Effect of Pomegranate peel extract on some physical, chemical traits and sensory evaluation of Karadi ram meat during refrigerate storage

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Abstract

This study was carried out in High Education lab., Animal Science Department, College of Agricultural Science, University of Sulaimani during July to August, 2018 to examine the effect of Pomegranate Peel extract (PPE) on some Physio-chemical and shelf life of Karadi ram meat during refrigeration storage. Freshly Longissimus dorsi (LD) muscle were assigned to four treatments: C (control: no immersed with PPE), T1 (immersed with 0.5 % v/w PPE), T2 (immersed with 1 % v/w PPE) and T3 (immersed with 1.5 % v/w PPE). Meat samples were dipped with PPE up to 24 hours, then stored under refrigerator condition (4 ± 1 ^{o}C) for 0, 3 and 6 days. Results showed that PPE treatments lead to decrease pH, moisture, and water holding capacity (WHC) and increase cooking loss (CL). T3 recorded significantly (P<0.01) less pH value (5.505 and 5.535) after 3 and 6 days of storage period respectively, T3 also recorded significantly (P<0.01) lower moisture content (74.002%) than T1 (77.568%) after 3 days of storage, while the lower moisture content observed in T3 (71.243%) after 6 days of storage period. The significant (P<0.01) lower percentage of WHC was shown in T3 (55.500 and 47.950%) after 3 and 6 days' storage period respectively, moreover the significant (P<0.01) highest percentage of cooking loss was observed in T3 (53.550 and 55.450%) for the same storage period respectively. PPE considerably delayed lipid oxidation in T3 (0.478 and 0.528 mg malonaldehyde / kg meat / kg meat) after 3 and 6 days' storage period respectively, Results showed myoglobin contents were significantly (P<0.01) higher in T3 (2.804 mg/gm meat) and T2 (2.748 mg/gm meat) after 3 days' storage period, also higher in T2 (1.971 mg/gm meat) and T1 (1.922 mg/gm meat) after 6 days' storage period, whereas the lower Met – Myoglobin formation was recorded in T3 (52.045 and 53.902%) after 3 and 6 days' storage period respectively. The best sensory scores were observed in T3 (4.000 and 4.000) for meat color and flavor respectively. It can be concluded that PPE can be utilized of as natural antioxidant source in processed meat.

Keywords: Antioxidant, Pomegranate peel, chemical traits, physical traits, sensory evaluation.

تأثير استخدام مستخلص قشور الرمان في بعض الصفات الفيزيائية، الكيميائية والتقييم الحسي للحم الكباش الكرادية خلال الخزن بالتبريد

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الملخص:

أجريت هذه الدراسة في مختبر الدراسات العليا، قسم العلوم الحيوانية، كلية العلوم الزراعية، جامعة السليمانية خلال شهري تموز واب 2018 لتحديد تأثير مستخلص قشور الرمان في بعض الصفات الفيزيائية والكيميائية، التقييم الحسي ومدة صلاحية لحم الكباش الكرادية خلال فترات الخزن بالتبريد. وزعت عضلة الظهر الطويلة (LD) الطازجة الى اربعة معاملات: المعاملة الاولى: السيطرة (اللحوم غير المغمورة بمستخلص قشور الرمان)، المعاملة الثانية: اللحوم المغمورة بمستخلص قشور الرمان بتركيز 0.5% حجم/وزن، المعاملة الثالثة: اللحوم المغمورة بمستخلص قشور الرمان بتركيز 1% حجم/وزن، المعاملة الرابعة: اللحوم المغمورة بمستخلص قشور الرمان بتركيز 1.5% حجم/وزن. تم غمر عينات اللحم في مستخلصات قشور الرمان لمدة 24 ساعة،

