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EFFECT OF LEMON PEEL AND PULP EXTRACT ON SOME LOCAL KURDISH RAM MEAT QUALITIES AND ITS SHELF LIFE

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Abstract

To investigate the effectiveness of adding lemon peels and pulp extracts on some quality properties and shelf-life of the sheep longisimussdorsi muscle during refrigerated storage at 4±1°C for 0, 4, and 8 days for this purpose am meat trim of visible fat and connective tissue, they cut in small cubes. The meat samples divide into four equal proportions and mix with different concentrations of lemon peel and pulp extract according to the following formulations: Control; T1 1%; T2 2% and T3 3% of lemon peel and pulp extract, by applied immersion method. The results showed acceptable results of moisture content, Water-holding capacity cooking loss, thiobarbituric acid, met-myoglobin, myoglobin, and sensory traits of the samples treated with lemon peel in comparison to the control group. The phiso-chemical traits changed during the storage periods but the meat sample treated with lemon extract was more stable than control groups. These results suggested that using lemon peels and pulp extracts to maintain physio-chemical properties of ram meat and extend shelf-life during refrigerated storage, which may have implications of meat processors.

Key words: Lemon Extract, Karadi Ram, Meat, Quality Traits, Refrigeration.

تأثير مستخلص قشور ولب الليمون في بعض خصائص لحم الكباش الكردية المحلية خلال فترة الحفظ بالتبريد

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المستخلص

تم اجراء هذه الدراسة للكشف عن تاثير إضافة مستخلص مائي لقشورولب الليمون في بعض خصائص الجودة وفترة التخزين للعضلة longisimussdorsi في الأغنام خلال التخزين بالتبريد عند درجة 4 مئوية لمدة 0 و 4 و 8 أيام، ولهذا الغرض تم ازالة الدهون والنسيج الضام من العضلة ، وقطعت على شكل مكعبات صغيرة، وقسمت عينات اللحم بشكل متساوي في أربعة معاملات وخلطت بتركيزات مختلفة من مستخلص قشر ولب الليمون كالتالي: معاملة السيطرة (بدون مستخلص قشر ولب الليمون)، (1%مستخلص قشر ولب الليمT1) ، (2%مستخلص قشر ولب الليمون T2)، (3%مستخلص قشر ولب الليمونT3)، أظهرت النتائج نتائج مقبولة لمحتوى الرطوبة ، قابلية الاحتفاظ بالماء، وحامض الثيوباربيتوريك، الميت مايكلوبين، الميكلوبين، والصفات الحسية في العينات المعاملة بمستخلص قشر ولب الليمون مقارنة بمجموعة السيطرة. حدثت تغييرات في الصفات الفيزيائية الكيميائية خلال فترات التخزين، ولكن كانت عينة اللحوم المعاملة بمستخلص الليمون أكثر ثباتًا من مجموعة السيطرة. يمكننا الاستنتاج بأنه يمكن استخدام مستخلص الليمون للحفاظ على الخواص الفيزيائية والكيميائية للحوم أثناء التخزين بالتبريد.

الكلمات المفتاحية: مستخلص الليمون، كباش كرادي، لحم، صفات الجودة، التبريد.

Introduction

Important sources of proteins, vitamins, minerals, fat, saturated fatty acids, cholesterol, mineral elements it is meat and meat products (21; 30; 31;33). Meat quality is the key criterion of meat and meat product evaluation, which susceptible to quality deterioration and shelf life impact directly on quality changes, a rapid quality deterioration is observed in meat stored improperly (6). The most meat-eating qualities for consumers including tenderness, juiciness, meat colour and flavour (23). lipid oxidation affects meat quality which leads to the formation of numerous other compounds which have adverse effects on the quality attributes and nutritive value of meat products, this process frequently limits the shelf-life of processed meat. One of the causes for the meat and meat products deterioration is lipid oxidation, because their appearance determines the onset of a large number of unfavorable changes in sensory, and nutritional value (13).

