Egyptian Journal of Food Science
http://ejfs.journals.ekb.eg/

Enhancement of Ultrafiltrated White Soft Cheese with Cold Pressed Oils as Naural Food Additives for Extending Shelf life

Manal Khider*, Ratiba B. Ahmed and Mohamed G. A. Hassaan
Dairy Department, Faculty of Agriculture, Fayoum University, Fayoum, Egypt

WHITE soft cheese is the most popular cheese in Egypt, but it is a perishable product which can be contaminated by pathogenic and spoilage microorganisms decreasing shelf life and causing health risks to humans. Accordingly; the aim of this study is extending the shelf life, improving the properties and quality of the UF-white soft cheese using some cold pressed oils, which contain high phenolic compounds, good flavor, aroma and nutritional value and does not contain Trans fatty acids. These oils are effective for food safety and preservation, so in this study different cold pressed oils were used like Marjoram, Thyme, Rosemary, Moringa and Cardamom oils, each was added separately at level of 200 ppm to the UF-buffalo's milk retentate to obtain five treatments; O_1, O_2, O_3, O_4 and O_5, respectively, while, UF-cheese with no addition served as control. Chemical, microbiological, rheological and sensory properties of the resulted UF-cheese samples were estimated during 14 days of storage at 5±1°C. The results showed that moisture and pH values were decreased during storage, while, the other all chemical parameters (fat, total nitrogen, water soluble nitrogen) were increased. The rheological properties of all UF-cheese treatments were improved and decreased by the end of cold storage period compared with control. Regarding the microbiological investigation, the UF-white soft cheese treatments that enhanced with Rosemary and thyme oils exhibited the lowest total viable count, yeast & mold and spore forming bacterial counts, followed by that enhanced with Moringa oil. No coliform groups or staphylococci was detected in all UF-white soft cheese treatments and control. Among the added oils, thyme, Moringa and Cardamom oils improved the sensory parameters and total score points of enriched UF-white soft cheese, comparing with the other treatments and control. However, all UF-white soft cheese containing cold pressed oils remained acceptable along storage period.

Keywords: Cold pressed oils, Marjoram oil, Moringa oil, Thyme oil, Rosemary oil, Natural food additives.

Introduction

White soft cheese is one of the most abundant dairy products marketed and consumed in Egypt and appreciated worldwide (Alizadeh et al*.,* 2006; Mahgoub et al., 2013). Cheese that produced by ultrafiltration process (UF-) had mild taste because it exhibits less hydrolysis, which may relate to existence of whey proteins at high concentration and that may inhibit chymosin, microbial rennet's and probably inhibit other proteinases and peptidases (Hayes et al*.,* 2002). In spite of the advantages for using the UF-technique, butthe UF-cheese havesome quality properties that do not meet the consumer preferences because of the lack in the characteristic flavor development, lower protein and fat hydrolysis which subsequently affect the cheese flavor and texture enhancement (Hesari et al*.,* 2006). Soft cheese is a perishable product which can be contaminated by pathogenic and spoilage microorganisms, subsequently decrease the shelf life, deteriorate quality of cheese and cause health risks to humans (Hassanien et al*.,* 2014; Abd El-Salam et al., 2016). Moreover, consumers are looking for safer and healthier food, free of synthetic preservatives, which

*Corresponding author: mqa00@fayoum.edu.eg
Received :6/9/2022; Accepted :19/10/ 2022
DOI : 10.21608/EJFS.2022.161040.1139

are often considered harmful and carcinogenic substances (Moro et al*.,* 2015). Food industry and research institutions have been looking for natural preservatives as alternatives to synthetic ones to achieve the new demands of consumers and also existing market competitiveness (El-Soda, 1997). Therefore, several approaches have been used to improve the properties of UF-white soft cheese using various methods, such as using different plant extracts with antimicrobial potentials (Iwalokun et al*.,* 2004), or adding spices and essential oils of medical plants (Hassanien et al*.,* 2014).

Aromatic plants have a preservative and medicinal attributes, as well as enhance food with flavor. Recently, some edible oils used as food additives, for prevention growth of food-borne pathogens or to delay the onset of food spoilage (Oke et al., 2009). These oils which have been isolated from plant parts are famous for their biological behaviors and are also considered to be GRAS (Generally Recognized as Safe) (Sajadi & Bahramian, 2015). Thus, various researches have been focused on the application of such oils as effective agents in food safety and preservation (Zaky et al*.,* 2013). These oils have remarkable antioxidant and antimicrobial activities and have the potential to be used in food industry as a bio-preservative to prevent spoilage and to extend the shelf life of products. The antimicrobial effect of such oils against many species of pathogenic bacteria has been attributed to the presence of many phenolic compounds (Ismail et al., 2006; Sahar et al*.,* 2013). Crude extracted oils are rich sources of bioactive compounds, such as phenolics, tocols, phytosterols, and fatty acids with health-promoting and functional properties (Assirietal., 2016;Kiralanetal., 2017; Ramadan etal*.,* 2020).

Cold pressed oils are defined as oils obtained only by mechanical means, where the grains exposed to pressing for oil extracting at low temperature, which make it high quality because the properties of the oil do not alter and this is suitable for direct consumption. This type of oils contains high phenolic compounds, good flavor, aroma and nutritional value. Cold pressed oil does not contain Trans fatty acids, recently, an increase in the consumption of cold-pressed oils has been observed. In terms of nutritional values, these oils are more beneficial than the refined one. The bioactive components of cold-pressed oils which nutritionally valuable were tocopherols, sterols, carotenoids and phospholipids (Çakaloğlu et al., 2018;Chandra et al. 2020).

Essential oils are extracted from various parts of a plant or tree-root, seed, leaf, flower, fruit or bark. Historically, cold pressed oils were extracted by hand, and required the use of specialized sponges that could absorb the plants' oils and liquid. The sponges would then be pressed in a vice-like device over a container. The oil would collect and separate from the rest of the plant's extracted liquid. Most of the modern cold press machines help separating the oil from the rest of the plant pulp and liquid; the centrifugal force was utilized. cold pressing" involves no external application of heat, mechanical pressing process only created internally heat. This is important because, in certain plants, high levels of heat cause the delicate and tiny molecules within the oils to break down and degrade, which can minimize the oil's health benefits (Artnaturals, 2017).Essential oils offer a variety of beneficial effects that help flora survive and thrive in their natural habitats. In humans, essential oils have a powerful health impact on virtually all parts of the body. The integrity and potency of these oils can be preserved by using Cold-pressing, which offers greater health benefits to you. As the term implies, In Switzerland, for cold press method the temperature must not increase more than 50°C (Artnaturals 2017; Naeem et al., 2018). Cold press extraction is environmental friendly and it is one of the mechanical extraction as well as it required less energy than other techniques. No solvents used in this method and also cold press extraction do not involve either heat or chemical extraction. These oils have better nutritive properties than refined oils. However, they have a lot of advantages, but low productivity. The cold pressed oils can add to food as natural antioxidant additives as it possesses phytochemicals compounds Çakaloğlu et al. (2018).

Essential oils have no side effects on human and environment so it canbe utilized as substitutes to artificially synthesize chemical preservatives. Due to their antibacterial activities against contaminating microorganisms' essential oils can be involved into or coated onto edible films (Naeem et al., 2018). Rosemary (*Rosmarinus officinalis L.*) is an aromatic plant, it has been used for thousands of years for both culinary and medicinal proposes, due to its aromatic properties and health benefits (Holmes, 1999; Begum etal*.,* 2013). It is widely used as a preservative in the

food industry due to its inherent high antioxidant (Perez-Fons et al., 2010; Ramadan etal., 2020) and antimicrobial (Kabouche et al., 2005; Elbanna et al., 2018). Cardamom (*Elettaria cardamomum*) is consumed as a spice, food additive and aromatic beverage. The extracted oil from cardamom has antivirus activity (Sepahi et al., 2008). It is being reported by Hamid & Abdelrahman (2012), that addition of cardamom, cinnamon, and fenugreek improved quality, flavor and odor of the goat's milk cheese.

Marjoram (*Origanum majorana* L.) oil is used as a spice and condiment, the fresh or dried highly aromatic leaves and flowering tops of marjoram are widely used to flavor many foods. The volatile aromatic compounds are employed in the food industry as flavoring in foods and beverages (Vera, 1999). It possesses antioxidant activity, mainly because of its high content of phenolic acids and flavonoids, which is useful in health enhanced and food preservation.Marjoram is well known for its medicinal and insecticidal values, so it can be used in pharmaceutical industries (Yang et al., 2004). The plant is also reported to possess antioxidant (Hossain et al., 2008), antimicrobial (Barbosa et al., 2009) and anticancer activities (Al-Harbi, 2011). Moringa (*Moringa oleifera*), is widely cultivated in many tropical countries (Fahey, 2005) for treating bacterial infection, fungal infection and inflammation (Farooq et al., 2012). Moringa oil, has admirable quality and slow turn into rancid, which has good antioxidant capacity that flavonoids get antioxidant action during chelating process and this play a defensive role in cancer and heart disease (Middleton et al., 2000). Utilization of this oil able to gives health benefits in terms of hypocholesterolemic effects and scavenge of free radicals in the body (Bhatnagar & Krishna, 2013). Its extracts exhibit antimicrobial activity against many micro-organisms such as, *Escherichia coli*, *Enterobacter spp.*, *Pseudomonas aeroginosa*, *Salmonella spp.*, *Staphylococcus aureus*, *Streptococcus and Candida albicans* (Nepolean et al., 2009). Several reviews reported on the beneficial uses of Moringa oil in food, cosmetics, and medicine (Brilhante et al., 2017). It was reported that adding Moringa oil to labneh improves the sensory properties of labneh and extended its shelf life (El-Sayed et al., 2017).