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بعدها خزنت تحت ظروف التبريد (4±1 °م) لفترات 0، 3 و6 ايام. اظهرت نتائج العينات المعاملة بمستخلص قشور الرمان انخفاض pH ، الرطوبة وقابلية حمل الماء (WHC) وارتفاع الفقد عند الطبخ (CL) . سجلت المعاملة الثالثة معنوياً (P<0.01) اقل قيمة pH (5.505 و 5.535) بعد فترات خزن تبريد 3 و6 ايام على التوالي، وايضاً سجلت المعاملة الثالثة معنوياً (P<0.01) اقل محتوى الرطوبة (74.002%) مقارنةً بالمعاملة الاولى (77.568%) بعد فترة خزن تبريد 3 ايام، في حين اقل محتوى الرطوبة كانت للمعاملة الثالثة (71.243%) بعد فترة خزن 6 ايام. اقل قيمة معنوية (P<0.01) لقابلية حمل الماء (WHC) سجلت في المعاملة الثالثة (55.500 و 47.950 %) بعد فترات خزن 3 و 6 ايام على التوالي، واعلى قيمة معنوياً (P<0.01) للفقد عند الطبخ (CL) ايضاً كانت في المعاملة الثالثة (53.550 و 55.450 %) للفترات نفسها على التوالي. أدت استخدام مستخلص قشور الرمان الى تأخير عملية اكسدة الدهون بشكل ملحوظ في المعاملة الثالثة (0.478 و 0.528 ملغم MDA / كغم لحم) بعد فترات خزن 3 و6 ايام على التوالي. اظهرت نتائج محتويات المايوغلوبين اعلى قيمة معنوياً (P<0.01) في المعاملتين الثالثة (2.804 ملغم/غم لحم) والثانية (2.748 ملغم/غم لحم) بعد فترة خزن 3 ايام، وايضاً كانت اعلى معنوياً في المعاملتين الثانية (1.971 ملغم/غم لحم) والاولى (1.922 ملغم/غم لحم) بعد فترة خزن 6 ايام، بينما اقل قيمة ميت مايوغلوبين المتكونة سجلت في المعاملة الثالثة (52.045 و 53.902 %) بعد فترات الخزن 3 و 6 ايام على التوالي. افضل النتائج الحسية كانت للمعاملة الثالثة (4.000 و 4.000) بالنسبة للون ونكهة ورائحة اللحم على التوالي. من نتائج البحث يمكن الاستنتاج بأنه يمكن الاستفادة من مستخلص قشور الرمان كمصدرمضاد اكسدة طبيعي في تصنيع اللحوم.

Introduction

Meat is considered as an essential part of non-vegetarian food. It is preferred by the consumer because of its specific taste and it is a rich source of vitamins, supplying correct best animal proteins, important amino acids and fatty acids, minerals, trace elements and vitamins specifically B-complex (Singh et al., 2013) Meat purchasing decisions are affected by its color more than other meat quality factors due to the fact that it is a trademark of freshness and wholesomeness (Mancini and Hunt, 2005). Color, lipid oxidation and microbial growth are essential factors for the shelf-life and consumer acceptance of fresh meat (Jakobsen and Bertelsen, 2000). Quality of meat and meat products deteriorated due to their rich nutritional composition (Devatkal et al., 2012). Lipid oxidation causes meat deterioration by adversely affecting its color, flavor and nutritional value. Decrease in nutritional value of meat occurred as a result of losing essential fatty acids and vitamins and generation of toxic products such as malonaldehyde and cholesterol oxidation products (Tang et al., 2001). Several elements affect lipid oxidation such as temperature, light, concentration of oxygen within the surrounding atmosphere, quantity and composition of phospholipids, presence of anti-oxidants, pro-oxidants, metal ions, haem pigments, enzymes, mechanical methods etc… (Biswas et al., 2012). During processing there are many technological methods participate produce in the formation of several other compounds that have negative effect on meat and meat products and cause sensory changes (color, texture and flavour) and affect nutritional quality (Karakaya et al., 2011). Lipid oxidation may be reduced or inhibited by using antioxidants in meat and meat products and as a result improved quality of the meat product and shelf-life. There are a massive range of compounds which have been proposed to possess antioxidant activity, but only a few can be used in food processing. The use of antioxidants in food products is controlled by regulatory legal guidelines of a country or international standards (Karre et al., 2013). The antioxidants can be of artificial or natural origin. Plants are constantly the beneficiant source to supply man with bioactive substances (Tayel and El-Tras, 2012). Different plant products are being evaluated as natural antioxidants to keep and improve the meat and meat products quality. Natural antioxidant plant extracts were obtained from different sources such as: fruits (grapes, pomegranate, date, kinnow), vegetables, (broccoli, potato, drumstick, pumpkin, curry, nettle), herbs and spices (tea, rosemary, oregano, cinnamon, sage, thyme, mint, ginger, clove) for maintaining meat quality, extending shelf-life, reducing economic loss, were investigated to decrease the lipid oxidation (Mansour and Khalil, 2000; Devatkal et al., 2010; Huang et al., 2011; Das et al., 2012). Therefore, the aim of this study was to assess the antioxidant properties of pomegranate peel extract in Karadi ram meat during cold storage.