Idea of using food for health purposes rather than for nutrition may open up a whole new field for the meat industry, growing consumers concerns about synthetic antioxidant because of their safety and potential toxicology have pressed the food

industry to find alternative natural sources (34). Thus, there is interest in development and use of lemon peels "citrus waste" as functional ingredients with bioactive compounds and antioxidant content (such as: phenolics, flavonoids, ascorbic acid and carotenoids) through processing healthy meat products to enhance oxidative stability and preserve meat quality for longer shelf life as maintaining food safety according to consumers demand for natural and safe products (19).

The objective was Investigate study the effectiveness of lemon peel and pulp extracts at three levels (0, 1, 2 and 3 %) on some quality properties and shelf-life of the ram*longisimussdorsi* muscle during refrigerated storage at 4±1°C for 0, 4 and 8 days.

Materials and methods

Preparation of lemon peel and pulp extracts: Lemon peel and pulp powder prepare from dried peels and pulp of lemons (*C.Limonum*, which procure from a local market). The peels and pulp separate from juice then wash with distilled water. The peels and pulp dry in a hot air oven at 50°C for 48 h and ground to a fine powder and pass through a 24-mesh sieve. Lemon Peel and Pulp powders add in the concentration of 0, 1, 2 and 3% in the form of extracts.

Sample preparation: Ram fresh LD muscles purchase from a local market. Sheep meat trim of visible fat and connective tissue, then cut in small cubes. The meat samples divide into four equal proportions and mix with different concentration of lemon peel and pulp extract according to the following formulations: T_1 control (without lemon peel and pulp extract immersion); T_2 1%; T_3 2% and T_4 3% of lemon peel and pulp extract, by applied immersion method for 24 hrs at 4±1°C. The sample package and seal in polythene bags and store in refrigerator at 4^0C. Four random samples were taken from each group for analysis at each sampling time (0, 4 and 8 day). Chemical composition, Moisture content Moisture content was determined as weight loss after samples were dried in the convection oven at 105°C until weight was stabilized according to AOA method (2).

Physical analysis: pH of muscle sample measure according to the method described by Ibrahim *et al.*, (18). Muscle samples (10gm) homogenize with 100 ml distilled water for 1 min, the pH then measures by a pH meter.

Cooking loss determine according to Murphy and Zerby (24). Muscle samples (20gm) place in an open aluminum boxes and cook for 8.5 min in oven pre-heated to 176˚C to an internal temperature of 70˚C. After cooking, the samples must dry with a paper towel. Each sample cool for 30 min, cooking weight measure. The cooking loss calculate by the following formula:

$$\text{Cooking loss\%} = \frac{\text{raw sample weight (before cooking) (gm)} - \text{cooked sample weight (gm)}}{\text{raw sample weight (before cooking) (gm)}} \times 100$$

Water holding capacity (WHC) determine according to Wardlaw*et al.*, (29). 20gm of minced muscle sample place in centrifuge tube containing 30ml of 0.6M NaCl and stirre with glass rod for 1 min.

The tube keeps at refrigeration temperature (4˚C) for 15 min, stirre again and centrifuge at 2806.1 xg (4˚C) for 15 min. The supernatant measure and amount of water retain by samples and express in percentage. The WHC report as ml of 0.6 M NaCl per 100g of muscle according to the following formula:

$$\text{WHC \%} = \frac{\text{Initial solution weight - final solution weight}}{\text{sample weight (gm)}} \times 100$$

Biochemical analysis:

Thiobarbituric acid (TBA) value: The TBA values will determine according to the method described by Witte *et al*., (32). Twenty grams of the muscle will blend with 50ml of cold solution containing 20% trichloroacetic acid (TCA) in 2M phosphoric acid. The resulting slurry transfer quantitatively to a 100ml volumetric flask with 40ml distilled water. The sample dilute to 100ml with distilled water and homogenized by shaking. A 50ml portion filter through Whatman No.1 filter paper. Five ml of filtrate transfer to a test tube followed by 5ml of fresh thiobarbituric acid (TBA) (0.005M in distilled water). The blank prepares by mixing 5ml of distilled water with 5ml of TBA. The tubes stopper and the solution mix and keep in the dark for 15-17 hr at room temperature to develop the colour reaction.

