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RESEARCH ARTICLE

Effect of Lettuce, Marjoram and Cumin Essential Oils on the Quality and Shelf Life of Minced Meat during Refrigerated Storage

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Abstract

Essential oils (EOs) can improve the shelf life of foods due to its antimicrobial and antioxidant properties in addition to being natural flavoring agents. Nonetheless, very little EOs approaches depending on EOs utilization have been introduced by the food industry until now. In this study, the effect of certain EOs such as lettuce (*Lactuca sativa L.*), marjoram (*Origanum majorana L.*) and cumin (*Cuminum cyminum*) at a concentration of 2% on the chemical, bacterial quality and sensory properties of minced meat was investigated, as well as their capacity to extend the shelf life of minced meat during cold storage at 4°C for 12 days. The obtained results showed that oil-treated samples indicated significantly lowering values *($p<0.05$)* for chemical, bacterial assessment, and improving sensory properties than untreated (control) ones. In addition, cumin and marjoram EOs had the greatest impact followed by lettuce oil. Therefore, the studied EOs with special reference to 2% cumin oil could be used as an alternative option to synthetic chemical substances to eliminate the spoilage bacteria, prevent lipid oxidation, and consequently extend the shelf life of minced meat.

Keywords: Cumin oil, Lettuce oil, Marjoram oil, Minced meat quality, Shelf life.

Introduction

Meat and meat products have a unique nutrient value, supplying human with high-quality animal proteins, essential amino acids, fatty acids, minerals and vitamins [1]. On the other hand, meat is highly perishable and provides an appropriate environment for growth of pathogenic and spoilage microorganisms. Since the shelf life of meat and meat products generally depends on the degree of its microbial contamination, it was important for food technologists to improve the keeping quality, reduce or eliminate spoilage and pathogenic agents in meat [2].

Although the chemical preservatives employed in the food industry had certain advantages, they also had some problems with a harmful cumulative effect. Therefore, the recent approaches in food technology focus on finding not only safe and natural biocide, but also being an alternative for the chemical preservatives. Therefore, the researchers are aiming at natural antimicrobial agents as these agents can control the microbial burden, remove pathogens, improve the food shelf life and overcome the disadvantages of chemical substances [3].

Essential oils (EOs) are natural, aromatic oily liquids derived from all the plant parts by various methods [4]. They display antiviral, antibacterial, antifungal, anti-toxic, antiparasitic and insecticidal properties [5]. These natural substances are generally recognized as safe (GRAS), inhibiting lipid oxidation in foods and thus promises to provide natural food additives for food products. Consequently, EOs used for food preservation can counteract various Gram-positive and Gram-negative pathogens [6–8].

Today, lettuce consumption is widespread worldwide owing to its high nutritional value and medicinal importance. Lettuce EO is the most important source of antioxidant such as

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carotenoids (b-carotene and lutein), vitamins E and C, fiber, and phenolic compounds that are considered to play a key role in disease prevention by preventing low-density lipoprotein oxidation [9,10]. Lettuce oil is also considered as a good source of polyunsaturated fatty acids, vitamin C, phenolic compounds, and fiber content [11]. In addition, the tendency towards lettuce oil is worthwhile in the treatment of numerous disorders such as indigestible stomach diseases, bronchitis and urinary tract infections [12], and the reduction of subsequent diabetes complications [13].

Marjoram (*Origanum majorana L.*) essential oil is belonging to the family Lamiaceae that possesses a broad inhibitory spectrum against a range of Gram-negative, Gram-positive bacteria and yeasts [14]. Marjoram EO is commercially, used as a spice, as well as traditionally used for the treatment of asthma, indigestion, headache, rheumatism, dizziness, migraine and gastrointestinal disorders [15].

Cumin (*Cuminum cyminum*) is one of the most commonly used spices. Cumin seeds are popular as aromatic herbs and food spices. It has a powerful antimicrobial and antioxidant activity therefore it is recommended for use in food industry [16,17]. It is also used as a stimulant, a carminative, an astringent in cases of indigestion, flatulence and diarrhea in traditional and veterinary medicine [18].Therefore, the aim of the present work was to assess the impact of lettuce, marjoram and cumin essential oils on the quality and shelf life of minced meat under refrigerated conditions.