Thyme and its essential oil extracted from leaves is commonly used as a spice and aroma additive in foodstuffs, respectively (Assiri et al., 2016; Ramadan et al., 2020). Numerous bioactive compounds were reported in thyme oil like, phenolics, and flavonoids compound (Viuda-Martos et al., 2010; Viuda-Martos et al., 2011). The effectiveness of selected essential oil plant extract was investigated as bio-preservatives in some dairy products by Elsaadany et al. (2017), they found that the inhibitory effect of herbal extracts against some studied microorganisms' dependent on type of herb and its concentration. Agar diffusion test showed that thyme extract shows potential effect against *E. coli* and *Staph. aureus*. Also, thyme oil had high antioxidant activity and antimicrobial effect. In this concern, the aim of this study, is using cold pressed oils (Marjoram, Thyme, Rosemary, Moringa and Cardamom) as natural food additives in the manufacture of UF-white soft cheese as a trial to extend the shelf life, improving flavor, texture and studying its effect on chemical, rheological, sensory and microbiological properties during the storage period.

Materials and Methods

Materials

Fresh raw buffaloes' milk was obtained from the herd of animal production farm, Faculty of Agriculture, Fayoum University, Egypt. The UF-Retentate (concentration factor 2.5 X) (55ºC) was prepared from fresh raw buffaloes' milk at dairy processing pilot plant, Fac. Agric., Fayoum Univ., Egypt.Microbial rennet powder (CHY-MAX, 2280 IMCU/ml) was obtained from Chr. Hansen' Lab., Denmark. Food quality grade calcium chloride was obtained from El-Naser for chemical Co., Cairo, Egypt. Dry fine edible grade table salt (sodium chloride), produced by Egyptian Minerals and Salt Company (EMISAL) was obtained from local market, Fayoum, Egypt.

Chemicals, microbiological media and cold pressed oils

All chemicals used in this study were analytical grade and were purchased from Merck and Sigma Companies. All the media used in this study were prepared as described in Oxoid (1990). Pure fine grade Cold pressed oils; Cardamom, Marjoram, Rosemary, Moringa and Thyme were purchased from local market, Saudi Arabia, produced by Wadi Al-Nahil Co., Saudi Arabia (KSA).

Methods

Pre-experiment

Pretreatment is prepared before the main experiment. UF-white soft cheese made

according to Renner & Abd El-Salam (1991), using UF-Retentate (2.5x). In this pretreatment different types of natural cold pressed oils are used as additives in UF-cheese making. The concentrations used from the cold pressed oils ranged from 200-400 ppm. From this pretreatment it was found that the high concentrations used from cold pressed oils affected the overall acceptability of the UF-cheese, so the limiting accepted level from cold pressed oils was 200 ppm to be applied in this study.

Main experiment

Manufacture of UF-white soft cheese using some cold pressed oils as natural food additives

In this study, UF- cheese was made and enhanced with cold pressed oils as natural food additives. The milk retentate (2.5X) was divided into six equal parts: UF-control (no additives) and the other five parts were enhanced each with one of the following cold pressed oils: Marjoram, Thyme, Rosemary, Moringa and Cardamom oil, which were added with concentration of 200 ppm directly and individually to the milk retentate before adding the rennet, as explained in Fig. 1, to obtain five UF-cheese treatments enhanced with different cold pressed oils; O_1, O_2, O_3, O_4 and O_5 for previous oils, respectively. Both UF-cheeses were made according to Renner & Abd El-Salam (1991). All UF- cheese treatments and control was stored at 5°C for 14 days, then sampled in triplicate in fresh age and at 7, 14 days of storage for Chemical composition, microbiological examination, textural and sensory properties.

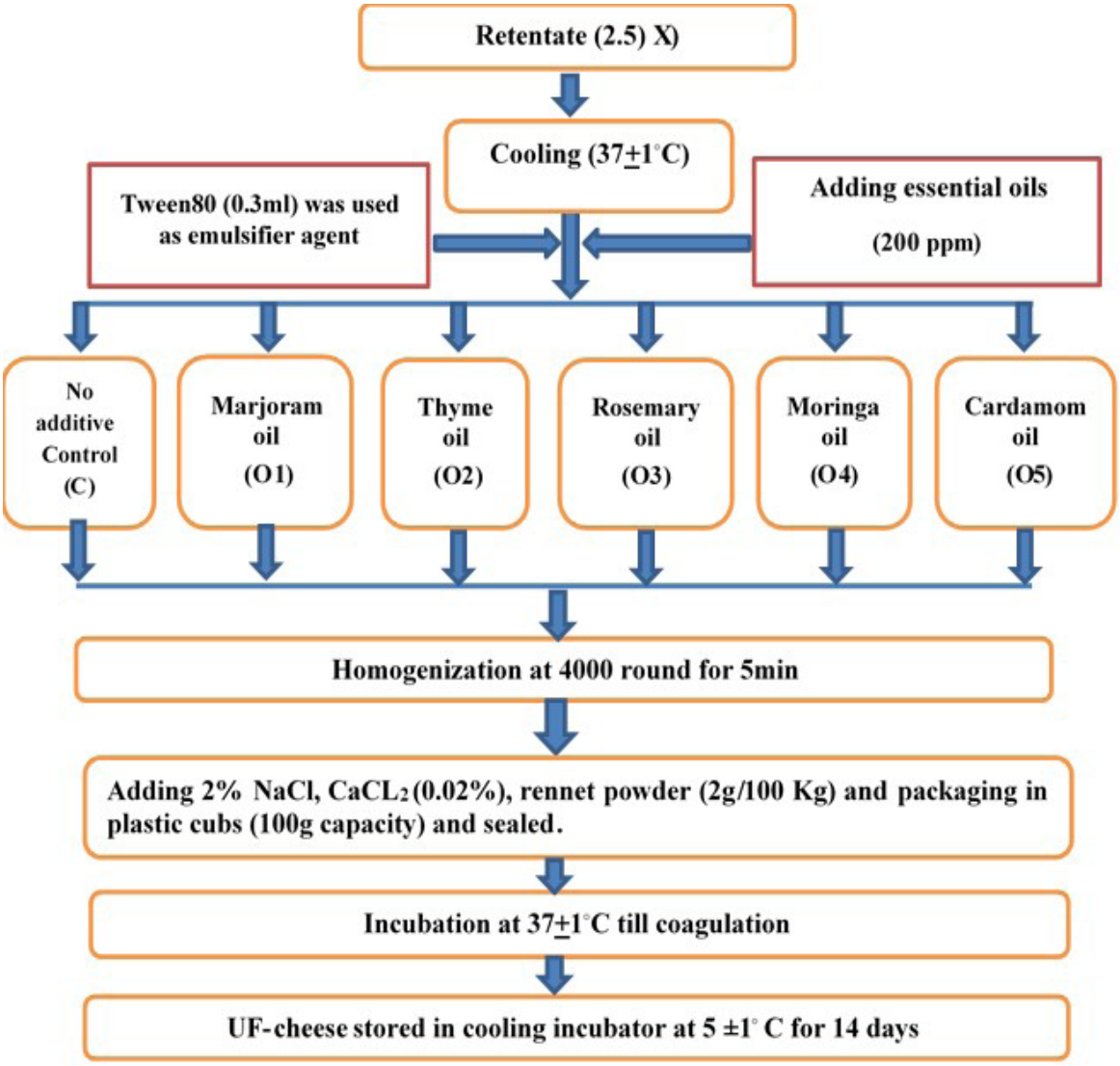


Fig. 1. Flow diagram explains the steps of UF-white soft cheese making with different cold pressed oils.

Methods of Analysis

Chemical analysis and microbiological examination

Fat, moisture, ash, total nitrogen (TN) and water soluble nitrogen (WSN) contents were determined as described in AOAC (2005). The pH values of UF-white soft cheese samples were measured using laboratory pH meter with a glass electrode Model pH -(ORION 420).Under aseptic conditions, 1 gram of each cheese sample was mixed with 1 ml sterilized sodium citrate solution (20%) and then 8 ml of physiologic solution was added, to obtain the first dilution which used for making the further suitable dilutions required for the microbiological investigations. Total viable counts (Log cfu/g) of cheese samples were enumerated with plate count agar medium according to APHA (1992), the plates were incubated at 35±1°C for 48hr. While, potato dextrose agar medium was used for counting (Log cfu/g) yeast and molds as described by Atlas & parks (1997), the plates were incubated at 25±1°C for 3-5 days. Coliform groups were enumerated on MacConkey's agar medium as described in Oxoid (1990) and the plates were incubated at 37°C for 24 hr. Staphylococci were enumerated on Mannitol salt agar medium as described in the United States Pharmacopeia (1995) and the plates were incubated at 37±1°C for 18-72 hr. Spore former counts (Log cfu/g) were enumerated on plate count agar (AOAC, 2005), samples dilutions were heated at 85°C for 10 min. in water bath. The colony counts were enumerated on plate count agar medium and the plates were incubated at 37±1°C for 48-72 hr.

Sensory evaluation

All samples of UF-white soft cheese enhanced with different cold pressed oils were sensory evaluated when fresh, at 7 and 14 days of storage period by ten of the staff members of Dairy and Food Science Departments, Faculty of Agriculture, Fayoum University. They were selected on the basis of interest and experience in sensory evaluation. Panelists judged the cheese samples using the following points: flavor (50 points), Body and texture (35 points) and color & appearance (15 points) according to Hassan et al. (1983).

