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Improving The Quality Characteristics Of Beef Burger By Adding Thyme Essential Oil And Jojoba Oil

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ABSTRACT

The present study aimed to investigate the effect of addition of different concentration of thyme essential oil (0.02, 0.04, 0.06%), and jojoba oil (1%) on the quality, and stability of beef burger. The obtained results indicated that the best sensory quality were attained at the highest thyme essential oil concentration (0.06%), while slight improvement in sensory quality could be noticed in samples treated with jojoba oil (1%) as compared with control samples. The storage time significantly affected by the TBA values, as treated samples with thyme essential oil and jojoba oil showed significant lower values of TBA compared with the control samples. Treated samples with (0.04 ; 0.06%) thyme essential oil (E.O.) and jojoba oil (1%) revealed significant reduction in Enterobacteriacae, Staphylococci, total mould, Proteolytic bacteria and Lipolytic bacterial count at zero time and during storage time compared with control samples. thyme essential (0.04 ; 0.06%) oil and jojoba oil (1%) revealed significant improvement in beef burger quality with superior quality of thyme essential oil 0.06% treated samples.

INTRODUCTION

Modern trends towards production of pre-cooked, refrigerated ready-to-eat meat products have made the control of lipid oxidation increasingly important. Processed meat which are minced and cooked are susceptible to accelerate lipid oxidation, which is one of the main factors responsible for loss of quality of meat products besides a microbiological deterioration *(1,2)*. Therefore, much attention in recent years has been focused on the use of extracts from herbs and spices to improve sensory characteristics, retard lipid oxidation and extend the shelf life of meat products *(3)*.

The antimicrobial activity of plant oils and extracts has formed the bases of many applications, including processed meat preservation, pharmaceuticals, alternative medicine and natural therapies *(4-10)*.

Thyme is traditionally used as flavouring agents in meat and meat products *(11,12)*. Recently, its essential oil is known to include carvacolo, borneol, geraniol, but most importantly, thymol. Thyme essential oil also contains a variety of flavonoids, including apigenin, naringenin, luteolin, and thymonin *(13,14)*. These flavonoids increase thyme antioxidant capacity *(15)*. The volatile oil components of thyme have also been known to have antimicrobial activity against different bacteria and fungi species. *Staphalococcus aureus, Bacillus subtilis, Escherichia coli and Shigella sonnei* are among bacterial species against which thyme has been shown to have antibacterial activity *(16,17)*. The thyme essential oil (500ppm) in vitro possess strong antimicrobial properties towards food born bacteria and fungi, including *Aspregillus Flavous, A. parasiticus, A. ochracus* and *fusarium moniliforme (10,18)*. Although essential oils are well documented *in vitro* as natural antimicrobial, some food components decrease the antimicrobial effects of the essential oil *(19-21)*.

Jojoba oil is the liquid wax produced in the seed of the Jojoba *(Simmondsia chinensis)* plant, the oil constitutes approximately 50% of the jojoba seed by weight *(22)*. It is a straight chain wax ester of 36 to 46 carbon atoms in length, each molecule consists of a fatty acid and a fatty alcohol joined by an ester bond *(23-25)*. Jojoba oil is not affected by prolonged storage or changes in temperature when compared with other vegetable oils, nor does it facilitate microbial growth *(23,24)*. Recently,

there has been renewed interest in its food potential *(26)*, as a vegetable and salad oil.

The questions concerning the safety of synthetic compounds have encouraged an increase interest in the use of natural substances and request for more detailed studies of plant resources and essential oils *(10)*. Therefore the objective of this study was to evaluate the effectiveness of thyme essential oil and jojoba oil for controlling sensory, physico-chemical and microbiological quality of beef burger during two weeks of refrigeration storage at 5°C.

MATERIAL AND METHODS

Extraction of thyme essential oil the extraction of thyme E.O., had been done in the department of Biochemistry, Faculty of Agriculture, Cairo University by hydro-distillation of dried plant leaves followed by evaporation under vacuum *(27)*. While jojoba oil (jojoba O) was obtained by direct extraction of jojoba seeds without refining.

Beef burger production was carried out in agreement with **(ESS) Egyptian standard specification** *(28)* as follows: Twenty kilograms of fresh locally produced meat was purchased from butcher shop at Giza market and directly transported to the laboratory in an ice box to be minced in electrical mincer (4mm). Minced meat, fat, soybean, black pepper, salt and water were thoroughly mixed for five minutes and divided into five portions. Where, first portion was used as control and the other portions were either mixed with thyme essential oil (0.02%), (0.04%), (0.06%), or jojoba oil (1%) respectively. The obtained pastes were formed into 50g beef burger using cardboard meat box, packed in foam plates and stored at refrigerator shelf at 5°C. Three samples from each treatment were examined every three days for two weeks as follows:

Sensory quality

Odour, Colour and overall acceptability of raw beef burger samples were assessed by the five well trained panelists to evaluate their sensory characteristics. Sensory scheme ranged from 0 (very bad) to 8 (very good) following the procedures of **AMSA** *(29)* was applied.