Materials and Methods

Preparation of samples

A total of 3 kg of fresh meat was purchased on the day of slaughter from local butcher shop in Zagazig city, Sharkia Governorate, Egypt. Beef was minced and immediately transferred in sterile bags to the meat hygiene and technology laboratory at the Food Control Department, Faculty of Veterinary Medicine, Zagazig University. However, the three EOs used in this study; lettuce oil *(Lactuca sativa L.),* cumin oil *(Cuminum cyminum L.)* and marjoram oil *(Origanum majorana L.)* were purchased from the unit of Squeeze and Extraction of medicinal and aromatic oils in the National Research Center, Dokki, Giza, Egypt.

Minced meat was divided into four groups, including untreated group (control), and three treated groups. For the three treated groups, samples (250 g of each) were individually mixed with marjoram, lettuce and cumin essential oils at concentration of 2% (2 ml of each oil per 100 g of minced meat). All groups were separately packed in polyethylene bags and stored at 4°C. Samples from each group were subjected to sensory, chemical and bacteriological examination every three days over a period of 12 days (trial duration).

Sensory Evaluation

Sensory evaluation was performed by a panel of seven judges consisting of faculty staff members and postgraduate students in the Faculty of Veterinary Medicine, Zagazig University at zero, 3rd, 6th, 9th, and 12th day of refrigerated storage .A 9-point descriptive scale (Excellent, 9; Very very good, 8; Very good, 7; Good, 6; Medium, 5; Fair, 4; Poor, 3; Very poor, 2; Very very poor, 1) was used to evaluate the overall acceptability according to Pearson and Tauber [19].

Physicochemical analyses

The pH values were recorded by using a pH meter as described by Defreitas *et al.* [20]. The total volatile nitrogen (TVN) was measured according to the procedure of Food and Agriculture Organization "FAO" [21]. Measurement of the thiobarbituric acid (TBA) value was performed according to Pikul *et al.* [22].

Bacteriological analysis

Ten grams from each of treated and untreated samples were aseptically homogenized in 0.1% sterile peptone water (90 mL) in a Stomacher (Seward, BA6021, UK) for 1 min. One milliliter of the original homogenate was transferred into a sterile test tube containing 9 mL of 0.1% sterile peptone water solution then appropriate serial dilutions were carried out. For the total aerobic plate count [23]; One milliliter of each serial dilution was cautiously transferred into sterile, duplicate, properly labelled Petri dishes, and carefully mixed with approximately 15 mL of previously prepared plate count agar (45±1°C). After solidification, both control and inoculated plates were incubated at 37°C for 48 h. A volume of 0.1 mL from each prepared dilution was evenly spread into duplicated plates of Violet red bile glucose agar (VRBGA) and then incubated at (37°C for 24 h) for Enterobacteriaceae counts [24]. All media for the bacteriological analyses were purchased from HiMedia Laboratories, Mumbai, India. The results were expressed as the logarithm of the colony forming units per gram (log CFU/g).

Statistical Analysis

Data of chemical and bacteriological analyses were subjected to analysis of variance (One way ANOVA) using the SPSS software package, version 20 (SPSS Inc., Chicago, Ill). The comparison of means among the groups was performed with Duncan's multiple range tests. Results were reported as mean values ± standard errors (SEs) and significance was considered at ($p < 0.05$).

Results

The sensory evaluation results of oil-treated and control minced meat samples during zero, 3rd, 6th, 9th, and 12th day of refrigerated storage are represented in Table 1. The sensory attributes of minced meat samples during storage at 4 ºC were improved with the addition of lettuce, marjoram and cumin essential oils. Generally, samples treated with cumin oil 2% revealed the highest sensory scores in comparison with the untreated ones, while the marjoram and lettuce oil-treated samples showed a less enhancement.

Table 1: Sensory characteristics of control and oil-treated minced meat samples during cold storage at 4 °C

Examined Groups	Mean sensory scores				
	Zero day	**3rd day**	**6th day**	**9th day**	**12th day**
Control	Excellent	Fair	Poor	Very poor	Very very poor
Lettuce oil 2%	Excellent	Good	Medium	Fair	Poor
Marjoram oil 2%	Excellent	Very good	Good	Medium	Fair
Cumin oil 2%	Excellent	Very very good	Very good	Good	Medium

Table 2: Changes in pH, total volatile nitrogen (TVN) and thiobarbituric acid (TBA) values (Mean ± SE) of examined minced meat during cold storage at 4 °C