Rheological properties

The texture properties of UF-cheese samples were evaluated using texture profile analyzer, using a universal testing machine (TL, Pro). Food Technology Corporation. Sterling, Virginia, USA. Data were collected by computer and the texture profile parameters were calculated from TL. Pro. Texture analyzer and computer interface. Texture profile analysis (TPA) was performed in the Dairy Research Department, Food Technology Research Institute, Agriculture Research Center. Hardness, Cohesiveness, Springiness, Gumminess and Chewiness of cheese samples were calculated as described by Bourne (1978).

Statistical analysis

All obtained data were expressed as mean value ± standard error and analyzed by using general linear model of SPSS (2007). Mean of the values, were compared with main effects by Duncan's multiple range tests (Duncan's, 1955) when significant F values were obtained $P \leq 0.05$.

Results and Discussion

Approximate chemical composition

Moisture, fat and Fat/dry matter (%)

Influence of adding different cold pressed oils on moisture, fat and fat/ dry matter (F/DM) contents of UF-white soft cheese during cold storage period were investigated and presented in Table 1. The results revealed that the moisture content in control cheese samples were, 69.81, 69.22 and 68.91% in fresh, 7 and 14 days of storage, respectively. The moisture contents of treated cheese samples were significantly different ($P \leq 0.05$) than control cheese. The treated cheese samples had lower moisture contents than control cheese at fresh and at different storage periods. Among all the UF-cheese treatments, the samples made with Cardamom oil (O_5 treatment) gained the highest moisture content (69.23%) in fresh age. While, the lowest moisture content (69.14 %) was noticed in O_2 and O_3 samples (UF-cheese treatments with Thyme and Rosemary EO, respectively). The results also indicated that moisture content in all cheese treatments were slightly decreased up to the end of storage periods. The loss in moisture content was mainly attributed to water evaporation and also the increase of acidity in cheese samples;increases the curd contraction and causing expulsion of the moisture. Similar results were reported by Salama (2004). The results indicated that addition of cold pressed oils decrease in the moisture content of the resultant cheese compared to control. Similar results were reported by EL-Kholy et al. (2017); El-Sayed et al. (2017) and Abbas et al. (2018). According to the results obtained in the same Table 1, the variations in the fat content of cheese samples were found to be highly significant

(P≤0.05) during storage and between treatments. The highest fat content (13.43%) was recorded for O_3 treatment, while control cheese recorded the lowest fat content (12.8%) between all UF-white soft cheese treatments in fresh age. Generally, there was an increase in the fat content during the storage period, which could be attributed to the gradual decrease of moisture content in all UF-white soft cheese treatments throughout the storage period.

Salama (2004) and EL-Kholy et al. (2017) reported that addition of essential oils extracted from cumin, rosemary and thyme and their mixture for cheese making recorded more fat content compared with the control cheese. El-Sayed et al. (2017) studied the effect of adding different ratios of Moringa oil in labneh making and concluded that TS, fat and F/DM content increased in labneh by increasing the added ratio of Moringa oil. Kavas et al. (2015) found the same trend in fat content when used the ginger essential oil in the manufacture of Kashar cheese. They found that fat content of treated cheese was higher than control and this was due to higher dissolution of the essential oil in the lipid fraction of the cheese. The results in Table 1, indicated that cheese treated samples had higher fat/DM contents than control cheese. Fat/DM contents were, 42.63, 42.97, 43.20, 43.52, 43.24 and 43.00% for C, O_1, O_2, O_3, O_4 and O_5, respectively at fresh time of storage. The corresponding values increased at the end of storage period to reach 42.68, 43.44, 44.32, 44.39, 43.82 and 43.56%, respectively, close results were reported by Khider et al. (2022).

Changes in pH values and titratble acidity

Changes in pH values and titratable acidity of UF- white soft cheese enhanced with different cold pressed oils are shown in Fig. 2. There was a significant difference (P≤0.05) in pH values (Fig. 2a) between UF-white soft cheese treatments during storage period. The pH values decreased during storage period in all cheeses, the highest pH value (6.63) was found in control cheese, while, the lowest pH value (6.40) was recorded in O_5 treatment at fresh time. The decrease in pH values during storage period were correlating to the increase in acidity, which could be attributed to the breakdown of some lactose into lactic acid during storage (Hassan & Amjad, 2010). The pH values were, 6.49 in control cheese and 6.25, 6.22, 6.21, 6.19 and 6.15 for O_1, O_2, O_3, O_4 and O_5 UF-white soft cheese treatments, respectively at the 14th day of storage. These results are similar to that reported by EL-Kholy et al. (2017). The results showed that acidity (%) of fresh UF-white soft cheese samples were 0.25, 0.32, 0.31, 0.30, 0.31 and 0.32% for control, O_1, O_2, O_3, O_4 and O_5 treatments, respectively. By the end of cold storage period (14 days) it reached to 0.36, 0.40, 0.39, 0.39, 0.41 and 0.44% in the same previous order. These trends were close to what obtained by Khider et al. (2022). The acidity in UF- cheese treatment made by cardamom was the highest among all other treatments as it registered 0.38 and 0.44% at 7 and 14 days of storage, respectively. Moreover, acidity development was increased in all UF-cheese samples and control cheese during storage. Similarly, El-Sayed et al. (2017) reported that acidity values of labneh fortified with Moringaoil was increased during storage.

Nitrogenous content

Total nitrogen content

Results in Table 2 illustrate the total nitrogen (TN %) of different UF-white soft cheese treatments during storage period. There is a significant difference (P≤0.05) between UF-white soft cheese treatments made with differentcold pressez oils during storage, but among all UF-white soft cheese treatments and control there is few changes. Generally, there is an increase in TN% during storage period, which may relate to the decrease in moisture content with progress of storage. Similar trends were obtained by Abd El-Salam (2015); Akhgar et al. (2016) and Metry et al. (2017). The highest TN content was recorded at the 14th day in UF-white soft cheese that made with cardamom oil (O_5) which recorded 1.75%. However, the lowest TN content was noticed in control which recorded 1.72% at 14 days of storage. This was in accordance to the results of EL-Kholy et al. (2017), who reported that at the end of storage period, UF-soft cheese containing cumin, rosemary and thyme mixture oil had the highest nitrogen content followed by the UF-soft cheese containing both the rosemary and thyme essential oils. However, the lowest nitrogen content was found in the control UF-soft cheese. The results obtained in the present study are in agreement with those obtained by Mutlag & Hassan (2008), who reported significant increase in nitrogen content during storage period of labneh containing essential oil compared to the untreated control Labneh.

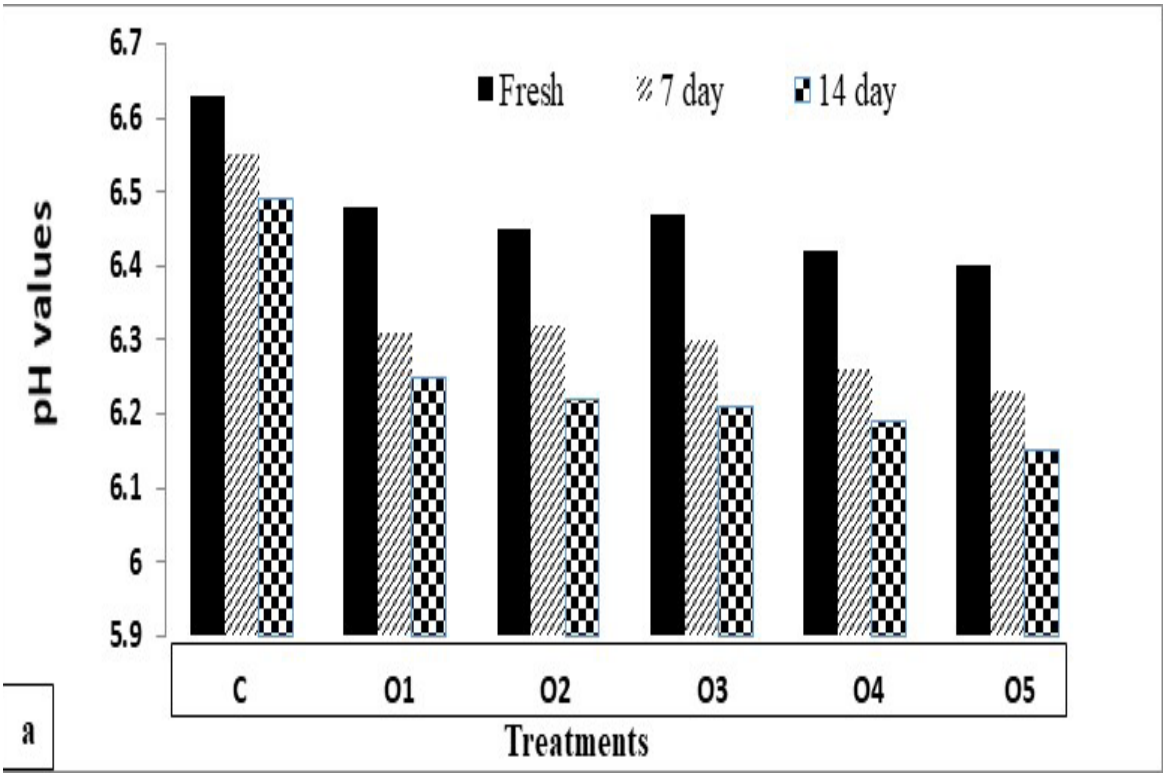
Water soluble nitrogen and water soluble nitrogen/ total nitrogen contents

Water soluble nitrogen (WSN) content and water soluble nitrogen/total nitrogen (WSN/TN) ratio as affected by using different cold pressed oils are recorded in Table 2. The results showed that, WSN% was increased with progress of storage period of all cheeses. On the other hand, there were no significant differences (P≥0.05) in WSN among the treated cheese samples. Similar results were reported by Salama (2004). The results also indicated that, WSN and WSN/TN ratio of control were significantly (P≤0.05) lower than cheeses from all treatments. Also, it can be noted that the WSN content increased slightly by adding the essential oils. The lowest values of WSN (0.28, 0.33%) were for, control and O_2 UF-cheese treatment, respectively, followed by O_1 UF-cheese treatment (0.34%). Similar reading observed for O_3, O_4 and O_5 UF-cheese treatments (0.35%) at 14 days of storage period. This increase referred to the proteolysis of cheese protein which leads to the production of more soluble nitrogenous compounds. This investigation was in accordance with Zaky et al. (2013), who stated that the addition of dill and caraway essential oils caused more proteolytic activity than in control samples. Similarly, Abbas et al. (2018) reported that, fortification of UF-soft buffalo cheese with extracted basil essential oil enhanced the growth of starter culture and the proteolytic activity and the subsequent soluble nitrogen in UF-cheese samples.