Physico-chemical characteristics

Thiobarbituric acid (TBA)-value (mg malonldhyde/kg) was estimated by distillation technique using 2- Thiobarbituric acid 0.02 M (sigma) as described by **FAO** *(30)*.

pH determination: 10 g of each sample was homogenized with 20 ml of distilled water and pH value was determined using pH meter (suntex-T-s-l) with calibrated probe type (Ingold), *(31)*.

Microbiological Quality

Samples homogenate and Serial decimal dilutions were prepared following the recommendation cited previously *(32)*. The serial dilutions of each sample were investigated for count of Enterobacteriacae on violet red bile decstrose agar, Staphylococci on Barid Parker agar, total mould on Sabaured Dextrose agar, Proteolytic bacteria using 10% Skim milk agar and Lipolytic bacteria using Tributyrine agar applying the techniques described by **APHA** *(33)*.

Statistical analysis

The results are presented as the mean of three replicates with standard deviation. The statistical analysis was computed using analysis of variance procedure *(34)*, the significant mean differences between treatment means were separated by Duncan's Multiple Range Test *(35)*.

RESULTS AND DISCUSSION

Sensory evaluation

Fig.1. represents excellent odour, colour and overall acceptability for all examined samples for the first three days of storage. Decline of odour, colour and overall acceptability were noticed in the control samples at the 6th day with rejectionable characteristics at the 9th. While thyme EO treated samples revealed acceptability for 12 and 15 days for 0.02% and 0.04, 0.06% respectively.

It is worth to mention that a significant improvement of odour and overall acceptability of investigated samples were observed at zero time due to addition of thyme essential oil, this could be referred to its aromatic effect ***(11,12)***. Furthermore, the highest thyme E.O. concentration (0.06%) showed the best sensory quality. On the other hand, slight improvement in sensory characteristics could be noticed in samples treated with jojoba oil as compared with control samples. Addition of thyme E.O. and jojoba oil to beef burger formulation showed extension storage time than control samples by six days for thyme E.O. (0.04, 0.06%) and jojoba oil (1%).

TBA-value

TBA-value is valuable test in determination of lipid oxidation ***(36)***. Table 1. indicates a gradual increase of TBA-values of all examined samples during storage time. While no significant difference ($P \leq 0.05$) among treated samples and control at zero time, which indicates that oxidative deterioration of beef burger lipid occurred during storage time.

At the third day of storage significant reduction ($P \leq 0.05$) of TBA-values of thyme E.O. and jojoba oil treated beef burger samples was obvious. Moreover, an inverse trend was observed with addition of thyme E.O., where, the lowest TBA-values were recorded in samples containing 0.06% followed by 0.04 and 0.02% respectively. These results could be attributed to the high antioxidant effect of flavonoids contents (apigenin, naringenin, luteolin, and thymonin) including thyme E.O., ***(13-15)***.

Regarding jojoba oil treated beef burger, their TBA-values were significantly lower than that of control samples, however, these values are significantly higher than samples that treated with 0.04 and 0.06% thyme E.O. Such findings may be attributed to the stringent antioxidant effect of thyme E.O. which is related to the scavenger nature of its flavonoids content. In contrast the antioxidant effect of jojoba oil which is referred to its molecular stability ***(23,24)***.

pH-value

pH- value of examined samples (Table 2) reveals that no significant difference ($P \leq 0.05$) could be established among control, thyme E.O. and jojoba oil treated beef burger samples. Such finding could be referred to the low quantity of oil added in the burger formulation and due to buffering effect of meat ***(37)***.

Microbiological quality

Microbial quality of beef burger was assessed through estimation of Enterobacteriacae, Staphylococci, proteolytic, lipolytic bacterial and total mould counts (Tables 3-7). Whereas microbial load could have been implicated for public hazard.

In general, addition of thyme E.O. and Jojoba oil to beef burger formulation significantly minimized ($P \leq 0.05$) microbial load of examined samples. At zero time enterobacteriacae, staphylococci, proteolytic, lipolytic bacteria and total mould counts of control samples were significantly higher ($P \leq 0.05$) than the other treated samples and continued for the end of the experiment. Meanwhile, microbial load of samples treated with jojoba oil was significantly higher than that of samples treated with different concentration of thyme E.O. These results may emphasize the antimicrobial activity of phenolic compounds in thyme E.O. The antimicrobial activities of thyme EO have been

attributed to some volatile constituents in the oil *(13.14)*.