The absorbance read at 530 nm by using spectrophotometer (Shimdzu, Japan). The TBA value express as mg malonaldehyde (MDA)/kg muscle, and calculate by multiplying the absorbance (A) by 5.2 factor as follows:

$$\text{TBA value (mg MDA/kg muscle)} = A_{530} \times 5.2$$

Determination of percent met-myoglobin and myoglobin concentration:

Pigment of meat extract from muscles of each treatment using a modified procedure of Krzy Wicki (22). Muscle samples (1gm) blend with 10ml ice-cold 0.04M phosphate buffer at pH 6.8 for 10 sec in a magnetic stirrer, keep at 4˚C for 1 hr, the mixture centrifuge at 2806.1 xg for 30 min at 4˚C. The supernatant further clarify by filtration through Whatman No.1 filter paper. The absorbance of filtrate measure at 525, 572 and 700 nm using a UV-VIS spectrophotometer (Shimadzu, Japan). The percent met-myoglobin (Met-Mb) and myoglobin concentration determine using the formula stated by KrzyWicki (22).

$$\text{\% Met-Mb} = [1.395 - (A_{572} - A_{700} / A_{525} - A_{700})] \times 100$$

$$\text{Myoglobin concentration (mg/g muscle)} = (A_{525} - A_{700}) \times 2.303 \times \text{dilution factor sample weight (gm)}$$

Sensory evaluation: The muscle samples of LD evaluate for sensory attributes (colour, flavor and aroma, tenderness, juiciness and overall acceptability). The muscle samples cook in oven at 176˚C for 8.5 min until reaching the internal temperature of 70˚C, then serve warm at 60˚C to eight trained panelists (24). Muscle samples from different treatments evaluate in each session. The samples order randomizes within the session. Water serve after each sample assessment. Panelists rated each sample for different attributes with five-point scale ranging between 1 and 5. The higher score values indicate greater preference (4).

Statistical analysis Data analyze using statistical analysis (SAS program) general Linear Model (GLM) within Allison (28) program, Factorial Complete Randomized Design (CRD) was used to study the effect of treatments and storage periods on studied traits, assuming the following model:

$Y_{ijk}= \mu + T_i + P_j + (TP)_{ij} + E_{ijk}$ i = 1, 2,3 and 4 j = 1, 2 and 3

where: Duncan's multiple range test (8) will use to determine significant differences among means within each factor on all studied traits.

Results and Discussion

The results of moisture content after treatment with lemon peels and pulp extracts at three levels 0, 1, 2 and 3 % at 4±1°C for 0, 4 and 8 days shown in table 1, there were significant ($p<0.01$)differ among treatments, in 1st 0 day, the highest content recorded in Control 79.840% while the lowest recorded in T2 78.567 %, in 2nd (4days) the highest contents recorded in T1 78.633% and lowest content recorded in control 77.857%, in 3rd 8days periods, the highest content recorded in T3 77.903% while the lowest recorded in control 75.870%. The moisture content decreases significantly ($p<0.01$) during the storage periods in control, T1 and T3 treatments. Moisturizing content is one of the main components of meat that affect the flavoring qualities of meat, especially the softness and aromatic qualities. The results showed a high ($P <0.01$) in the moisture content of the samples treated with lemon peel in comparison to control group, this may be due to the effectiveness of the lemon extract bioactive compounds preserve the integrity of the cellular membranes of the meat from oxidative damage (25).

The results of pH value showed in the table (2), there were significant ($p<0.01$) differ among treatments in 3st period, T3 recorded the lowest pH 5.800 while the highest pH 5.900 recorded in control. The pH value not differ significantly ($p<0.01$) among storage periods within the same treatments. For evaluating meat quality, one of the important quality tests is pH. The pH of meat is determined by how much glycogen is in the muscle prior to slaughter, converted glycogen in the meat to lactic acid after slaughter might consider a vital parameter of changing in pH values of the meat 6,12. Braddock, (3) reported that added lemon albedo (white soft middle layer) to meat sample make pH values lower than control samples and may be due to the presence of some organic acids in lemon , this results also observed in our results as table 2.