TABLE 1. Effect of adding different cold pressedoils on moisture, fat and fat /dry matter (%) of UF-white soft cheese during cold storage period at 5±1ºC.

*Treatments	Storage period (days)	(%) Moisture content	(%) Fat content	(%) Fat/ dry matter
C	Fresh	69.81^{a}	12.87^{k}	42.63^{i}
	7	69.22^{b}	13.07^{e}	42.46^{ij}
	14	68.91^{c}	13.27^{j}	42.68^{hi}
O_1	Fresh	69.21^{b}	13.23^{j}	42.97^{gh}
	7	68.67^{d}	13.53^{gh}	43.19^{fg}
	14	68.00^{i}	13.90^{de}	43.44^{def}
O_2	Fresh	69.14^{b}	13.33^{ij}	43.20^{fg}
	7	68.62^{de}	13.73^{f}	43.75^{cd}
	14	68.12^{g}	14.13^{ab}	44.32^{a}
O_3	Fresh	69.14^{b}	13.43^{hi}	43.52^{cde}
	7	68.55^{ef}	13.83^{ef}	43.97^{b}
	14	67.94^{i}	14.23^{a}	44.39^{a}
O_4	Fresh	69.17^{b}	13.33^{ij}	43.24^{efg}
	7	68.59^{def}	13.57^{g}	43.20^{fg}
	14	67.98^{i}	14.03^{bc}	43.82^{c}
O_5	Fresh	69.23^{j}	13.23^{j}	43.00^{gh}
	7	68.53^{f}	13.53^{gh}	42.99^{gh}
	14	68.92^{c}	13.54^{b}	43.56^{cde}
SE±		0.03	0.014	0.112

a, b,.. and k: Means having different superscripts within each column are significantly different (P ≤ 0.05), SE: Standard error, ***C**: UF-White soft cheese without addition (Control), **O1**: UF-White soft cheese with Marjoram oil (200 ppm), **O2**: UF-White soft cheese with Thyme oil (200 ppm), **O3**: UF-White soft cheese with Rosemary oil (200 ppm), **O4**: UF-White soft cheese with Moringa oil (200 ppm) and **O5**: UF-White soft cheese with Cardamom oil (200 ppm).



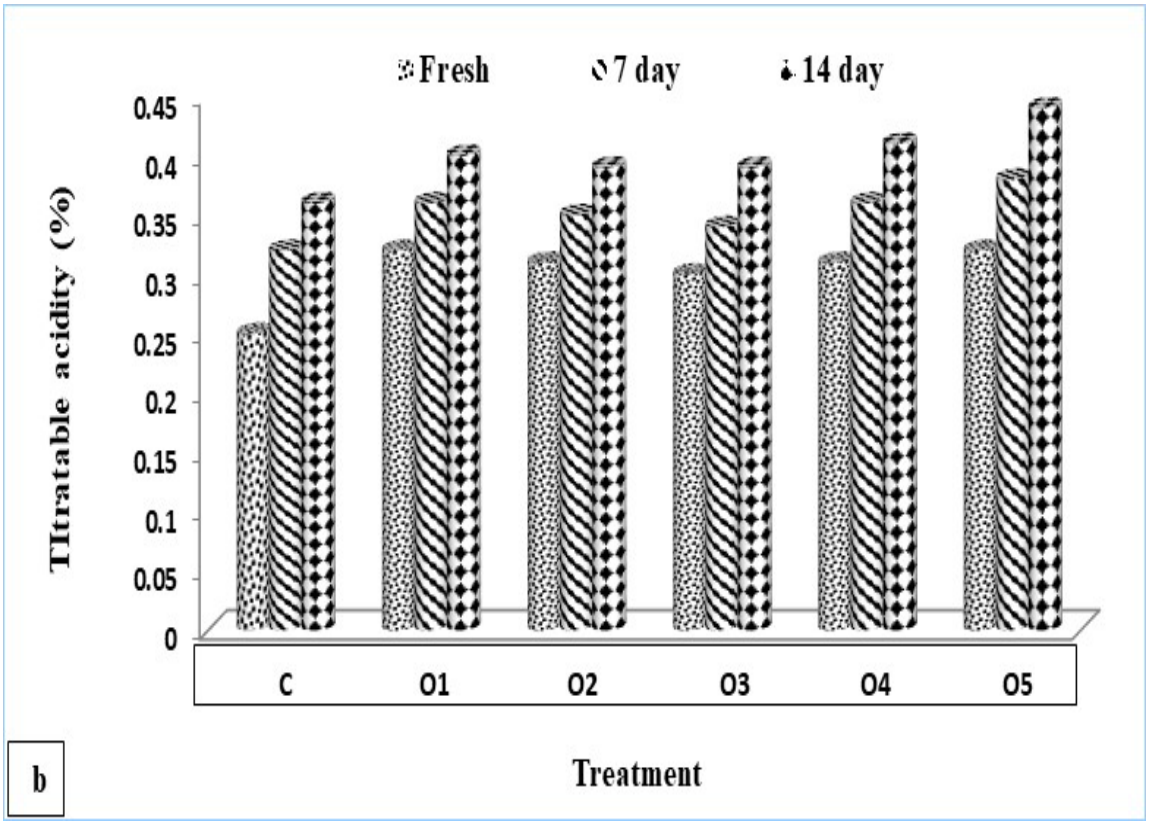


Fig. 2. Changes in pH values (a) and titratable acidity (b) of UF-white soft cheese enhanced with different cold pressed oils during storage at 5±1°C.

TABLE 2. Effect of adding different cold pressed oils on the nitrogenous distribution of UF-white soft cheese during storage at 5±1°C.

*Treatments	Storage period (days)	TN (%)	(%) WSN	(%) WSN/ TN
C	Fresh	1.61	0.26	16.15
	7	1.65	0.28	16.97
	14	1.72	0.28	16.27
O_1	Fresh	1.63	0.30	18.40
	7	1.68	0.33	19.64
	14	1.74	0.34	19.54
O_2	Fresh	1.63	0.31	19.02
	7	1.68	0.31	18.45
	14	1.74	0.33	18.96
O_3	Fresh	1.62	0.34	20.99
	7	1.68	0.34	20.24
	14	1.74	0.35	20.11
O_4	Fresh	1.64	0.33	20.12
	7	1.68	0.34	20.24
	14	1.74	0.35	20.83
O_5	Fresh	1.63	0.33	20.25
	7	1.66	0.34	20.49
	14	1.75	0.35	20.00
SE±		0.01	0.009	0.534

***C**: UF-White soft cheese without addition (Control), **O_1**: UF-White soft cheese with Marjoram oil (200 ppm), **O_2**: UF-White soft cheese with Thyme oil (200 ppm), **O_3**: UF-White soft cheese with Rosemary oil (200 ppm), **O_4**: UF-White soft cheese with Moringa oil (200 ppm) and **O_5**: UF-White soft cheese with Cardamom oil (200 ppm).

Results in Fig. 3 showed the ash content of UF-white soft cheese treatments, there was no significant difference ($P \geq 0.05$) between UF-white soft cheese treatments and during storage period in ash content. It is noticed that ash content was increasing in all UF-white soft cheese treatments during storage period. The highest percentages of ash at fresh age were in O_1, O_3 and O_4 treatments where it was 2.35, 2.35 and 2.36, respectively. The ash contents of other treatments were 2.30%, 2.34 and 2.30% for C, O_2 and O_5, respectively at fresh time. While, at the end of storage period, the ash increased in all cheese samples, where it was 2.48, 2.52, 2.50, 2.55, 2.48 and 2.52 for C, O_1, O_2, O_3, O_4 and O_5, respectively. Similar results were obtained by EL-Kholy et al. (2017), who reported that the addition of essential oil from cumin, rosemary and thyme and their mixtures significantly increased the ash content of UF-soft cheese during storage.

Microbiological examination of different UF-white soft cheese enhanced with some cold pressed

Total Viable Count (TVC)

Regarding the TVC of different UF-white soft cheeses treatments are shown in Table 3. The results illustrated that, there were a significant difference ($P \leq 0.05$) among treatments and during storage period. In all cheese treatments the TVC was increasing during cold storage period. The lowest numbers of TVC was 4.95 and 4.98 log cfu /g in UF- white soft cheese treated with Thyme (O_2) and Rosemary (O_3) oils, respectively. While, the highest one was 6.08 log cfu/g for UF-cheese control. These numbers of TVC increased in all UF-cheese samples at the end of storage period, it was 7.21, 5.35, 5.33, 5.38, 5.38 and 5.43 log cfu/g in C, O_1, O_2, O_3, O_4 and O_5, respectively. Generally, it is noticed that TVC was less in treatments made with Thyme and Rosemary, respectively. These results are in accordance with those reported by

Abd El-Baky (2006); Elsaadany et al. (2017), where they mentioned that the antimicrobial compounds present in spice extracts can extent shelf-life of foods by reducing microbial growth rate or viability. Similarly, Celikel & Kavas (2008) found that thyme essential oil extract had superior antibacterial activity than sage, myrtle, laurel and orange oils. EL-Kholy et al. (2017) showed that the total viable count (TVC) of all treated cheeses decreased in the presence of essential oils from cumin, rosemary and thyme and their mixture compared with the control cheese, which may be attributed to the antimicrobial effect of the essential oils. El-Sayed et al. (2017) concluded that Moringa *oleifera* oil showed strong antimicrobial activity against Gram-positive bacteria and Gram-negative bacteria more than mold and yeast.