Considering the antimicrobial effects of different thyme E.O. concentrations, the data given in Tables 3-7 indicated that 0.04 and 0.06% concentrations significantly minimized microbial load than control, 0.02% thyme and jojoba oil treated samples. As 0.04 and 0.06% thyme treated samples revealed 4.6, 4.11, 2.3, 3.09, 2.22 and 5.9, 4.47, 3.3, 3.39, 3.4 log cfu/g reduction in counts of *enterobacteriacae, staphylococci, mould, proteolytic* and *lipolytic bacterial* than control samples respectively at 12th day of storage.

Conclusion

From the obtained results, it could be concluded that addition of thyme E.O. to beef burger formulation at concentration of 0.04 and 0.06% not only minimize lipid oxidation but also improves its sensory characteristics and enhance the wholesomeness of the product during two weeks of refrigerated storage. Jojoba oil incorporation in beef burger formulation also showed lower TBA-value and microbial load than control samples. Moreover, beef burger samples treated with thyme E.O. 0.06% were superior in quality to other treated samples.

Table 1. TBA- value of examined samples.

Experimental period (day)	Treatment				
	Control	Thyme 0.02%	Thyme 0.04%	Thyme 0.06%	Jojoba 0.1%
Zero	0.257 ± 0.009 a	0.257 ± 0.009 a	0.257 ± 0.009 a	0.257 ± 0.009 a	0.257 ± 0.009 a
3rd	0.298 ± 0.011 a	0.271 ± 0.010 b	0.264 ± 0.010 b	0.261 ± 0.009 b	0.264 ± 0.010 b
6th	0.495 ± 0.018 a	0.323 ± 0.012 bc	0.302 ± 0.011 c	0.274 ± 0.010 d	0.349 ± 0.013 b
9th	0.712 ± 0.026 a	0.420 ± 0.015 c	0.325 ± 0.012 d	0.318 ± 0.011 d	0.488 ± 0.018 b
12th	0.930 ± 0.033 a	0.511 ± 0.018 c	0.386 ± 0.014 d	0.344 ± 0.012 e	0.553 ± 0.020 b
15th	----------	0.670 ± 0.024 b	0.422 ± 0.015 c	0.376 ± 0.014 c	0.626 ± 0.023 b

- Rows with similar letters are not significantly different at (P ≤ 0.05). - Each value represents the mean ± S.D.

Table 2. pH - values of examined samples.

	Treatment				
	Control	Thyme 0.02%	Thyme 0.04%	Thyme 0.06%	Jojoba 0.1%
Zero	5.79 ± 0.208 a	5.71 ± 0.206 a	5.66 ± 0.204 a	5.61 ± 0.202 a	5.65 ± 0.203 a
3rd	6.03 ± 0.217 a	5.85 ± 0.211 a	5.83 ± 0.210 a	5.85 ± 0.211 a	5.90 ± 0.212 a
6th	6. 21 ± 0.221 a	6.09 ± 0.219 a	6.01 ± 0.216 a	6.09 ± 0.219 a	6.08 ± 0.219 a
9th	6.39 ± 0.224 a	6.19 ± 0.223 a	6.11 ± 0.220 a	6.09 ± 0.219 a	6.16 ± 0.222 a
12th	6.53 ± 0.235 a	6.38 ± 0.230 a	6.27 ± 0.226 a	6.26 ± 0.225 a	6.33 ± 0.228 a
15th	-----	6.45 ± 0.232 a	6.40 ± 0.230 a	6.37 ± 0.229 a	6.45 ± 0.232 a

- Rows with similar letters are not significantly different at (P ≤ 0.05). - Each value represents the mean ± S.D.

Table 3. Mean Enterobacteriaceae count log10 cfu /g of examined samples

Experimental period (day)	Treatment				
	Control	Thyme 0.02%	Thyme 0.04%	Thyme 0.06%	Jojoba 0.1%
Zero	3.00 ± 0.108 a	2.69 ± 0.097 b	2.65 ± 0.095 b	2.65 ± 0.095 b	2.52 ± 0.091 b
3rd	4.47 ± 0.161 a	2.65 ± .095 bc	2.69 ± 0.097 b	2.47 ± 0.089 c	2.65 ± 0.095 bc
6th	5.77 ± 0.208 a	3.00 ± 0.108 c	2.65 ± 0.095 d	2.48 ± 0.089 d	3.90 ± 0.140 b
9th	7.30 ± 0.263 a	3.90 ± 0.140 c	3.00 ± 0.108 d	2.48 ± 0.089 e	4.30 ± 0.155 b
12th	8.90 ± 0.320 a	4.69 ± 0.169 c	4.30 ± 0.155 d	3.00 ± 0.108 e	5.32 ± 0.192 b
15th	------	6.30 ± 0.227 b	4.85 ± 0.175 c	3.30 ± 0.119 d	7.24 ± 0.282 a

- Rows with similar letters are not significantly different at ($P \leq 0.05$). - Each value represents the mean ± S.D.