Chemical parameters	Storage period	Control samples	Essential oil-treated samples		
			Lettuce oil 2%	**Marjoram oil 2%**	**Cumin oil 2%**
pH	Zero day	5.68 ± 0.01^{a}	5.66 ± 0.01^{ab}	5.65 ± 0.01^{bc}	5.62 ± 0.01^{c}
	3rd day	6.73 ± 0.01^{a}	5.90 ± 0.01^{b}	5.79 ± 0.02^{bc}	5.73 ± 0.01^{c}
	6th day	6.96 ± 0.04^{a}	6.11 ± 0.02^{b}	5.94 ± 0.01^{c}	5.85 ± 0.01^{d}
	9th day	7.42 ± 0.02^{a}	6.25 ± 0.01^{b}	6.03 ± 0.01^{c}	5.96 ± 0.03^{d}
	12th day	7.79 ± 0.01^{a}	6.34 ± 0.01^{b}	6.18 ± 0.03^{c}	6.07 ± 0.01^{d}
TVN (mg / 100 g)	Zero day	2.40 ± 0.03^{a}	2.29 ± 0.02^{a}	2.26 ± 0.01^{a}	2.18 ± 0.01^{a}
	3rd day	19.03 ± 0.07^{a}	7.82 ± 0.62^{b}	6.95 ± 0.48^{c}	6.61 ± 0.15^{d}
	6th day	27.58 ± 0.65^{a}	11.79 ± 0.32^{b}	10.02 ± 0.36^{c}	8.99 ± 0.44^{d}
	9th day	33.89 ± 0.71^{a}	16.15 ± 0.67^{b}	14.72 ± 0.59^{c}	13.47 ± 0.56^{d}
	12th day	41.38 ± 0.49^{a}	20.53 ± 0.39^{b}	18.29 ± 0.89^{c}	17.06 ± 0.65^{d}
TBA (mg / kg)	Zero day	0.05 ± 0.02^{a}	0.04 ± 0.01^{a}	0.04 ± 0.01^{a}	0.03 ± 0.01^{a}
	3rd day	0.84 ± 0.08^{a}	0.29 ± 0.04^{b}	0.22 ± 0.04^{c}	0.17 ± 0.02^{d}
	6th day	1.09 ± 0.07^{a}	0.51 ± 0.03^{b}	0.38 ± 0.03^{c}	0.32 ± 0.05^{d}
	9th day	1.38 ± 0.09^{a}	0.76 ± 0.06^{b}	0.63 ± 0.02^{c}	0.55 ± 0.03^{d}
	12th day	1.75 ± 0.10^{a}	0.89 ± 0.04^{b}	0.77 ± 0.02^{c}	0.72 ± 0.04^{d}

Means carrying different superscript letters within the same row are significantly different ($P < 0.05$).
According to the Egyptian standards [30], the total volatile nitrogen (TVN) and thiobarbituric acid (TBA) value in raw minced meat must be less than 20 mg/ 100g and 0.9 mg malonaldhyde /kg, respectively.

Data illustrated in Table 2 shows the changes of pH values in the control and oil-treated samples during cold storage at 4 ºC. The mean pH values in control samples was 5.68, 6.73, 6.96, 7.42 and 7.79 on zero, 3rd, 6th,9th, and 12th day of storage period, respectively. The lowest amounts of pH at zero time for lettuce, marjoram and cumin oil-treated samples were respectively 5.66, 5.65, and 5.62, while, the highest amounts were 6.34, 6.18, and 6.07, respectively on the 12th day of storage period.

Regarding the changes in chemical quality of control and oil-treated samples, the mean TVN values in control sample were respectively, 2.40, 19.03, 27.58, 33.89 and 41.38, however, the samples treated with lettuce oil recorded TVN values of 2.29, 7.82, 11.79, 16.15 and 20.53, in that order on zero, 3rd, 6th,9th, and 12th day of storage. The recorded values were 2.26, 6.95, 10.02, 14.72 and 18.29 by using marjoram oil 2% on the scheduled examination days, whereas, cumin oil-treated samples recorded TVN values of 2.18, 6.61, 8.99, 13.47 and 17.06, correspondingly on zero, 3rd, 6th,9th, and 12th day of storage. On the other hand, the recorded TBA values of control samples at zero increased from 0.05 to 1.75 mg malonaldhyde/kg at the 12th day of storage. The highest respective amounts of TBA at zero time for lettuce, marjoram and cumin oil-treated samples were 0.89, 0.77, and 0.72, while the lowest amounts were 0.04, 0.04, and 0.03 mg malonaldhyde/kg, respectively on the 12th day of storage period.