Yeast and mold counts

The total yeast and mold (Y&M) counts of UF-white soft cheese enhanced with different cold pressed oils during storage period are shown in Table 3. No counts of Y&M were detected in all UF- white soft cheese treatments enhanced with different cold pressed oils at fresh age or after 7 days of storage. Moreover, samples of UF-cheese enhanced with rosemary were free of Y&M even after 14 days of storage, indicating more antifungal effect than other added cold pressed oils, which was verified in a previous study (Elbanna et al., 2018). The control samples showed high count of Y&M during storage period, comparing with all enhanced UF-cheese treatments. The results indicated that the addition ofcold pressed oils to UF-cheese led to reduction in count of Y&M in the resultant cheese compared with control. These results are in line with the findings of EL-Kholy et al. (2017), where they reported that Y&M were not detected in cheese samples containing essential oils like, cumin, rosemary and thyme and their mixtures throughout storage period. This may indicate the effectiveness of added essential oils in inhibiting growth of Y&M counts. On the other hand, Y&M were increased in the control cheese samples after 14 days of storage. Al-Otaibi & Demerdash (2008) reported that labneh containing each of thyme, marjoram and sage essential oils had extended shelf life, which may relate to the remarkable inhibitory effects of phenolic compounds, aldehydes and alcohols against yeasts and molds (Sacchetti et al. 2005). The results obtained in the present study are also in agreement with those reported by Mutlag & Hassan (2008), who mentioned that essential oils, particularly thyme, had potential antifungal activity. The inhibitory effect of essential oils might be due to the constituents of this essential oil, which have several targets in the cell, such as degradation of the cell wall and weakening of the membrane, causing enhanced permeability, leading to the loss of intracellular components (Tserennadmid et al*.,* 2011).

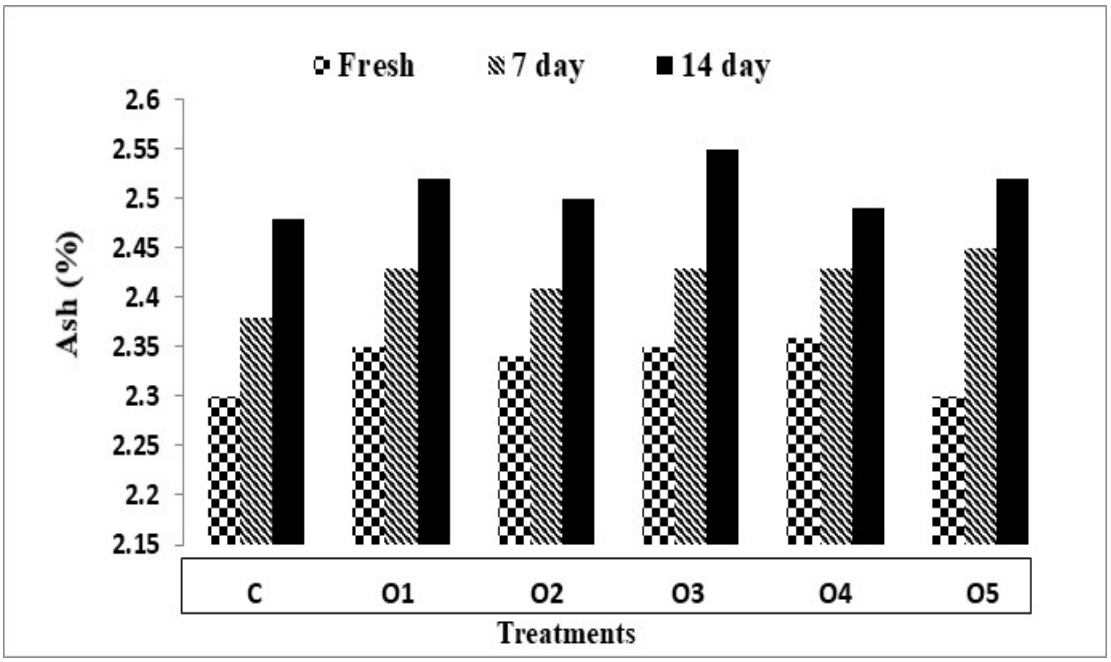


Fig. 3. Ash content of UF-white soft cheese enhanced with different cold pressed oils during storage at 5±1ºC.

Spore forming bacterial, Staphylococcus and Coliform group counts

Spore forming bacterial counts were illustrated in Table 3, it is noticed that the highest reading of spore formers were recorded in the control UF-white soft cheese and it was increased during the cold storage period and at 14th day. While, no spore formers were detected in samples of all UF-white soft cheese that enhanced with different cold pressed oils at fresh age, especially samples of the UF-white soft cheese treatments that enhanced with Thyme (O_2), Rosemary (O_3) and Moringa oils (O_4), where also were free from spore formers at the 7thday of storage which indicating more antibacterial activity. In case of the obtained results of UF-cheese control in this study are in agreement with finding of El-Sissi (2002) who reported that, the spore formers gradually increased throughout storage of Domiati cheese which, probably due to the combination of low salt and low acidity development. Both Coliform bacteria and *Staphylococcus aurous* were not detected in the samples of UF-white soft cheese treatments and control during storage period at 5±1ºC. These results were in agreement with finding of Awad et al. (2015).

Rheological properties of UF-white soft cheese enhanced with different cold pressed oils

The changes in rheological parameters were determined by the texture profile analyzer (TPA) in terms of hardness, cohesiveness, springiness, gumminess and chewiness during storage periods. Generally, UF-white soft cheeses exhibited considerable variations in the initial measurements (hardness, gumminess and chewiness) (Table 4) compared to the control cheeses. The variation of textural parameters might be due to the different compositional analysis of different cheese samples and different proteolytic pattern depending on the type of additive used in the manufacture of different UF-white soft cheese. In addition, the different moisture and fat contents of cheese samples may alter the rheological parameters of the cheese matrix.

TABLE 3. Effect of adding different cold pressed oils on Microbial counts (Log cfu/g) of UF-white soft cheese during storage at 5±1ºC.

Treatments*	Storage period (days)	Total viable counts	Yeast &Mold counts	Spore forming bacterial counts
C	Fresh	6.08^{c}	ND	1.30
	7	6.58^{b}	2.48	1.70
	14	7.21^{a}	2.70	1.85
O_1	Fresh	5.11^{ij}	ND	ND
	7	5.20^{g}	ND	1.0
	14	5.36^{ef}	2.0	1.48
O_2	Fresh	4.947^{n}	ND	ND
	7	5.084^{jk}	ND	1.0
	14	5.338^{f}	1.0	1.0
O_3	Fresh	4.980^{mn}	ND	ND
	7	5.118^{ij}	ND	ND
	14	5.389^{e}	ND	1.0
O_4	Fresh	5.024^{m}	ND	ND
	7	5.17^{gh}	ND	ND
	14	5.38^{ef}	1.0	1.2
O_5	Fresh	5.06^{kl}	ND	ND
	7	5.15^{hi}	ND	1.0
	14	5.44^{d}	1.0	1.2
±SE		0.01	—	—

Note: a, b,...and n: Means having different superscripts within each column are significantly different (P ≤ 0.05), **ND:** Not detected, ***C**: UF-White soft cheese without addition (Control), **O_1**: UF-White soft cheese with Marjoram oil (200 ppm), **O_2**: UF-White soft cheese with Thyme oil (200 ppm), **O_3**: UF-White soft cheese with Rosemary oil (200 ppm), **O_4**: UF-White soft cheese with Moringa oil (200 ppm) and **O_5**: UF-White soft cheese with Cardamom oil (200 ppm).

Hardness and Cohesiveness

Results in Table 4 show the hardness values of different cheese treatments, generally, it is noticed from the obtained results that hardness values of all resultant UF-cheese were decreased during storage, which may be attributed to the occurred proteolysis, which decreases the surface area occupied by the protein fraction in cheese microstructure, leading to a decrease of the force bearing component in cheese texture (Abd El-Aziz et al*.,* 2012). The difference in textural behavior among cheese samples may be attributed to many factors including rate of protein degradation, moisture content, fat distribution and pH (Cavalier et al*.,* 1991).

The values for the cohesiveness as obtained by the texture profile analysis (TPA) test for fresh and stored UF-cheese samples as affected by adding different cold pressed oils, are presented in Table 4. In fresh UF-white soft cheese samples; the lowest cohesiveness value was 0.73 for UF-cheese samples that treated with Thyme (O_2) oil. While, the highest values were recorded for samples treated with Rosemary oil (0.93). It is also noticed that the value of cohesiveness for UF-cheese enhanced with Moringa oil (O_4) decreased at the end of storage period (14^{th} days) more than the other all UF-cheese treatments and control. Similar results were obtained by El-Kholy et al. (2017).