Materials and methods

Preparation of Pomegranate peel extracts

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Dried Pomegranate peel powder was bought from a local traditional market. Water extract was prepared by addition of 50 g of Pomegranate peel powder added to 500 ml boiled distilled water in enclosed bottle and left for 24 h at room temperature with constant shaking; the extract was obtained by filtration through Whatman No. 1 filter paper. The extract was collected in a separate bottle. The filtrates were concentrated by Soxhlet apparatus, and the extract was dried, placed in sealed bottles and stored at 4◦C. These extracts were used as natural antioxidant.

Experimental design

Three factors were studied in this experiment:

1. Pomegranate peel extract concentration: 0 %, 0.5 %, 1 % and 1.5 % (v/w).
2. Storage conditions: aerobic and vacuum atmosphere at 4 ^{0}C.
3. Storage time: 0, 3, and 6 days

Muscle samples were immersed in 100 ml of antioxidant solution at concentration of 0.5, 1 and 1.5 % (v/w) of pomegranate extract solution, and left for 24 hr, the samples were removed from the solutions, patched in polyethylene bags, stored in refrigeration at 4^{o}C until analysis.

Sample Preparation

Sheep LD muscle were bought of samples fresh from a local market. Karadi ram meat was trimmed of visible fat and connective tissue; they were cut in small cubes. Meat samples were divided into four equal proportions and mixed with different concentration of pomegranate peel extract according to the following formulations: control (without antioxidant); T1 0.5%; T2 1% and T3 1.5% of pomegranate peel extract respectively, using immersion method. Sample were then packaged and sealed in polythene bags and stored in refrigerator at 4^{o}C. Four random samples were taken from each group for analysis at each sampling time (0, 3 and 6 days)

Physical analysis

pH

pH of muscle sample was measured according to the method described by Ibrahim *et al.*, (2010). Muscle samples (10g) were homogenized with 100 ml of distilled water for 1 min, the pH was then measured by a pH meter.

Cooking loss

Cooking loss was determined according to Murphy and Zerby (2004). Muscle samples (20g) were placed in an open aluminum boxes and cooked for 8.5 min in pre-heated oven to 176˚C to attain internal temperature to 70˚C. After cooking, samples were dried with a paper towel. Each sample was cooled for 30 min, cooking weight was measured. The cooking loss was calculated by the following formula:

$$\text{Cooking loss\%} = \frac{\text{Raw sample weight} - \text{cooked sample weight}}{\text{Raw sample weight (g)}} \times 100$$

Water holding capacity (WHC)

Water holding capacity (WHC) was determined according to Wardlaw *et al.*, (1973). 20g of minced muscle sample was placed in a centrifuge tube containing 30ml of 0.6M NaCl and was stirred with glass rod for 1 min. The tube was kept at refrigeration temperature (4˚C) for 15 min, stirred again the centrifuged at 2806.1 xg (4˚C) for 15 min. The supernatant was measured and amount of water retained by samples and expressed in percentage. The WHC was reported as ml of 0.6 M NaCl per 100g of muscle according to the following formula:

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

Chemical and biochemical analysis

Moisture content

Moisture content was determined as weight loss after the samples were dried in a convection oven at 105˚C for 16 hr (AOAC. 2000).