The effect of EOs on the bacteriological quality (aerobic plate count and Enterobacteriaceae count) of minced meat samples along storage period revealed that the mean count of aerobic plate count (APC) in control group was 5.84±0.42, 6.68±0.32, 7.92±0.26, 8.94±0.64 and 9.57±0.94 log CFU/g at zero, 3rd, 6th, 9th and 12th day of storage, respectively. By using lettuce oil 2%, the respective mean counts of APC in samples was 5.84±0.42, 6.29±0.11, 6.96±0.00, 7.19±0.17, 7.97±0.18 log CFU/g at zero, 3rd, 6th,9th, and 12th day of storage period. However, APC values in cumin oil-treated group were 5.84±0.42, 6.17±0.51, 6.52±0.27, 6.64±0.15and 6.96±0.10 log CFU/g, while the respective mean values of minced meat treated with marjoram 2% were 5.84 ± 0.42, 6.22±0.39, 6.76±0.09, 6.94±0.02 and 7.19±0.06 log CFU/g at zero, 3rd, 6th,9th, and 12th day of storage period (Table 3).

Table 3: Changes in bacterial count (log CFU/g) of examined minced meat during cold storage at 4 °C.

Chemical parameters	Storage period	Control samples	Essential oil-treated samples		
			Lettuce oil 2%	Marjoram oil 2%	Cumin oil 2%
APC	Zero day	5.84 ± 0.42[a]	5.84 ± 0.42[a]	5.84 ± 0.42[a]	5.84 ± 0.42[a]
	3rd day	6.68 ± 0.32[a]	6.29 ± 0.11[b]	6.22 ± 0.39[c]	6.17 ± 0.51[d]
	6th day	7.92 ± 0.26[a]	6.96 ± 0.00[b]	6.76 ± 0.09[c]	6.52 ± 0.27[d]
	9th day	8.94 ± 0.64[a]	7.19 ± 0.17[b]	6.94 ± 0.02[c]	6.64 ± 0.15[d]
	12th day	9.57 ± 0.94[a]	7.97 ± 0.18[b]	7.19 ± 0.06[c]	6.96 ± 0.10[d]
TEC	Zero day	4.57 ± 0.25[a]	4.57 ± 0.25[a]	4.57 ± 0.25[a]	4.57 ± 0.25[a]
	3rd day	5.24 ± 0.64[a]	4.87 ± 0.36[b]	4.62 ± 0.51[d]	4.69 ± 0.30[c]
	6th day	5.98 ± 0.36[a]	5.06 ± 0.70[b]	4.90 ± 0.96[c]	5.04 ± 0.89[b]
	9th day	6.46 ± 0.01[a]	5.62 ± 0.37[b]	5.53 ± 0.87[c]	5.60 ± 0.30[b]
	12th day	7.13 ± 0.01[a]	5.82 ± 0.02[b]	5.79 ± 0.42[c]	5.81 ± 0.25[bc]

Means carrying different superscript letters within the same row are significantly different ($P < 0.05$).
Results are (mean±SE) of three independent experiments.
APC = Total aerobic plate count TEC= Total Enterobacteriaceae count

Concerning the total Enterobacteriaceae count (TEC), the initial bacterial count was 4.57 ± 0.25 at zero day. On subsequent storage intervals, the control group exhibited a higher TEC that valued as 5.24 ± 0.64, 5.98 ± 0.36, 6.46 ± 0.01 and 7.13±0.01 log CFU/g at 3rd, 6th, 9th and 12th day, respectively. The count of the TEC in the group treated with marjoram oil

2% was 4.57 ± 0.25, 4.62 ± 0.51, 4.90 ± 0.96, 5.53 ± 0.87 and 5.79 ± 0.42 log CFU/g at zero, 3rd, 6th, 9th and 12th day, respectively. When comparing the result of the control group over the whole period with the other treated groups, it was concluded that marjoram oil 2% has the best efficacy until the end of storage (12th day). Therefore, this result confirmed the effectiveness of the marjoram oil. Meanwhile, cumin oil 2% had considerable effectiveness in decreasing the TEC. Throughout the storage interval, the respective TEC in this group were 4.57 ± 0.25, 4.69 ± 0.30, 5.04 ± 0.89, 5.60 ± 0.30 and 5.81 ± 0.25 log CFU/g at zero, 3rd, 6th, 9th and 12th day of storage. Afterward, lettuce oil 2%, which has the least potency on the initial count of TEC during the storage for 12 days.