Springiness, Gumminess and Chewiness

Springiness values of the fresh UF- white soft cheese samples for control and that enhanced with different cold pressed oils were presented in Table 4. Springiness were decreasing during storage in control and all UF-cheese that enhanced with different oils, but there are little differences in springiness between UF-cheese treatments and control during storage, whereas, the values were, 5.99, 5.99, 6.00, 5.97, 5.99 and 5.99 mm for control (C), O_1, O_2, O_3, O_4 and O_5 UF-cheese treatments, respectively. Similar results were obtained by El-Kholy et al. (2017). Changing in texture can be attributed to the release of calcium ions from mono-calcium and di-calcium para k-caseinate molecules that are responsible for the springiness of cheese curd and to the hydrolysis of these molecules during storage (Romeih, 2006).

Results in Table 4 show gumminess of different UF-cheese treatments, the highest gumminess values in fresh age were, 1.5, 0.8 and 0.8 N for samples of control O_2 and O_3, respectively. The gumminess values decreased with progressed of cold storage period (14^{th} day) to reach 0.9, 0.63, and 0.6 N for same previous order, respectively. By the end of storage period the lowest readings were 33, 35 and 0.50 N for samples of treatments enhanced with Marjoram, Cardamom and Moringa oils, respectively, similar results were reported by El-Kholy et al. (2017).

Chewiness values in fresh or stored cheese are collected in Table 4. The values in fresh age were 3.26, 4.07, 5.11, 5.70, 5.45 and 3.28 mj for control, O_1, O_2, O_3, O_4 and O_5 UF-cheese treatments, respectively and by the end of storage it reached to 1.91, 1.95, 3.6, 3.87, 3.73 and 3.22 mj, respectively for same previous order. Generally, the results shown in Table 4 indicated that UF-cheese samples containing cold pressed oils showed low values for all rheological parameters compared to the control cheese. Among the cheese samples containing cold pressed oils; cheese containing Moringa, Cardamom and Rosemary had the lowest values for all rheological properties at the end of storage period.

Organoleptic properties of UF-white soft cheese incorporated with different cold pressed oils

UF-white soft cheesemade withdifferent cold pressed oils was sensory evaluated when fresh and during cold storage period at 7 and 14 days. The points given by panelists are presented in Table 5. The results showed that the treated UF-white soft cheese samples significantly (P□0.05) gained the maximum total scores compared with control samples. From these results it is observed that at fresh time there was no clear difference among treatments O_1 to O_5 in color & appearance and body & texture. While, addition of Marjoram, Thyme and Moringa oils O_1, O_2 and O_4 were improved flavor of the UF-cheese than control cheese and other UF-cheese treatments (O_1, O_3 and O_5), this could be attributed to the accumulation of volatile fatty acids, carbonyl compounds and other flavor compounds which enhance cheese flavor. Similar results were reported by Hussein (2004). At 7days of storage, O_1, O_5 and O_4 treatments were obtained the highest total scores compared with other treatments. By the end of storage period, the total scores of all treatments and control was in the order of 96.20, 94.30, 95.40, 94.30, 93.00 and 91.10 for O_1, O_2, O_3, O_4, and O_5, respectively.

TABLE 4. Effect of adding different cold pressed oils on rheological properties of UF-white soft cheese during storage at 5±1ºC .

Parameters	storage period (days)	Treatments*					
		C	O_1	O_2	O_3	O_4	O_5
Hardness (N)	Fresh	0.60	0.70	0.90	1.20	0.90	0.60
	14	0.55	0.40	0.80	0.87	0.83	0.35
Cohesiveness (~)	Fresh	0.86	0.87	0.73	0.93	0.84	0.84
	14	0.83	0.84	0.77	0.72	0.74	0.79
Springiness (mm)	Fresh	6.60	6.59	6.59	6.56	6.60	6.60
	14	5.99	5.99	6.00	5.97	5.99	5.99
Gumminess (N)	Fresh	1.50	0.60	0.80	0.80	0.63	0.50
	14	0.90	0.33	0.63	0.60	0.50	0.35
Chewiness (mj)	Fresh	3.26	4.07	5.11	5.70	5.45	3.28
	14	1.91	1.95	3.60	3.87	3.73	3.22

***C**: UF-White soft cheese without addition (Control), **O_1**: UF-White soft cheese with Marjoram oil (200 ppm), **O_2**: UF-White soft cheese with Thyme oil (200 ppm), **O_3**: UF-White soft cheese with Rosemary oil (200 ppm), **O_4**: UF-White soft cheese with Moringa oil (200 ppm) and **O_5**: UF-White soft cheese with Cardamom oil (200 ppm).

The flavor of UF-white soft cheese and overall score were affected by different types of cold pressed oils used. Similar results were reported by Abd El-Baky (2006) who reported that adding cardamom, thyme or clove essential oils to white soft cheese made from goat's improved flavor of cheese. EL-Kholy et al. (2017) mentioned that the highest scores obtained were for the UF-soft cheese sample containing either the cumin essential oil or the mixture of cumin, rosemary and thyme. Also it can be concluded that the untreated and treated UF-white soft cheese samples with the different essential oils were still accepted by the panelists even at the end of storage period. El-Sayed et al. (2017) concluded that addition of Moringa *oleifera* oil at different concentration to labneh improves the sensory properties, acceptability, and nutritional value and extend the shelf life.

Conclusion

The results concluded that adding the cold pressed oils to the retentate of UF-white soft cheese as natural food additives especially, rosemary followed by thyme oil, can be used to extend the shelf life of the UF-white soft cheese. In addition, these cold pressed oils in particular Marjoram, Rosemary and Cardamom oils improve the sensory attributes and could be successfully used as natural and safe additives in producing of the UF-white soft cheese.

TABLE 5. Effect of adding different cold pressed oils on organoleptic scores of UF-white soft cheese during storage at 5±1ºC.

Treatments*	Storage period (days)	Flavor (50)	Body & texture (35)	Color & appearance (15)	Total (100)
	Fresh	45.30^{cd}	33.80^{a}	14.00^{ab}	93.10^{bc}
C	7	45.50^{cd}	34.10^{a}	14.40^{ab}	94.00^{b}
	14	45.80^{abcd}	31.80^{b}	13.50^{b}	91.10^{c}
	Fresh	45.90^{abcd}	33.20^{ab}	14.50^{a}	93.60^{bc}
O_1	7	46.50^{abcd}	34.00^{a}	14.40^{ab}	94.90^{ab}
	14	47.80^{a}	34.20^{a}	14.20^{ab}	96.20^{a}
	Fresh	46.70^{abcd}	33.30^{ab}	14.20^{ab}	94.20^{b}
O_2	7	46.10^{abcd}	33.60^{a}	14.30^{ab}	94.00^{b}
	14	46.30^{abcd}	33.80^{a}	14.20^{ab}	94.30^{b}
	Fresh	45.30^{cd}	34.00^{a}	14.30^{ab}	93.60^{bc}
O_3	7	46.70^{abcd}	33.40^{ab}	14.00^{ab}	94.10^{b}
	14	45.60^{bcd}	33.90^{a}	14.40^{ab}	93.90^{bc}
	Fresh	46.30^{abcd}	34.30^{a}	14.80^{a}	95.40^{ab}
O_4	7	47.20^{abc}	33.50^{ab}	13.90^{ab}	94.60^{ab}
	14	46.80^{abcd}	33.10^{ab}	14.40^{ab}	94.30^{b}
	Fresh	47.70^{ab}	33.40^{a}	14.00^{ab}	95.10^{ab}
O_5	7	46.90^{abcd}	33.80^{a}	14.60^{a}	95.30^{ab}
	14	44.70^{d}	34.00^{a}	14.30^{ab}	93.00^{bc}
±SE		0.717	0.56	0.247	1.13

Note: a, b ….and d: Means in the same column with different superscript letters are significantly different (P≤ 0.05), **SE: standard error, *C**: UF-White soft cheese without addition (Control), **O_1**: UF-White soft cheese with Marjoram oil (200 ppm), **O_2**: UF-White soft cheese with Thyme oil (200 ppm), **O_3**: UF-White soft cheese with Rosemary oil (200 ppm), **O_4**: UF-White soft cheese with Moringa oil (200 ppm) and **O_5**: UF-White soft cheese with Cardamom oil (200 ppm).

References

Abbas, H.M., Kassem, J.M., Mohamed, S.H.S. and Zaky, W.M. (2018) Quality appraisal of ultra-filtered soft buffalo cheese using basil essential oil. *Acta Scientiarum Polonorum, Technologia Alimentaria,* **17**, 305–312.https://doi.org/10.17306/J.AFS.0572

Abd El-Aziz, M. Mohamed, S.H. and Seleet, F.L. (2012) Production and evaluation of soft cheese fortified with ginger extract as a functional dairy food. *Polish Journal of Food and Nutrition Sciences,* **62**, 77-83. https://doi.org/10.2478/v10222-011-0046-0

Abd El-Baky, H.M.A. (2006) Utilization of goat's milk in soft cheese making. *M.Sc. Thesis,* Fac. of Agri., Cairo Univ.,Fayoum, Egypt.

Abd El-Salam, B.A. (2015) Effect of milk fat replacement with vegetable oil and/or whey protein concentrate on microstructure, texture and sensory characteristics of fresh soft cheese. *International Journal of Dairy Science,* **10**, 117-125.https://doi.org/10.3923/ijds.2015.117.125

Abd El-Salam, B.A. and Saad, M.F. (2016) Influence of selected essential oils on some pathogenic microorganisms in white soft cheese. *International Journal of ChemTechResearch,* **9**, 214-220. https://sphinxsai.com/2016/ch_vol9_no12/1/(214-220)V9N12CT

Akhgar, N.R, Hesari, J. & Azadmard D.S. (2016) Effect of slurry incorporation into retentateon

proteolysis of Iranian ultrafiltered whitecheese. *Czech Journal of Food Sciences,* **34,**173–179. https://doi.org/10.17221/361/2015-CJFS

Al-Harbi, N.O. (2011) Effect of marjoram extract treatment on the cytological and biochemical changes induced by cyclophosphamide in mice. *J. Medicinal Plant Research,* **5**, 5479–5485. https://www.researchgate.net/publication/287837639

Alizadeh, M., Hamedi, M., and Khosroshahi, A. (2006) Modeling of proteolysis and lipolysis in Iranian white brine cheese. *Food Chemistry,* **97**, 294–301. https://doi.org/10.1016/j.foodchem.2005.05.009

Al-Otaibi, M., and El-Demerdash, H. (2008) Improvement of the quality and shelf life of concentrated yoghurt (labneh) by the addition of some essential oils. *African Journal of Microbiology Research,* **2**, 156–161.http://www.academicjournals.org/ajmr

AOAC. (2005) Association of Official Analytical Chemists.Official methods of analysis 18th ed. Gaithersburg, Maryland INC., USA.