Thiobarbituric acid (TBA) value

The TBA values were determined according to the method described by Witte *et al.*, (1970). Twenty grams of the muscle were blended with 50ml of cold solution containing 20% trichloroacetic acid (TCA) in 2M phosphoric acid. The resulting slurry was transferred quantitatively to a 100ml volumetric flask with 40ml distilled water.

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The sample was diluted to 100ml with distilled water and homogenized by shaking. A 50ml portion was filtered through Whatman No.1 filter paper. Five ml of filtrate was transferred to a test tube followed by 5ml of fresh thiobarbituric acid (TBA) (0.005M in distilled water). The blank was prepared by mixting 5ml of distilled water with 5ml of TBA. The tubes stoppered and the solution mixed and kept in the dark for 15-17 hr at room temperature to develop the colour reaction. The absorbance was read at 530 nm using spectrophotometer (Shimdzu, Japan). The TBA value was expressed as mg malonaldehyde (MDA)/kg muscle, and calculated by multiplying the absorbance (A) by 5.2 factor as follows:

$$\text{TBA value (mg MDA/kg muscle)} = \text{A530} \times 5.2$$

Determination of percent met-myoglobin and myoglobin oncentration

Pigment of meat was extracted from muscles of each treatment using a modified procedure of Krzy Wicki (1982). Muscle samples (1g) were blended with 10ml of ice-cold 0.04M phosphate buffer at pH 6.8 for 10 sec in a magnetic stirrer, kept at 4˚C for 1 hr, the mixture was centrifuged at 2806.1 xg for 30 min at 4˚C. The supernatant was further clarified by filtration through Whatman No.1 filter paper. The absorbance of filtrate was measured at 525, 572 and 700 nm using a UV-VIS spectrophotometer (Shimadzu, Japan). The percent met-myoglobin (Met-Mb) and myoglobin concentration were determined using the formula stated by KrzyWicki (1982).

$$\%\,\text{Met} - \text{Mb} = [1.395 - (\text{A572} - \text{A700}\,/\text{A525} - \text{A700})] \times 100$$

$$\text{Myoglobin concentration (mg/g muscle)} = \frac{(\text{A525} - \text{A700}) \times 2.303 \times \text{dilution factor}}{\text{sample weight (g)}}$$

Sensory evaluation

The muscle samples of LD were evaluated for sensory characteristics including color, flavor and aroma, tenderness, juiciness and overall acceptability. Muscle samples (after 6 days storage period) were cooked in oven at 176C˚ for 8.5 min until the internal temperature reached 70˚C, then served warm at 60˚C to eight trained panelists (Murphy and Zerby, 2004). Muscle samples from different treatments were evaluated in each session. The samples order was randomized within the session. Water was served 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 (Cross *et al*., 1978).

Statistical analysis

Data was analyzed using statistical analysis system (SAS, 2010). General Linear Model (GLM) within SAS program, Factorial Complete Randomized Design (CRD) was used to study the effect of treatments and storage periods on studied traits.

Results & Discussion

pH value

Changing in PH value (Table 1) showed significant differences (P<0.01) among treatments after 3 and 6 days of refrigerator storage. Pomegranate Peel extracts led to decrease pH value. After 3 days of storage, T3 recorded significantly lower pH value (5.505) compared with T1 (5.695) and C (5.975), T1 and T2 recorded significantly lower pH value (5.695 and 5.585 respectively) as compared with C (5.975). Also after 6 days of storage results revealed that T3 significantly lower pH value (5.535) as compared with T2 (5.740), T1 (6.010) and C (6.400 Highest pH value). This results may be due to the presence of some acids like Ellagic acid and its derivatives (Ellagitannis, Punicalagin, Punicalin) in pomegranate peel extracts which may decrease the pH of meat and approaching the iso electric point, thus reduce the electrical repulsion force between proteins molecules carrying the same charge (Tahir , 1983 and Guo et al , 2003). pH increased during refrigerated storage period, there were significant differences (P<0.01) between storage periods for all treatments (with exception of T3).