Discussion

The organoleptic examination is usually the main guide of the quality from the consumers' perspective. Thus, it is advantageous to compare sensory evaluation for untreated and treated meat samples. The improvement of sensory attributes of minced meat samples during refrigerated storage (4ºC) by using cumin, marjoram, and lettuce oils compared with the control samples over the storage period were in accordance with Seydim and Sarikus [25] who found that the sensory properties of food could be modified by addition of EOs. Interestingly, samples containing cumin oil 2% showed the highest improvement of sensory characteristics followed by marjoram oil, while the samples treated with 2% of lettuce oil demonstrated lower enhancement. These results are comparable with Skrovankova et al. [5] and Mohamed and Mansour [14] who reported that some plant EOs such as cumin and marjoram oils comprise antioxidant substances that improve meat color and flavor. Cumin can also be added for both nutritional purposes and preservation of meat due to the high phenolic content and good antioxidant activity [26,27].

The pH measurement is of great importance in order to determine the shelf life and quality of meat. It is evident that the pH value was greater for the control sample at zero time. This rise in pH values may be attributed to the microbial spoilage that causes protein breakdown leading to the accumulation of alkaline compounds. The oil-treated samples exhibited lowering in pH values than control samples, which may be explained by the antimicrobial activity of added oils. However, the pH values followed an increasing trend throughout the storage period in control and all treated samples. There was a significant effect ($p < 0.05$) of all treated in comparison with the control samples. The obtained results were corresponded with El-Desouky et al. [28] who suggested that the addition of cumin and marjoram oils to minced meat could decrease the pH values of treated samples during cold storage than the control group. These findings may be due to antimicrobial activity of the active components of cumin and marjoram EOs that include cumaldehyde, cymene, limonene and linalol [16,29].

Concerning the mean values of total volatile nitrogen (TVN), the control samples showed the highest incremental rate compared to other treatments and had TVN about 27.58 mg/100g at 6th day of storage. However, the TVN value of about 20 mg TVN/100g raw samples indicates minced meat spoilage according to the Egyptian Standards [30]. The samples treated with cumin and marjoram oils showed the lowest incremental rate compared to other groups. With the progression of cold storage, the oil-treated samples led to a significant reduction ($P < 0.05$) of TVN values as compared to control ones. This is may be due to the effectiveness of these EOs on microorganisms. The progressive increase in TVN during cold storage might be attributed to the breakdown of nitrogenous substances because of microbial activity and any autolytic enzymes found naturally in meat tissues. The achieved results seemed comparable to the results of El-Desouky et al. [28] and Shaltout et al. [31] who evaluated the antimicrobial and antioxidant properties of certain EOs.

With regard to the values of thiobarbituric acid (TBA) as a lipid oxidation indicator, it could be noted that at zero time there were no significant effects ($P > 0.05$) in the level of thiobarbituric acid of all treatments. The thiobarbituric acid values of all treatments increased significantly ($P < 0.05$) as the storage period progressed. However, the lowest TBA value (0.72 mg malonaldhyde/kg) was recorded for 2% cumin oil-treated samples, meanwhile the largest increase in TBA value was reported for control samples (1.75 mg malonaldhyde/kg) at the end of experiment (day 12). The results obtained were concurred with that obtained by Shaltout et al. [31] who found that TBA values of minced meat treated with EOs were significantly lower than control samples ($P< 0.05$), suggesting that spice extracts were extremely safe and highly protective against lipid oxidation in raw minced meat under refrigerated conditions. In general, the increase of TBA levels reported in oil-treated samples were less than that found in the control samples that might be explained by the antioxidant activity due to the total phenols and phenolic compounds found in the added EOs [32–35]. TBA results for oil-treated samples after 12 days of storage were below the permissible threshold (< 0.9 mg malonaldhyde/kg for minced meat) set by the Egyptian standards [30].