Table 1 Effect of lemon peels and pulp extracts at three levels (0, 1, 2 and 3 %) on Moisture contents during refrigerated storage at 4±1°C for 0, 4 and 8 days. Mean ± Standard division

Treatments	Storage periods (at 4 °C)		
	0 day	4 days	8 days
Control	79.840± 0.240 a A	77.857± 0.376 a B	75.870 ± 0.704 a C
T1 (1% lemon peel and pulp extract)	79.168± 0.312 b A	78.633±0.208 b A	77.830± 0.286 b B
T2 (2% lemon peel and pulp extract)	78.567± 0.301 b A	78.125±0.125 ab A	77.819± 0.286 b A
T3 (3% lemon peeland pulp extract)	78.817±0.825 b A	78.387±0.335 ab AB	77.903±0.042 b B

*Mean with different small letter (a, b) among treatments are significantly differ ($p<0.01$).
** Mean with different capital letter (A, B) among periods are significantly differ ($p<0.01$).

Table 2 Effect of lemon peels and pulp extracts at three levels (0, 1, 2 and 3 %) on pH value during refrigerated storage at 4±1°C for 0, 4 and 8 days. Mean ± Standard division

Treatments	Storage periods (at 4 °C)		
	0 day	4 days	8 days
Control	5.843±0.006 a A	5.870±0.010 a A	5.900±0.070 a A
T1 (1% lemon peel and pulp extract)	5.847± 0.006 a A	5.863±0.006 a A	5.893±0.067 a A
T2 (2% lemon peel and pulp extract)	5.827±0.015 a A	5.857±0.006 a A	5.883±0.076 a A
T3 (3% lemon peeland pulp extract)	5.810±0.010 a A	5.817±0.015 a A	5.800±0.010 b A

*Mean with different small letter (a, b) among treatments are significantly differ ($p<0.01$).
** Mean with different capital letter (A, B) among periods are significantly differ ($p<0.01$).

The effect of lemon peels and pulp extracts on WHC percentage showed in table 3, there were significant ($p<0.01$)differ between treatments, in 1st 0 day, the highest percentage recorded in T3 52.592% while the lowest recorded in control 49.570%, in 2nd 4days there were no significant difference among treatments, in 3rd 8days periods, the highest percentage recorded in T3 50.472% while the lowest recorded in control 46.247%. The WHC percentage decrease significantly ($p<0.01$) during the storage periods in control treatments but persist at same level in other meat sample that treated with lemon peel. One of the quality properties of fresh meat impact on most traits such as technological quality and sensory traits is water-holding capacity WHC (5).The high percentage of WHC in meat samples treated with Lemmon peel may be due to fact that WHC is related to soluble dietary fiber SDF content, and high levels of SDF produce a high WHC value. This could be explained by the higher WHC of soluble fibers, such as pectin and gums than cellulosic fibers. So, the higher WHC of lemon peel extract treatments could be due to the chemical structures, which possess a higher WHC than cellulosic fibers in citrus peel.(22).The meat pH and the protein composition impact on the water holding capacity , the high pH Table 2, may leads to the highest water holding capacity of meat (29).

Table 3 Effect of lemon peels and pulp extracts at three levels (0, 1, 2 and 3 %) on Water holding capacity percentage during refrigerated storage at 4±1°C for 0, 4 and 8 days. Mean ± Standard division

Treatments	Storage periods (at 4 °C)		
	0 day	4 days	8 days
Control	49.570±0.120 a A	49.480± 0.680 a A	46.247± 2.345 a B
T1 (1% lemon peel and pulp extract)	50.897± 2.025 ab A	49.693 ± 0.705 a A	48.893± 0.654 b A
T2 (2% lemon peel and pulp extract)	50.512 ± 2.120 ab A	49.790 ± 0.753 a A	49.196 ±0.534 b A
T3 (3% lemon peeland pulp extract)	52.592 ±0.602 b A	51.392 ±0.643 a A	50.472 ± 0.583 b A

*Mean with different small letter (a, b) among treatments are significantly differ ($p<0.01$).
** Mean with different capital letter (A, B) among periods are significantly differ ($p<0.01$).