Moisture content

There were significant effects (P<0.01) among treatments in moisture content (Table

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1) after 3 and 6 days of storage period. Results showed that T3 recorded significantly lower (P<0.01) moisture content (74.002%) as compared with T1 (77.568%) after 3 days storage period. T3 showed significantly lower (P<0.01) moisture content (71.243%) compared with T1 (74.465%) and T2 (75.327%) after 6 days storage period. These results can be attributed to the decrease pH value of meat samples treated with pomegranate peel extracts which contain some acids (Tahir, 1983 and Guo et al, 2003). Results showed that moisture content decreased significantly (P<0.01) with increasing storage period for all treatments (with exception of T2).

Table (1): Effect of different concentration of Pomegranate peel extract on pH and moisture content in LD muscle of Karadi ram meat during refrigerator storage (Means ± SE).

Treatment	pH			Moisture %		
	0 day	3 day	6 day	0 day	3 day	6 day
C	a A 5.55±0.05	a B 5.97±0.08	a C 6.40±0.1	a A 78.35±0.004	ac AB 76.61±1.04	ab B 74.19±0.92
T1	a A 5.45±0.05	a B 5.69±0.04	b C 6.01±0.02	a A 78.24±0.80	a A 77.56±0.21	a B 74.46±0.69
T2	a A 5.45±0.05	bc AB 5.58±0.02	c B 5.74±0.06	a A 78.10±0.89	ac A 75.75±1.63	a A 75.32±1.32
T3	a A 5.45±0.05	c A 5.50±0.04	d A 5.53±0.02	a A 78.05±0.07	bc B 74.00±1.18	b B 71.24±0.79

- Means having different small letters (a,bc,….) among treatments for each Column are significantly different (P < 0.01)
- Means having different capital letters (A,BC,….) among periods for each Row are significantly different (P < 0.01)

Water holding capacity (WHC) and cooking loss

Results present in Table (2) shows significant differences (P<0.01) among treatments in both water holding capacity and cooking loss percentage after 3 and 6 days of storage period. Significantly lower (P<0.01) water holding capacity observed in T3 (55.500%) compared with T2, T1 and C (57.650, 58.425 and 58.750% respectively) after 3 days of storage. With increasing pomegranate peel extract concentration, water holding capacity decreased after 6 days of storage period, T3 recorded significantly lower water holding capacity (47.950%) whereas higher percentage was recorded in C (58.075%). T3 significantly higher (P<0.01) cooking loss percentage (53.550%) as compared with C (51.400%) after 3 days storage. T3 showed higher cooking loss percentage (55.450%) as compared with T1 and C (53.250 and 52.350% respectively). The decrease in water holding capacity and increase in cooking loss in sample treated with pomegranate peel extracts may be due to the decreased pH value, which may led to decrease meat susceptibility to water retention and increase cooking loss. (Tahir, 1983 and Chandralekha et al, 2012), Results showed that water holding capacity was decreased, and cooking loss was increased significantly (P<0.01) as storage period was increased for all treatments (with exception of C).

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Table (2): Effect of different concentration of Pomegranate peel extract on WHC and Cooking loss percentage in LD muscle of Karadi ram meat during refrigerator storage (Mean ± SE).

Treatment	WHC%			Cooking loss%		
	0 day	3 day	6 day	0 day	3 day	6 day
C	a A 58.90±0.1	a A 58.75±0.15	a A 58.07±0.07	a A 50.90±0.30	a A 51.40±0.40	a A 52.35±0.35
T1	a A 58.10±0.1	a A 58.42±0.025	b B 54.80±0.61	a A 50.92±0.07	ab AB 52.10±0.91	a B 53.25±0.76
T2	a A 58.10±0.20	a A 57.65±0.35	c B 51.15±0.35	a A 50.86±0.37	ab AB 52.90±0.66	ab B 53.85±0.66
T3	a A 57.90±0.91	b B 55.50±0.30	d C 47.95±0.76	a A 51.05±0.96	b B 53.55±0.45	b B 55.45±0.55

- Means having different small letters (a,bc,….) among treatments for each Column are significantly different (P < 0.01)
- Means having different capital letters (A,BC,….) among periods for each Row are significantly different (P < 0.01)

Myoglobin (Mb) and Met-myoglobin (Met-Mb)