Table 4. Mean Staphylococci count log10 cfu /g of examined samples.

Experimental period (day)	Treatment				
	Control	Thyme 0.02%	Thyme 0.04%	Thyme 0.06%	Jojoba 0.1%
Zero	2.84 ± 0.102 a	2.40 ± 0.086 bc	2.41 ± 0.087 bc	2.30 ± 0.083 c	2.48 ± 0.089 b
3rd	3.69 ± 0.133 a	2.48 ± 0.089 c	2.47 ± 0.089 c	2.30 ± 0.083 c	2.78 ± 0.100 b
6th	4.48 ± 0.161 a	2.95 ± 0.106 c	2.60 ± 0.094 d	2.00 ± 0.072 e	3.47 ± 0.125 b
9th	6.30 ± 0.227 a	3.00 ± 0.108 c	2.70 ± 0.097 d	2.30 ± 0.083 e	3.95 ± 0.142 b
12th	6.95 ± 0.250 a	4.30 ± 0.155 b	2.84 ± 0.102 c	2.48 ± 0.100 d	4.47 ± 0.161 b
15th	----------	5.00 ± 0.180 c	3.48 ± 0.125 d	3.00 ± 0.108 e	6.30 ± 0.227 b

- Rows with similar letters are not significantly different at ($P \leq 0.05$). - Each value represents the mean ± S.D.

Table 5. Mean Total mould count log10 cfu /g of examined samples.

Experimental period (day)	Treatment				
	Control	Thyme 0.02%	Thyme 0.04%	Thyme 0.06%	Jojoba 0.1%
Zero	2.99 ± 0.108 a	2.69 ± 0.097 b	2.70 ± 0.097 b	2.69 ± 0.097 b	2.70 ± 0.097 b
3rd	3.95 ± 0.142 a	2.69 ± 0.097 b	2.70 ± 0.097 b	2.48 ± 0.022 b	2.70 ± 0.097 b
6th	4.30 ± 0.155 a	3.30 ± 0.119 c	2.78 ± 0.100 d	2.48 ± 0.089 e	3.90 ± 0.140 b
9th	5.69 ± 0.205 a	3.85 ± 0.139 c	3.95 ± 0.142 c	2.69 ± 0.097 d	4.60 ± 0.166 b
12th	6.60 ± 0.238 a	5.00 ± 0.180 c	4.30 ± 0.155 d	3.30 ± 0.119 e	6.20 ± 0.223 b
15th	----------	6.60 ± 0.238 b	4.95 ± 0.178 c	3.85 ± 0.139 d	7.30 ± 0.263 b

- Rows with similar letters are not significantly different at ($P \leq 0.05$). - Each value represents the mean ± S.D.

Table 6. Mean Proteolytic count log10 cfu /g of examined samples.

Experimental period (day)	Treatments				
	Control	Thyme 0.02%	Thyme 0.04%	Thyme 0.06%	Jojoba 0.1%
Zero	3.77 ± 0.136 a	2.48 ± 0.089 b	2.48 ± 0.089 b	2.48 ± 0.089 b	2.47 ± 0.089 b
3rd	3.77 ± 0.136 a	2.30 ± 0.083 b	2.48 ± 0.089 b	2.30 ± 0.083 b	2.47 ± 0.089 b
6th	4.00 ± 0.144 a	2.69 ± 0.097 c	2.30 ± 0.083 d	2.69 ± 0.097 c	3.60 ± 0.130 b
9th	4.47 ± 0.161 a	3.30 ± 0.119 c	2.80 ± 0.101 d	2.84 ± 0.102 d	3.95 ± 0.142 b
12th	6.39 ± 0.230 a	4.00 ± 0.144 c	3.30 ± 0.119 d	3.00 ± 0.108 e	4.30 ± 0.155 b
15th	----------	5.30 ± 0.191 b	3.95 ± 0.142 c	3.30 ± 0.119 d	5.60 ± 0.202 a