According to the data of bacteriological analyses, control sample always had high APC and TEC when compared with oil-treated samples. Moreover, sample treated by cumin oil had low APC whereas marjoram oil-treated sample had the best efficacy on TEC when compared with other treated samples during subsequent cold storage. According to ANOVA analysis, there was a significant difference in bacterial counts among untreated and oil-treated groups ($P< 0.05$). In this concern, according to the Egyptian standards [30], the shelf life of minced meat treated with cumin and marjoram oils was 12 days except the sample treated with 2% lettuce oil, which had shelf life until 9 days, corresponding only 6 days for control sample. These findings were similar to the results achieved by El-Desouky et al. [28] who indicated a reduction in APC in refrigerated minced beef owing to the antibacterial impact of marjoram and cumin oils. Moreover, they found that marjoram oil at 2 and 3% showed the bactericidal effect on the third and sixth days, respectively. Meanwhile, cumin oil had bactericidal effect at 2 and 3% for sixth and seventh days, respectively.

Due to increased cell membrane permeability and more easy lipid membrane solubility, EOs were more efficient at low temperatures [36]. Cumin and marjoram EOs have been shown to be effective against a broad spectrum of bacteria, yeast and mold species [26,37–40]. The main components of marjoram and cumin EOs that include cumaldehyde, cymene, limonene and linalol are therefore responsible for their antimicrobial activity [41,42]. However, marjoram oil is distinguished by a varied pattern in its composition due to several variables including the species, growth stages, herb origins, and climatic conditions [43]. These components may penetrate the inside of the cell and interact with intracellular sites that are critical to bacterial activities [44] and prevent the function of glucosyl transferase enzyme accountable for bacteria adhesion to host sites [45]. Additionally, the Lactuca sativa extract has exhibited strong efficacy against free radicals and oxidative damage to major biomolecules [32]. Scientific evidence about the biological activities of lettuce oil including antimicrobial, antioxidant, and neuroprotective activities has been documented in several reports [12, 46–48]. These variations in bacterial counts may be attributed to the complex chemical composition, structure, as well as functional groups of EOs are responsible for their wide range of antimicrobial activity [49,50].

Conclusion

Marjoram oil, cumin oil and lettuce oil can be used as natural preservatives with a remarkable antibacterial and antioxidant activities. The physicochemical criteria especially TVN and TBA were allied with the results of microbiological assessment. The result of this study confirmed the role of investigated oils particularly cumin oil during the storage in maintaining the meat quality and extending its shelf life depending on the sensory evaluation and the values of pH, APC and TEC. Therefore, it is possible to use them in food as natural preservatives instead of the chemicals without compromising the sensory attributes in addition to keeping them in good microbiological and chemical quality.

Conflict of interest

There is no conflict of interest to declare.

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الملخص العربي

تأثير زيوت الخس والبردقوش والكمون على جودة ومدة حفظ اللحوم المفرومة أثناء الحفظ بالتبريد

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يمكن للزيوت الأساسية (EOs) تحسين فترة حفظ الأغذية بسبب خصائصها كمضادات للميكروبات ومضادات للأكسدة ولما لها من نكهات طبيعية. على الرغم من ذلك، فقد تم الاعتماد على استخدام الزيوت الطبيعية بصورة ضئيلة في صناعة المواد الغذائية حتى الآن. في هذا البحث، تم دراسة تأثير بعض الزيوت الأساسية مثل زيت الخس (*Lactuca sativa L.*) وزيت البردقوش (*Origanum majorana L.*) وزيت الكمون (*Cuminum cyminum*) بتركيز (٢٪) على الخصائص الحسية والجودة الكيميائية والبكتيرية للحوم المفرومة، وكذلك قدرتها على إطالة مدة الحفظ أثناء التخزين البارد في ٤ درجات مئوية لمدة ١٢ يوماً. أظهرت النتائج المتحصل عليها أن العينات المعالجة بالزيوت أدت إلى تحسين الخواص الحسية وكذلك انخفاض معنوي في قيم التحليل الكيميائي والبكتيري مقارنة بالعينات (الضابطة) غير المعالجة. بالإضافة إلى ذلك، كان زيت الكمون الأقوى تأثيراً يليه زيت البردقوش والخس. لذلك يمكن استخدام الزيوت الأساسية قيد الدراسة وبخاصة زيت الكمون تركيز ٢ % كخيار بديل للمواد الكيميائية الاصطناعية للقضاء على البكتيريا المفسدة ومنع أكسدة الدهون وبالتالي إطالة مدة حفظ اللحوم المفرومة.