The results of cooking loss percentage showed in the table 4, there were significant differ among treatments in all storage periods, in the 1st period, the meat of control group recorded the highest percentage 21.010% in contrast the lowest percentage recorded in T3 16.217%. In the 2nd period 4 days, the highest percentage recorded in meat of control group 24.207% while the lowest percentage recorded in T3 18.273%. In the end of experiment 8 days the highest percentage recorded in meat of control

group 27.617% in contrast the lowest percentage recorded in T3 17.747%. The cooking loss percentage increase significantly ($p<0.01$) during the storage periods in control treatments. meat sample treated with lemon peel extract shown decrease in cooking loss in comparison to control may be due to the increase in emulsion stability and the high ability of lemon peel to retain moisture in the matrix, also related to meat chemical structure, soluble dietary fiber (SDF) content produce a high WHC value and low cooking loss (22). This finding is supported by Aleson-Carbonell et al., (1), on the incorporation of lemon albedo fibers in beef patties formulation which shows that dietary fibers increased cooking yield, because of their ability to keep moisture in the formulation. Rocha Garza and Zayas, (27) reported that, in meat products, quality attributes such as texture, structural binding and yield are determined by the ability of the protein matrix to retain water and bind fat.

Table 4 Effect of lemon peels and pulp extracts at three levels (0, 1, 2 and 3 %) on cooking loss percentage during refrigerated storage at 4±1°C for 0, 4 and 8 days. Mean ± Standard division

Treatments	Storage periods (at 4 °C)		
	0 day	4 days	8 days
Control	21.010 ± 0.641 a A	24.207 ± 1.758 a B	27.617 ± 0.040 a C
T1 (1% lemon peel and pulp extract)	20.508 ± 1.019 ab A	19.659 ± 0.466 b A	19.590 ± 0.172 b A
T2 (2% lemon peel and pulp extract)	18.322 ± 3.105 bc A	19.455 ± 0.434 b A	18.604 ± 0.531 b A
T3 (3% lemon peeland pulp extract)	16.217 ± 2.531 c A	18.273 ± 0.253 b A	17.747 ± 0.294 b A

*Mean with different small letter (a, b) among treatments are significantly differ ($p<0.01$).
** Mean with different capital letter (A, B) among periods are significantly differ ($p<0.01$).

Results of thiobarbituric acid value during refrigerated storage at 4±1°C for 0, 4 and 8 days represented in table 5, there were significant differ among treatments in all storage periods, in the 1st period, the meat of control group recorded the highest TBA value 0.911 mg MDA/ kg meat, while the meat of T3 recorded the lowest value 0.557mg MDA/ kg meat. In the 2nd period 4 days, the highest value recorded in meat of control group 0.948mg MDA/ kg meat while the lowest value recorded in T3 0.632mg MDA/ kg meat. In the end of experiment 8 days the highest value recorded in meat of control group 1.050mg MDA/ kg meat while the lowest percentage recorded in T3 (0.678mg MDA/ kg meat). The TBA value increase significantly ($p<0.01$) during the storage periods in T2 and T3 treatments. TBA is used as a lipid oxidation indicator during storage of meat products (11). Meat of all treatments not exceed the acceptable limited 5 mg MDA/ kg meat (19).The high efficiencies found in

lemon peel treatments were closely confirming the role of the antioxidant activity of lemon peel extracts containing polyphenol components is due to their capacity to be donors of hydrogen atoms or electrons and to capture the free radicals. DPPH is a free radical and it is a powerful oxidant which reduced by lemon peel extract and protects meat lipids from oxidation (15).

Table 5 Effect of lemon peels and pulp extracts at three levels (0, 1, 2 and 3 %) on thiobarbituric acid value during refrigerated storage at 4±1°C for 0, 4 and 8 days. Mean ± Standard division

Treatments	Storage periods (at 4 °C)		
	0 day	4 days	8 days
Control	0.911 ± 0.035 a A	0.948 ± 0.036 a A	1.050 ± 0.078 a A
T1 (1% lemon peel and pulp extract)	0.811 ± 0.005 b A	0.829 ± 0.013 b A	0.866 ± 0.007 b A
T2 (2% lemon peel and pulp extract)	0.673 ± 0.046 c A	0.713 ± 0.018 c AB	0.747 ± 0.021 c B
T3 (3% lemon peeland pulp extract)	0.557 ± 0.058 d A	0.632 ± 0.210 d B	0.678 ± 0.026 d B

*Mean with different small letter (a, b) among treatments are significantly differ ($p<0.01$).
** Mean with different capital letter (A, B) among periods are significantly differ ($p<0.01$).

