter oil had lower AV than cheeses containing olive oil. Also (Abdel-Ghany *et al.*, 2020) found that cheese made with butter oil had lower AV than cheeses containing rice bran oil.

Table 3. Oxidative stability of Tallaga cheeses during storage at 7ºC

Storage period (day)	C	T1	T2	T3	T4	LSD
	Peroxide value (meq/kg)					
Fresh	3.63^{e}	5.89^{a}	4.54^{d}	4.72^{b}	4.60^{c}	0.22
15	4.92^{e}	6.19^{a}	5.22^{d}	5.64^{b}	5.32^{c}	0.18
30	5.86^{e}	7.81^{a}	6.54^{d}	6.94^{b}	6.64^{c}	0.12
60	6.77^{e}	8.99^{a}	7.70^{d}	8.00^{b}	7.90^{c}	0.14
	Acid value (mg KOH/g oil)					
Fresh	0.65^{c}	0.74^{b}	0.74^{b}	0.80^{a}	0.76^{b}	0.05
15	0.75^{c}	0.89^{b}	0.86^{b}	0.92^{a}	0.88^{b}	0.06
30	0.88^{e}	1.12^{a}	0.94^{d}	1.04^{b}	0.99^{c}	0.04
60	0.92^{d}	1.20^{a}	1.00^{c}	1.10^{b}	1.05^{c}	0.06

Means followed by different small letters in the same column are significantly different ($p \leq 0.05$). L.S.D: Least significant difference
Control (C): milk (standardized 4% fat) T1: 4% Sunflower oil without (TBHQ), T2: 4% Sunflower oil with (TBHQ), T3: 4% Sunflower oil+0.2% dill oil T4: 4% Sunflower oil +0.2 coriander oil

Microbial examination

Total bacterial count

Differences in total bacterial counts of cheese made from sunflower oil treatments are presented in Table (4). A significant difference in viable bacterial count between control and the other cheese treatments was observed. The results stated that the total bacterial count decreased gradually throughout the storage until the end of the storage period. Generally, the highest counts of the total bacterial count were found in control cheese made with 4% fat milk (C) after 60 days of storage compared with cheese made from sunflower oil. While adding dill and coriander oils to cheese made from sun flower oil decreased total bacterial count compared with the other treatments, this might be due to the antibacterial action of dill oil (Ramadan *et al.,* 2013) and coriander oil (Khan *et al.*, 2017). The results are in agreement with those reported by (Mahgoub *et al.,* 2013).

Table 4. Microbial examination of Tallaga cheeses during storage at 7ºC

Storage period (day)	Treatment C	T1	T2	T3	T4
	Total bacterial count (cfu/g) 10^6				
Fresh	58.0	46.0	40.0	36.0	30.0
15	33.0	34.0	31.0	24.0	21.0
30	26.0	20.0	18.0	11.0	7.0
60	11.0	8.0	6.0	4.0	2.0
	Moulds & yeasts (cfu/g) 10^2				
Fresh	4.0	1.0	ND	ND	ND
15	8.0	3.0	ND	ND	ND
30	11.0	7.0	ND	ND	ND
60	19.0	9.0	4.0	ND	ND

Control (C): milk (standardized 4% fat) T1: 4% Sunflower oil without (TBHQ), T2: 4% Sunflower oil with (TBHQ), T3: 4% Sunflower oil+0.2% dill oil T4: 4% Sunflower oil +0.2 coriander oil

Moulds and yeasts

The differences in moulds and yeast counts in cheeses are presented in Table (4). Results showed that moulds and yeast count increased gradually in all treatments up to the end of the storage period. Control cheese had the highest moulds and yeast counts when fresh and after three 60 days of storage compared with cheese made from sunflower oil. While moulds & yeasts not detected in cheeses made using sunflower oil with addition dill and coriander oils. This might be due to the antifungal action of dill oil (Ramadan *et al.,* 2013) and coriander oil(Khan *et al.,* 2017). The general trend of these results agreed with those reported by (Al-Jasser and Al-Dogan 2009; Mahgoub *et al.,* 2013).

Organoleptic properties

As reported in the Egyptian Standards (ES, 2005c) the following standards for vegetable oil soft cheeses: the product should retain its characteristics of appearance, flavour, texture, and free of rancidity. The results of the sensory panel´s assessments of cheese quality during ripening are given in Table (5).