The results in Table (3) showed that myoglobin content and met – myoglobin formation were significantly (P<0.01) influenced by the addition of pomegranate peel extracts after 3 and 6 days of storage period. After 3 days of storage period T3 and T2 recorded significantly, higher myoglobin contents (2.804 and 2.748 mg/g of meat respectively) as compared with T1 and C (2.645 and 2.570 mg/g of meat respectively). Whereas after 6 days of storage period T2 and T1 recorded significantly higher myoglobin contents (1.971 and 1.922 mg/g of meat respectively) as compared with C (1.831 mg/g of muscle). Results showed that significantly (P<0.01) lower Met – myoglobin formation was observed in T3 (52.045 and 53.902% after 3 and 6 days of storage periods respectively) as compared with C (53.126 and 54.818% after the same periods respectively). These improvements may be due to the fact that flavonoid compounds and catechins (antioxidants) were existed in pomegranate peel extracts and may play effective role in maintaining myoglobin reduction actions for the longest possible storage period, thus providing color protection of meat by its ability to delay the formation of met – myoglobin (Naveena, et al 2008). During storage periods (3 and 6 days storage) there were significant (P<0.01) decrease and increase in myoglobin content and Met – myoglobin formation respectively for all treatments.

Thio barbituric acid (TBA)

The results in Table (4) indicated that there were significant differences (P<0.01) in TBA (Thio barbituric acid) value among treatments after 3 and 6 days of storage period. T3 recorded significantly lower value of TBA (0.478 and 0.528 mg malonaldehyde / kg meat) after 3 and 6 days of storage period respectively, as compared with T1 (0.613 and 0.645 mg malonaldehyde / kg meat) and C (0.763 and 1.450 mg malonaldehyde / kg meat) after 3 and 6 days of storage period respectively. Also T2 (0.505 and 0.542 mg malonaldehyde / kg meat) and T1 (0.613 and 0.645 mg malonaldehyde / kg meat) after 3 and 6 days storage period respectively showed significantly lower TBA value as compared with C (0.763 and 1.450 mg malonaldehyde / kg meat) after 3 and 6 days of storage period respectively. The results revealed that the meat sample which treated with Pomegranate Peel extracts showed a preservation effect on meat by inhibiting lipid oxidation due to its antioxidants contents like flavonoids, ellagic acid, catechins and gallic (Li et al, 2006 , Zahin et al, 2010 and

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Devatkal et al, 2010), where these compounds slow fat oxidation by stabilize free radicals formation through preventing hydrogen atom transferring to the free radicals , so these free radicals are stable and thus prevent evolution of peroxide compounds like aldehydes, ketones and carboxylates (Geoffroy et al, 1994). During storage periods TBA value was significantly (P<0.01) increased in T3 and C, this may be attributed to the partial meat dehydration , increase oxidation of unsaturated fatty acid (Shahidi and Naczk, 2004) and to the decrease total phenolic with increasing storage period (Chidanandaiah and Sanyal, 2009).

Table (3): Effect of different concentration of pomegranate peel extract on Mb and Met-Mb content in LD Muscle of Karadi ram meat during refrigerator storage (Mean ± SE)

Treatment	Mb (mg/gm Muscle)			Met-Mb %		
	0 day	3 day	6 day	0 day	3 day	6 day
C	a A 2.91±0.008	a B 2.57±0.05	a C 1.83±0.06	a A 48.47±0.24	a B 53.13±0.43	a C 54.82±0.07
T1	a A 2.90±0.006	a B 2.64±0.04	b C 1.92±0.01	a A 48.52±0.31	ab B 52.59±0.29	ab C 54.56±0.11
T2	a A 2.91±0.005	b B 2.75±0.02	b C 1.97±0.02	a A 48.51±0.39	ab B 52.33±0.12	ab C 54.25±0.25
T3	a A 2.92±0.003	b B 2.80±0.006	ab C 1.92±0.006	a A 48.52±0.29	b B 52.04±0.05	b C 53.90±0.08

- Means having different small letters (a,bc,….) among treatments for each Column are significantly different (P < 0.01)
- Means having different capital letters (A,BC,….) among periods for each Row are significantly different (P < 0.01)