The effect of lemon peels and pulp extracts on Met- myoglobin percentage showed in table 6, in the 1st periods 0 day results showed that Met- myoglobin percentage in meat of control, T1 and T2 group differ significantly ($p<0.01$) with T3, the highest percentage recorded in control group 49.108% while the lowest recorded in meat of T3 group 37.038%, in the 2nd period, the Met- myoglobin percentage in meat of control and T1 groups differ significantly ($p<0.01$) with T3 groups, also the control group meat differ ($p<0.01$) with the T2, the highest percentage recorded in Control group, in contrast, the lowest recorded in T3 49.645 and 39.455% respectively. In the end of experiment 8 days, the Met- myoglobin in control and T1 groups meat differ significantly ($p<0.01$) with T2 and T3 groups, the highest percentage recorded in control group, and the lowest recorded in T3 49.874 and 42.525% respectively. The met- myoglobin percentage decrease significantly ($p<0.01$) during the storage periods in T3 treatment group. Meat colour is affected by the amount and chemical state of the pigment myoglobin, which after oxidation results in the unattractive colored met myoglobin 10; 17. The high antioxidant contents in lemon peel extracts such as: phenolics, flavonoids, ascorbic acid and carotenoids, retards the conversion of deoxymyoglobin and oxymyoglobin to metmyoglobin (14).

Table 6 Effect of lemon peels and pulp extracts at three levels (0, 1, 2 and 3 %) on Met- myoglobin (%) during refrigerated storage at 4±1°C for 0, 4 and 8 days. Mean ± Standard division

Treatments	Storage periods (at 4 °C)		
	0 day	4 days	8 days
Control	49.108±0.098 a A	49.645 ±0.065 a A	49.874 ±0.134 a A
T1 (1% lemon peel and pulp extract)	48.859 ± 0.189 a A	49.209 ± 0.260 ab A	49.833 ± 0.125 a A
T2 (2% lemon peel and pulp extract)	48.044 ± 0.732 a A	48.236 ± 0.613 b A	47.296 ±1.475 b A
T3 (3% lemon peeland pulp extract)	37.038 ± 0.054 b A	39.455 + 0.558 c B	42.525 ±1.532 c C

*Mean with different small letter (a, b) among treatments are significantly differ ($p<0.01$).
** Mean with different capital letter (A, B) among periods are significantly differ ($p<0.01$).

The effect of lemon peels and pulp extracts on Myoglobin values showed in table 7, in the 1st periods 0 day results showed that Myoglobin values in meat of control, T1 and T2 group differ significantly ($p<0.01$) with T3, the highest value recorded in meat of T3 group 5.091 mg/gm muscle while the lowest value recorded in meat of control group 3.732 mg/gm muscle, in the 2nd period, the Myoglobin values in meat of control groups differ significantly ($p<0.01$) with T1, T2 and T3 groups, the highest percentage recorded in T3 group, in contrast, the lowest recorded in control group 4.865 and 3.299 mg/gm muscle respectively. In the end of experiment 8 days, the Myoglobin values in control and T1 groups meat differ significantly ($p<0.01$) with T2 and T3 groups, the highest percentage recorded in T3 group, and the lowest recorded in control group 4.690 and 2.956 mg/gm muscle respectively. The Myoglobin values decrease significantly ($p<0.01$) during the storage periods in 4 treatment groups. The colour and colour stability of meat is important for consumers and retailers. Samples treated with lemon peel and pulp extracts greatly improved pigment stability compared with the control which due to high contents in phenolics, flavonoids,ascorbic acid, carotenoids in lemon peel which certainly contributed to the highest antioxidant potential (bioactive compounds) found in these fractions protect myoglobin from oxidation to met-myoglobin (14).