APHA. (1992) American Public Health Association. Standard methods for the examination of water and wastewater, 16th ed., Washington, USA.

Artnaturals (2017) Essential oils extraction: Cold press method. (https://artnaturals.com/blog/essential-oils-extraction-with-the-cold-press-method.html

Assiri, A.M.A., Elbanna, K., Abulreesh, H.H. and Ramadan, M.F.J. (2016) Bioactive Compounds of Cold-pressed Thyme (*Thymus vulgaris*) Oil with Antioxidant and Antimicrobial Properties. *Journal of Oleo Science,* **65**, 629-640.Doi: 10.5650/jos.ess16042J

Atlas, R. and Parks, L.C. (1997) Handbook of microbiological media. 2nd ed., CRC press, 1706.

Awad, R.A.; Salama, W.M. and Ragb, W.A. (2015) Enhancing yield and acceptability of Kareish cheese made of reformulated milk. *Annals of Agricultural Sciences,* **60**, 87–93.https://doi.org/10.1016/j.aoas.2015.03.004

Bagci, Y., Kan, Y., Dogu, S. and Çelik, S.A. (2017) The Essential Oil Compositions of Origanum majorana L. Cultivated in Konya and Collected from Mersin-Turkey. *Indian Journal of Pharmaceutical Education and Research,* **51**, S463-S469.DOI: 10.5530/ijper.51.3s.68

Begum, A., Sandhya, S., Ali, S.S., Vinod, K.R., Reddy, S. and Banji, D. (2013) An in-depth review on the medicinal flora *Rosmarinus officinalis* (Lamiaceae). ACTA Scientiarum Polonorum Technologia Alimentaria, **12**, 61-73.http://www.food.actapol.net/volume12/issue1/6_1_2013.pdf

Bhatnagar, A.S. and Krishna, A.G.G. (2013) Natural antioxidants of the Jaffna variety of Moringa oleifera seed oil of Indian origin as compared to other vegetable oils. *Grasas Y Aceites,* **64**, 537-545. https://doi.org/10.3989/gya.010613

Barbosa, L.N., Rall, V.L., Fernandes, A.A., Ushimaru, P.I., Da S.P.I. and Fernandes, A. Jr. (2009) Essential oils against foodborne pathogens and spoilage bacteria in minced meat. *Foodborne Pathogensand Disease,* **6**, 725–728.https://doi.org/10.1089/fpd.2009.0282

Bourne, M.C. (1978) Texture profile analysis. *Food Technology,* **32**, 62- 72.

Brilhante,R.S.N., Sales,J.A., Pereira,V.S., et al. (2017) Research advances on the multiple uses of *Moringa oleifera*: A sustainable alternative for socially neglected population. *Asian Pacific Journal of Tropical Medicine,* **10**, 621-630.https://doi.org/10.1016/j.apjtm.2017.07.002

Çakaloğlu, B., Özyurt, V.H. and Ötleş, S. Cold press in oil extraction. (2018) A review. *Ukrainian Food Journal,* **7**, 640-654.DOI: 10.24263/2304-974X-2018-7-4-9

Cavalier, C., Queguiner, C. and Cheftel, J.C. (1991) Preparation of Cheese Analogues by Extrusion Cooking. In: Processing and Quality of Foods, P. Zeuthen, J.C. Cheftel, C. Eriksson, R. Gormley, & P. Link (Ed.). Vol. 1, High Temperature-Short Time processing. London: Elsevier Applied Science Pub, 373.Celikel, N. and Kavas, G. (2008) Antimicrobial properties of some essential oils against some pathogenic microorganisms. *Czech Journal of Food Sciences,* **26**,174–181.

Chandra, S., Kumar, M., Dwivedi, P. and Shinde, L.P. (2020) Functional and Nutritional Health Benefit of Cold-Pressed Oils.*International Research Journal of Food and Nutrition,* **2**, 1-5. https://scirange.com/abstract/irjfn.2020.1.5

Creamer L. K., Olson N. F. (1982) Rheological evaluation of maturing Cheddar cheese. *Journal of Food Science,* **47**, 631-636. http://dx.doi.org/10.1111/j.1365-2621.1982.tb10138.x.

Duncan, D. (1955) Multiple range and multiple F Tests Biometrics, 11,1-45.

Elbanna K., Assiri A.M.A., Tadros M., Khider M., Assaeedi A. and Mohdaly A.A.A. (2018) Ramadan M.F.Rosemary (*Rosmarinus officinalis*) oil: composition and functionalityof the cold-pressed extract. *Journal of Food Measurementand Characterization,* **12**, 1601–1609.https://doi.org/10.1007/s11694-018-9775-7.

EL-Kholy, Wedad, A.M., Aamer, Reda, A. and Mailam, M.A. (2017) Effect of Some Essential Oils on the Quality of UF-Soft Cheese during Storage. *Alexandria Journalof Food Scienceand Technology,* **14**, 13-27.https://doi.org/10.12816/0038401

Elsaadany, K. M., El-Dakhakhny, E.A., Hassan, A.M, and Morsy, N.S. (2017) Effectiveness of Selected Essential Oil Plant Extracts as Bio-Preservatives in: Fermented Dairy Products. *Journal of Applied Sciences Research,* **13**, 1-9.http://www.aensiweb.net/AENSIWEB/jasr/jasr/2017/February/1-9

El-Sayed, S. M., El-Sayed, H. S., Salama, H. H., and El-Nor, S. A. (2017) Improving the nutritional value and extending shelf life of labneh by adding *Moringa oleifera* oil. *International Journal of Dairy Science,* **12**, 81-92.https://doi.org/10.3923/IJDS.2017.81.92

El-Sissi, M. G. M. (2002) Utilization of blue cheese slurry for accelerated ripening of Domiati cheese. *Egyptian Journalof Dairy Science,* **30**, 83-99.

El-Soda, M. (1997) Control and enhancement of flavour in cheese. In: Microbiology and biochemistry of cheese and fermented milk. 2nd ed. pp. 219-252. Chapman and Hall, London. UK.

Fahey J.W. (2005) *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic and prophylactic properties. Part I. *Trees for Life Journal*, 1-15. http://www.TFLJournal.org/article.php/20051201124931586

Farooq, F., Rai, M., Tiwari, A., Khan, A.A. and Farooq, S. (2012) Medicinal properties of *Moringa oleifera*: an overview of promising healer. *Journal ofMedicinal Plants Research* **6**, 4368-4374.https://www.researchgate.net/publication/229439393

Fathollahi, I., Hesari J., Azadmard S., and Oustan S., (2010) Influence of proteolysis and soluble calcium levels on textural changes in the interior and exterior of Iranian UF white cheese during. World Academy Science Engineering and Technology, 66, 844–849. http://scholar.waset.org/1307-6892/11029

Hassanien, M.F.R., Mahgoub, S.A. and El-Zahar, K.M.C. (2014) Soft cheese supplemented with black cumin oil: Impact on food borne pathogens and quality during storage. *Saudi J. Biol. Sci.,* **21**, 280–288.https://doi.org/10.1016/j.sjbs.2013.10.005

Hayes, M.G., McSweeney, P.L.H. and Kelly, A.L. (2002) The influence of native and heat denatured whey proteins on enzyme activity. 2. *Chymosin. Milchwissenschaft.,* **57**, 264–267.

Hamid, O.I.A and Abdelrahman, N.A.M. (2012) Effect of Adding Cardamom, Cinnamon and Fenugreek to Goat's Milk Curd on the Quality of White Cheese During Storage. *International Journal of Dairy Science,* **7**, 43-50.http://scialert.net/fulltext/?doi=ijd...

Hassan, A. and Amjad, I. (2010) Nutritional evaluation of yoghurt prepared by different starter cultures and their physiochemical analysis during storage. *African Journal of Biotechnology,* **9**, 2913-2917. https://doi.org/10.5897/AJB2010.000-3121

Hassan, H.N.; Mehanna, N.M.; El-Deeb, S.E and Mashaly, R.I. (1983) Manufacture of white soft cheese from hydrolyzed –lactose milk. *Egyptian Journal of Dairy Science,* **11**, 137- 145.

Hesari, J., Ehsani, M.R., Khosroshahi, A. and McSweeney, P.L.H. (2006) Contribution of rennet and starter to proteolysis in Iranian UF white cheese. *Lait,* **86**, 291–302.https://doi.org/10.1051/lait:2006011

Holmes, P. (1999) Rosemary oil. The international Journal of aromatherapy, 9, 62-66.Hossain, M.B., Brunton, N.P., Barry-Ryan, C., Martin-Diana, A.B. and Wilkinson, M. (2008) Antioxidant activity of spice extracts and phenolics in comparison to synthetic antioxidants. *Rasayan Journal of Chemistry* **1**, 751–756. https://doi.org/10.21427/D7105D

Hussein, G.A.M. (2004) Manufactured of flavoured Tallaga cheese. *Egyptian Journalof Dairy Science,* **32**, 277-290.