Table 5. Organoleptic properties of Tallaga cheeses during storage at 7ºC

Storage period (day)	Treatment C	T1	T2	T3	T4	LSD
	Appearance (10)					
Fresh	9.00^a	7.60^c	7.62^{bc}	7.70^b	7.75^b	0.18
15	9.33^a	7.84^{bc}	7.90^b	7.96^b	8.00^b	0.14
30	9.67^a	8.03^c	8.11^{bc}	8.24^b	8.30^b	0.12
60	9.72^a	8.18^c	8.22^{bc}	8.32^b	8.38^b	0.16
	Body& texture(40)					
Fresh	37.33^a	35.38^c	35.32^d	35.42^b	35.46^b	0.08
15	37.67^a	35.56^c	35.50^d	35.62^b	35.66^b	0.06
30	38.00^a	35.67^c	35.62^d	35.70^b	35.75^b	0.04
60	38.14^a	36.20^c	36.16^d	36.22^b	36.28^b	0.06
	Flavour (50)					
Fresh	48.67^a	40.33^d	44.30^d	44.55^c	44.83^b	0.28
15	46.67^a	39.00^d	45.12^d	45.60^c	45.90^b	0.30
30	47.67^a	36.33^d	46.30^d	46.82^c	46.94^b	0.24
60	48.20^a	34.90^d	46.92^d	47.00^c	47.14^b	0.26
	Total Score (100)					
Fresh	95.00^a	83.31^c	87.24^{bc}	87.67^b	88.04^b	1.12
15	93.67^a	82.40^c	88.52^{bc}	89.18^b	89.56^b	1.26
30	95.34^a	80.30^c	90.03^{bc}	90.76^b	90.99^b	1.14
60	96.06^a	79.28^c	91.30^{bc}	91.54^b	91.80^b	1.33

Means followed by different small letters in the same column are significantly different ($p \leq 0.05$). L.S.D: Least significant difference
Control (C): milk (standardized 4% fat) T1: 4% Sunflower oil without (TBHQ), T2: 4% Sunflower oil with (TBHQ), T3: 4% Sunflower oil+0.2% dill oil T4: 4% Sunflower oil +0.2 coriander oil

Data showed significant differences between the control cheeses (C) and all experimental cheeses when fresh and during ripening period up to 60 days. Control cheeses had the highest organoleptic properties compared with sunflower cheese treatments. Sunflower cheese containing dill and coriander oils at a ratio of 0.2% (T3 and T4) showed the highest score for organoleptic properties than other sunflower cheese treatments. Although all cheese treatments had been acceptable by panelists, all additives improved cheese properties and overall acceptability.

Also, the organoleptic properties of all cheese treatment improved as the storage period progressed until the end of storage except flavor, which improved as the storage period progressed until 60 days. These results agree with the results obtained by (Abd El-Salam, 2015; Al-Ismail, 2015; Omar *et al.,* 2017).

CONCLUSION

The previous results confirmed that Dill and Coriander oils as natural antioxidants improved oxidative stability, antioxidant activity, microbiological and organoleptic properties of produced cheese and encourage recommending to using it as alternative to TBHQ in vegetable oil Tallaga cheese manufacture.

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التأثير التحسيني لإضافة زيت الشبت والكزبرة على خصائص الجودة والثبات التأكسدي للجبن التلاجة المصنع باستخدام زيت نباتي

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تم تصنيع جبن التلاجة باستخدام لبن٤٪ دهن (كنترول)، وأضيف زيت دوار الشمس إلى اللبن الفرز كبديل لدهن اللبن. وأضيفت زيوت الشبت والكزبرة إلى معاملات الجبن المصنع بزيت دوار الشمس بمعدل ٠,٢٪ لكل منهما. وتلى ذلك تحليل معاملات الجبن من حيث التركيب الكيميائي والثبات التأكسدي والنشاط المضاد للأكسدة والخصائص الميكروبيولوجية والحسية عندما كانت طازجة وبعد ١٥ , ٣٠ و ٦٠ يومًا من التخزين عند ٧±١ درجة مئوية. أوضحت النتائج أن زيوت الشبت والكزبرة تحتوي على نسبة عالية من المركبات الفينولية وأظهرت فاعلية عالية كمضادات للأكسدة. لم تظهر فروق معنوية بين الأجبان المصنعة بزيت دوار الشمس في التركيب الكيميائي، ولكن ظهرت آثار إضافة زيوت الشبت والكزبرة على الثبات التأكسدي والنشاط المضاد للأكسدة والخصائص الميكروبيولوجية والحسية. لوحظ انخفاض واضح في قيم البيروكسيد والحمض لعينات الجبن المصنعة بزيت دوار الشمس المحتوية على زيوت الشبت والكزبرة أثناء فترة التخزين مقارنة بالجبن المصنع بزيت دوار الشمس بدون (TBHQ). وكذلك لم تظهر الأعفان والخمائر في عينات الجبن المحتوية على زيوت الشبت والكزبرة أثناء التخزين مقارنة بالجبن المصنع بزيت دوار الشمس بدون أي إضافات. كما سجلت النتائج تحسن في الخصائص الحسية لجميع معاملات الجبن مع تقدم فترة التخزين. وكان للجبن المصنع بزيت دوار الشمس والمحتوي على زيوت الشبت والكزبرة نكهة وخصائص تركيبية أفضل من المعاملات الأخرى.