Table (4): Effect of different concentration of pomegranate peel extract on TBA (mg malonaldehyde/kg Muscle) in LD Muscle of Karadi ram meat during refrigerator storage (Mean ± SE)

Treatment	TBA		
	0 day	3 day	6 day
C	a A 0.597±0.025	a B 0.763±0.038	a C 1.450±0.050
T1	a A 0.590±0.005	b A 0.613±0.062	b A 0.645±0.045
T2	a A 0.589±0.01	bc A 0.505±0.015	bc A 0.542±0.0085
T3	a A 0.590±0.03	c B 0.478±0.003	c AB 0.528±0.028

- Means having different small letters (a,bc,….) among treatments for each Column are significantly different (P < 0.01)
- Means having different capital letters (A,BC,….) among periods for each Row are significantly different (P < 0.01)

Sensory Evaluation

The results presented in Table (5) showed that there were significant differences among treatments in sensory characteristics scores (color, flavor, tenderness and Juiciness).It seemed that T3 had significantly (P<0.01) higher score of color (4.000) which was significantly higher than T1 (3.143) and C (2.857). T2 had higher color score (3.714) as compared with that of C (2.857), and similar results were found for Myoglobin's content and met – myoglobin formation Table (3).

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These results may be due to that pomegranate peel extracts contain flavonoid compounds and catechins, which play effective role in myoglobin reduction and maintaining the longest storage period, thus providing meat color protection through delay the met – myoglobin formation (Naveena et al, 2008). Results revealed that T3 was more acceptable in the flavor and aroma score, which had significantly (P<0.01) higher score (4.000) as compared with that of T1 (3.143) and C (2.857). T2 recorded significantly higher score of flavor and aroma (3.571) as compared with C (2.857). These improvement agreed with that found for TBA (Table 4) which may be due to the fact that meat samples treated with pomegranate peel extracts showed a preservation effect on meat by inhibiting lipid oxidation related to its antioxidants contents which prevent peroxide compounds evolution like ketones, aldehydes and carboxylates (Devatkal et al, 2010, Li et al, 2006, Zahin et al, 2010). Results included the fact of juiciness showed that pomegranate peel extracts treatment led to significant (P<0.05) decrease in juiciness, T3 recorded significantly lower score (2.000) as compared with C (3.142). Similar results were noticed for pH, moisture (Table 1), WHC and cooking loss (Table 2), which may be to the decrease of pH in pomegranate peel extraction treatments as affected by existence of some acids which decreased meat susceptibility to water retention and increased cooking loss and all affecting meat juiciness (Tahir, 1983 , Guo et al, 2003 and Chandralekha et al, 2012).

Table (5): Effect of different concentrations of pomegranate peel extract on sensory evaluation score in LD Muscle of Karadi ram meat (Mean ± SE)

Treatment	Color	Flavor & Aroma	Tenderness	Juiciness	Overall Acceptability
C	a 2.86±0.26	A 2.86±0.26	a 3.71±0.18	a 3.14±0.34	a 3.14±0.26
T1	ab 3.14±0.34	Ab 3.14±0.14	a 3.43±0.20	ab 2.86±0.34	a 3.14±0.14
T2	bc 3.71±0.18	Bc 3.57±0.20	a 3.57±0.20	ab 2.29±0.18	a 3.29±0.18
T3	c 4.00±0.22	C 4.00±0.22	a 3.57±0.20	b 2.00±0.31	a 3.29±0.29

- Means having different small letters (a,bc,….) among treatments for each Column are significantly different (P < 0.01)
- Means having different capital letters (A,BC,….) among Treatments for each Column are significantly different (P < 0.05)

Conclusions

This study demonstrated the antioxidant effect of pomegranate peel extracts on shelf life of Karadi ram meat. Results of TBA and myoglobin analysis confirmed that pomegranate peel extract had higher antioxidant activity and retarded the lipid oxidation, maintaining myoglobin reduction actions and delayed met – myoglobin formation which results in acceptable meat flavor, aroma and color scores. It's important to note that the by-product of the natural antioxidant can be utilized in processing food products.

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