Ismail, A.M., Harby, S. and Salem, A.S. (2006) Production of flavored labneh with extended shelf life. *Egyptian Journalof Dairy Science,* **34**: 59-68.

Iwalokun, B.A.; Ogunledun. A.; Ogbolu, D.O.; Bamiro, S.B and Jimi-Omojola, J. (2004) In-vitro antimicrobial properties of aqueous garlic extract against multidrug-resistant bacteria and candida species from Nigeria. *Journal of Medicinal Food*, **7**, 327-333.https://doi.org/10.1089/jmf.2004.7.327

Kabouche, Z. Boutaghane, N. Laggoune, S. Kabouche, A. Ait-Kaki, Z. & Benlabed, K. (*2005)* Comparative antibacterial activity offive Lamiaceae essential oils from Algeria. *International Journal of Aromatherapy,* **15**,129-133.DOI: 10.1016/j.ijat.2005.03.006

Kavas, G., Kavas, N., and Saygili, D. (2015) The effects of thyme and clove essential oil fortified edible films on the physical, chemical and microbiological characteristics of kashar cheese. *Journal of Food Quality,* **38**, 405–412.DOI: https://doi.org/10.1111/jfq.12157

Khider, M., Mailam, M.A., Fathia A.Y, and Metry W.A. (2022)Incorporation of Different Cheese Slurries into Retentate of Ultrafiltrated White Soft Cheese for Enhancing Flavor and QualityImprovement. *Egyptian Journal of Chemistry*, **65***,* 747 - 759.https://doi.org/10.21608/EJCHEM.2021.96192.4508

Kiralan, M., Ulaş, M., Özaydin, A., Özdemır, N., Özkan, G., Bayrak, A. and Ramadan, M.F. (2017) Blends of Cold Pressed Black Cumin Oil and Sunflower Oil with Improved Stability: A Study Based on Changes in the Levels of Volatiles, Tocopherols and Thymoquinone during Accelerated Oxidation Conditions. *Journal of Food Biochemistry,* **41**, 1-10 https://doi.org/10.1111/jfbc.12272

Lucey J.A., Johnson M.E. andHorne D.S. (2003) Invited Review: Perspectives on the basis of the rheology and texture properties of cheese. *Journal Dairy Science,* **86**, 2725–743https://ocul-gue.primo.exlibrisgroup.com

Mahgoub SA, Ramadan MF and El-Zahar KM. *(2013)* Cold Pressed *Nigella Sativa* Oil Inhibits the Growthof Foodborne Pathogens and Improves the Qualityof Domiati Cheese. *Journal of Food Safety,* **33**,470–480.DOI: 10.1111/jfs.12078

Middleton, Jr.E., Kandaswami, C. and Theoharides, T.C. (2000) The effects of plant flavonoids on mammalian cells: Implications for inflammation, heart disease and cancer. *Pharmacological Reviews,* **52**, 673-751. https://pharmrev.aspetjournals.org/content/52/4/673

Metry, W.A., Khider, M.K.A. and Yassin, F.A. (2017) Low Lactose White Soft Cheese Made with Bioprocessing Treats and Ultrafiltration Technique. Low Lactose White Soft Cheese Made with Bioprocessing Treats and Ultrafiltration Technique. *Journal of Food and Dairy Science,* Mansoura University, **8**, 435 – 443. https://jfds.journals.ekb.eg/article_38945_f0c7153fa1ebe167dae7b083edc8ad0b.pdf

Moro, A., Librán, C., Berruga, M.I., Zalacain, A., and Carmona, M. (2015) Dairy matrix effect on the transference of rosemary (*Rosmarinus officinalis*) essential oil compounds during cheese making. *Journal Sci. Food Agric.*, **95**, 1507–1513. https://onlinelibrary.wiley.com/doi/10.1002/jsfa.6853

Mutlag, A. and Hassan, E. (2008) Improvement of the quality and shelf life of concentrated yoghurt (labneh) by the addition of some essential oils. *African Journal of Microbiol. Reseach,* **2**, 156-161.https://www.researchgate.net/publication/228880781

Naeem, A., Abbas, T., Ali, T.M., Hasnain, A. (2018) Essential Oils: Brief Background and Uses. *Annals Short Reports.* **1**: 1006. http://www.remedypublications.com

Nepolean, P., Anitha, J. and Renitta, R.E. (2009) Isolation, analysis and identification of phytochemicals of antimicrobial activity of *Moringa oleifera* Lam. *Current Biotica,* **3**, 33-39. *https://www.semanticscholar.org*

Oke, F., Aslim, B., Ozturk, S. and Altundag, S. (2009) Essential oil composition,antimicrobial and antioxidant activities of *Satureja cuneifolia* Ten. *Food Chemistry,* **112**, 874- 879.https://doi.org/10.1016/j.foodchem.2008.06.061

Oxoid. (1990) Culture media, ingredients and other laboratory services. 6th ed. Published by Unipath Limited, Wade Road, Basingstoke Hampshire, R G 24 OPW, England.

Perez-Fons, L., Garzon, M.T. and Micol, V. (2010) Relationship between the antioxidant capacity and effect of rosemary (*Rosmarinus officinalis* L.) polyphenols on membrane phospholipid order. *Journal of Agriculture Food Chemistry*, **58**, 161–171.https://doi.org/10.1021/jf9026487

Ramadan MF, Khider M, Abulreesh HH, Assiri AMA, Elsanhoty RM, Assaeedi A andElbanna K. (2020) Cold pressed rosemary (*Rosmarinus officinalis*) oil. In: Cold pressed oils green technology, bioactive compounds, functionality and applications, ELSEVIER Academic Press, Chapter 60, 683-694. London Wall, London EC2Y 5AS, United Kingdom. https://www.researchgate.net

Renner, E. and Abd El-Salam, M.H. (1991) Application of ultrafiltration in the dairy industry. Elsevier Applied Sci. London and New York pp.182. https://agris.fao.org/agris-search/search.

do?recordID=GB9124371

Romeih, E.A. (2006) Rheological assessment of UF-White cheese. *Ph.D. Thesis*, Fac. Agric., Cairo Univ.

Sacchetti G., Maietti S., Muzzoli M., Scaglianti M., Manfredini S., Radice M., and Bruni R. (2005) Comparative evaluation of 11 essential oils of different origin as functional antioxidants, antiradicals and antimicrobials in foods. *Food Chemistry,* **91**, 621–632.DOI:10.1016/j. foodchem.2004.06.031

Sahar, H.S.M, Wafaa, M.Z., Jihan, M.K., Abbas, H.M., Salem, M.M.E., Said-Al Ahl, H.A.H. (2013) Impact of antimicrobial properties of some essential oils on cheese yoghurt quality. *World Applied Science Journal,* **27**, 497–507. http://dx.doi.org/10.5829/ idosi. wasj.2013.27.04.13623.

Sajadi, K. and Bahramian, S. (2015) Antifungal Effect of Aloe Vera Gel on *Penicillium Citrinum* in Culture Media and UF Cheese. *International Journal of Food Engineering,* **1**, 61-64.*https:// www.researchgate.net*

Salama, F.M.M. (2004) Improving the quality of Domiati cheese. Proc. *The 9th Egyptian Conf. for Dairy Sci. & Tech. Egyptian Journalof Dairy Science,* 385-397.

Sepahi A.A., Khanafari, A., Sojoudi, S., Yarigar, R.M., Jamshidi, A.H., and Rezazadeh, S.A. (2008) The effects of garlic and cardamom extracts on morphology and physiology properties methicillin resistant *Staphylococcus aureus* (MRSA) and *Pseudomonas aeruginosa*. *Journal of Medicinal Plants,* **7**, 29-38. 20.1001.1.2717204.2008.7.25.4.0

SPSS (2007) Statistical package for social sciences for windows. Version 16.0 Spss company Inc., Chicago, 11, USA., p.444.

Tserennadmid, R., Takó, M., Galgóczy, L., Papp, T., Pesti, M., Vágvölgyi, C. and Krisch, J. (2011) Anti-yeast activities of some essential oils in growth medium, fruit juices and milk. International *Journal of Food Microbiology,* **144**, 480–486. DOI:10.1016/j.ijfoodmicro.2010.11.004

Vera, R. and Chane-Ming, J. (1999) Chemical composition of the essential oil of marjoram (*Origanum majorana* L.) from Reunion Island. *Food Chemistry,* **66**, 143-145.https://www. academia.edu/34289779/

Viuda-Martos, M., Mohamady, M.A., Fernández-López, J., Abd ElRazik, K.A., Omer EA.Pérez-Álvarez, J.A. and Sendra, E. (2017) *In vitro* antioxidant and antibacterial activities of essentials oils obtained from Egyptian aromatic plants, 22, 1715-1722 https://doi.org/10.1016/j. foodcont.2011.04.003

Viuda-Martos, M., Navajas,Y.R., Zapata, E.S., Fernández-López, J. and Pérez-Álvarez, J.A. (2010) Antioxidant activity of essential oils of five spice plants widely used in a Mediterranean diet, 25, 1319-https://doi.org/10.1002/ffj.1951

Yang, Y.C., Lee, H.S., Clark, J.M. and Ahn, Y.J. (2004) Insecticidal activity of plant essential oils against Pediculus humanus capitis (*Anoplura*: *Pediculidae*). *Journal of Medical Entomology,* **41**, 699–704.https://doi.org/10.1603/0022-2585-41.4.699

Zaky, W.M., Kassem, J. and Abbas, H.M., Mohamed, S.H.S. (2013) Evaluation of salt-free labneh quality prepared using dill and caraway essential oils. *Life Science Journal,* **10**, 3379–3386.http://www. lifesciencesite.com