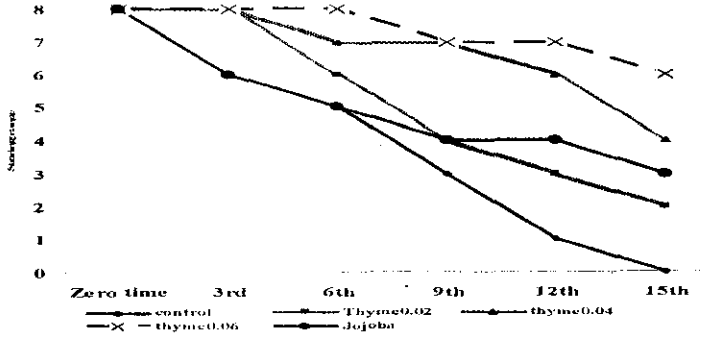
- Rows with similar letters are not significantly different at ($P \leq 0.05$). - Each value represents the mean ± S.D.

Table 7. Mean Lipolytic count log10 cfu /g of examined samples.

Experimental period (day)	Treatments				
	Control	Thyme 0.02%	Thyme 0.04%	Thyme 0.06%	Jojoba 0.1%
Zero	3.00 ± 0.108 a	2.48 ± 0.089 b	2.48 ± 0.089 b	2.48 ± 0.089 b	2.47 ± 0.089 b
3rd	3.30 ± 0.119 a	2.48 ± 0.089 b	2.48 ± 0.089 b	2.00 ± 0.072 c	2.47 ± 0.089 b
6th	3.95 ± 0.142 a	2.78 ± 0.100 c	2.30 ± 0.083 d	2.30 ± 0.083 d	3.47 ± 0.125 b
9th	4.00 ± 0.144 a	3.30 ± 0.119 c	2.70 ± 0.097 d	2.30 ± 0.083 e	3.69 ± 0.133 b
12th	6.00 ± 0.216 a	3.95 ± 0.142 b	3.78 ± 0.136 b	2.60 ± 0.094 c	3.69 ± 0.133 b
15th	---------	5.00 ± 0.180 a	3.78 ± 0.136 c	3.0 ± 0.108 c	4.30 ± 0.155 b

- Rows with similar letters are not significantly different at ($P \leq 0.05$). - Each value represents the mean ± S.D.

Fig.1: Overall acceptability of control and treated samples



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الملخص العربى

تحسين جودة البرجر البقرى بأضافة زيت الزعتر وزيت الجوجوبا

جيهان محمد عبد العزيز – أسامة علي عطا الله –** فاطمة محمد حسن علي
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**قسم الرقابة الصحية على الأغذية – كلية الطب البيطرى – جامعة بنى سويف

تعتبر الزيوت الطيارة من المواد الطبيعية التي تستخدم هذه الأيام كمضاد للأكسدة ومضاد للنمو الجرثومي عند استخدامها في مصنعات اللحوم ، ويهدف هذا البحث إلي دراسة مدي تأثير استخدام زيت الزعتر عند تركيزات ٠,٠٢% ، ٠,٠٤% ، ٠,٠٦% وزيت الجوجوبا (١%) عند خلطها مع مكونات البرجر البقري ودراسة مدي تأثيرها علي الجودة الحسية والكيميائية والميكروبيولوجية.

وقد أوضحت النتائج علي أن أفضل تركيز يمكن استخدامه لزيت الزعتر هو ٠,٠٦% لأنه أدي إلي تحسين الخواص الحسية وأن هناك تأثير بسيط لزيت الجوجوبا علي الجودة الحسية مقارنة بعينات المجموعة الضابطة عند نهاية فترة الحفظ. وقد أوضحت النتائج أيضاً بالنسبة لدرجة تركيز الأيون الهيدروجيني أنه لا توجد فروق معنوية بين العينات المضاف إليها الزيوت وعينات المجموعة الضابطة بينما أظهرت النتائج وجود فروق معنوية بين قيمة حامض الثيوبربتيوريك في العينات المضاف اليها زيت الزعتر وزيت الجوجوبا مقارنة بعينات المجموعة الضابطة. أما بالنسبة لفحص الميكروبيولوجي فقد دلت النتائج علي حدوث إنخفاض معنوي في العدد الكلي للبكتيريا والفطريات في العينات المضاف إليها زيت الزعتر وخاصة عند تركيزات ٠,٠٤% ، ٠,٠٦% مقارنة بعينات المجموعة الضابطة من بداية التجربة وخلال فترا ت الحفظ وأيضاً العينات المضاف إليها زيت الجوجوبا حدث انخفاض ملحوظ في الحمل البكتيري لتلك العينات.