Table 7 Effect of lemon peels and pulp extracts at three levels (0, 1, 2 and 3 %) on Myoglobin (mg/gm muscle) during refrigerated storage at 4±1°C for 0, 4 and 8 days. Mean ± Standard division

Treatments	Storage periods (at 4 °C)		
	0 day	4 days	8 days
Control	3.732 ± 0.059 a A	3.299 ± 0.264 a B	2.956 ± 0.060 a B
T1 (1% lemon peel and pulp extract)	3.826 ± 0.025 a A	3.712 ± 0.010 b A	3.166 ± 0.289 a B
T2 (2% lemon peel and pulp extract)	3.943 ± 0.040 a A	3.862 ± 0.434 b AB	3.525 ± 0.485 b B
T3 (3% lemon peeland pulp extract)	5.091 ± 0.148 b A	4.865 ± 0.104 c AB	4.690 ± 0.165 c B

*Mean with different small letter (a, b) among treatments are significantly differ ($p<0.01$).
** Mean with different capital letter (A, B) among periods are significantly differ ($p<0.01$).

The sensory traits results of meat treated with lemon peels and pulp extracts at three levels during refrigerated storage at 4±1°C for 8 days showed in table 8. There were significant differ ($p<0.01$) among treatments in color, tenderness, flavor and aroma traits, while the results of Juiciness and Overall acceptability not differ significantly ($p<0.01$) among treatments. The highest value recorded in meat treated with lemon peels and pulp extracts. According to Cross et al. (4), all treatment had acceptable score except Control and T1 for juiciness traits which recorded 2.8 and 2.8 respectively. The highest ($p<0.01$) color score recorded in T3 4.40 while the lowest score was in control 3.20, similar results were found for Met – Myoglobin formation and Myoglobin's contenting table 6 and 7 respectively. Samples treated with lemon peel and pulp extracts greatly improved pigment stability compared with the control which due to high contents in phenolics, flavonoids, ascorbic acid, carotenoids in lemon peel which certainly contributed to the highest antioxidant potential (bioactive compounds) found in these fractions protect myoglobin from oxidation to met-myoglobin (14). The results revealed that T3 was more acceptable in the tenderness score, and had significantly ($P<0.01$) highest score 4.40 as compared with control and T1 3.00 and 3.40 respectively which may be due to presence some organic acid in lemon peel extract that led to enhanced release of cathepsin enzymes. This allows the enzymes to increase degradation of the myofibrillar proteins 3; 9. Similar score was determined in beef burger treated with lemon albedo which had higher tenderness value as compared to untreated group 1. Samples treated with lemon Peel and pulp extracts showed significantly higher ($p<0.01$) flavor and aroma score, T3 recorded the highest 4.40 while control recorded the lowest flavor and aroma 3.60, These

improvement agreed with that found for TBA Table 5 which may be due to the role of the antioxidant activity of lemon peel extracts containing polyphenol components is due to their capacity to be donors of hydrogen atoms or electrons and to capture the free radicals. DPPH is a free radical and it is a powerful oxidant which reduced by lemon peel extract and protects meat lipids from oxidation and producing compounds responsible of flavors (15).

Table 8 Effect of lemon peels and pulp extracts at three levels (0, 1, 2 and 3 %) on sensory traits after 8 days refrigerated storage at 4±1°C. Mean ± Standard division

Treatments	Sensory traits				
	Color	Juiciness	Tenderness	Flavor and aroma	Overall acceptability
Control	3.20 ± 0.83 A	2.80 ± 0.83 A	3.00 ± 0.70 a	3.00 ± 0.707 A	3.60 ± 0.57 A
T1 (1% lemon peel and pulp extract)	4.00 ± 0.70 Ab	2.80 ± 0.44 A	3.40 ±0.89 a	3.80 ± 0.44 b	3.80 ± 0.44 A
T2 (2% lemon peel and pulp extract)	4.00 ± 0.00 Ab	3.00 ± 1.00 A	3.60 ± 0.54 ab	4.20 ± 0.44 B	3.80 ± 0.44 A
T3 (3% lemon peeland pulp extract)	4.40 ± 0.54 B	3.60 ± 0.54 A	4.40 ± 0.54 b	4.40 ± 0.54 B	4.00 ± 0.707 a

*Mean with different small letter (a, b) among treatments are significantly differ ($p<0.01$).
** Mean with different capital letter (A, B) among periods are significantly differ ($p<0.01$).

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