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Effect of Plum Puree on Quality Characteristics and Sensory Attributes of Functional Chevon Patties

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ABSTRACT

Three different levels (1%, 3% and 5%) of plum puree were attempted in the formulation of low sodium reduced fat meat emulsion to evaluate the possibility of its utilization as antioxidants in chevon patties. The product was evaluated for various quality characteristics and sensory attributes. The pH, and thiobarbituric acid (TBA) values were significantly ($P<0.05$) higher in control as compared to treatments and gradually decreased with the increasing levels of plum puree. Mineral contents and texture profile of plum puree added functional chevon patties did not differ significantly ($P>0.05$) in either of the treatment. Yellowness (b^*) and redness (a^*) values increased and lightness (L) value decreased significantly ($P<0.05$) with the increasing level of plum puree. All the sensory attributes were either comparable or higher score for PP_2 compared to control. Therefore, plum puree at 3% may suitably be used in the development of functional chevon patties without affecting quality and sensory attributes.

Keywords: Chevon patties, plum puree, quality, sensory attributes

Lipid oxidation is of great concern to the consumer because it causes physical and chemical deterioration of food quality, such as undesirable changes in taste, texture, appearance and development of rancidity, losses of important nutritional values and formation of potentially harmful components including free radicals and reactive aldehydes (Alamed *et al.,* 2009; Conde *et al.,* 2011). Especially, this process is favored in oil-in-water emulsions because of the large contact surface between the oxidizable lipid hydroperoxides in emulsion droplets and water-soluble prooxidants resulting in the propagation of oxidation reactions (Waraho *et al.,* 2012). Antioxidants are substances that at low concentrations retard the oxidation of easily oxidizable biomolecules, such as lipids and proteins in meat products, thus improving shelf life of the products by protecting them against deterioration caused by oxidation. These may be either synthetic or natural. Commonly used synthetic antioxidants are butylated hydroxytoluene and butylated hydroxyanisole (Brewer, 2011). However, synthetic antioxidants have now fallen under scrutiny due to potential toxicological effects. The meat industry is actively seeking natural solutions to minimize oxidative rancidity and increase products' shelf-life (Naveena *et al.,* 2008).

In response to recent demand for natural products and consumers' willingness to pay significant premiums for natural foods, because "natural" additives are perceived as beneficial for both quality and safety aspects and also possible beneficial effects on human health (Viuda-Martos *et al.,* 2010). Recent investigations have focused towards identification of novel antioxidants from natural sources. Due to their high content of phenolic compounds, fruits and other plant materials are regarded as a good source of natural antioxidants which provide an alternative to currently used conventional antioxidants (Nunez de *et al.,* 2008). They suppress the levels of reactive oxygen intermediates and thus play an important role in the defense mechanisms of plants (Gulcin *et al.,* 2003; Aehle *et al.,* 2004). Most natural antioxidants are obtained from plant resources including culinary herbs, fruits, vegetables, and oilseed products (Shahidi and Zhong, 2010). "Natural" additives are perceived as beneficial for both quality and safety aspects and also possible beneficial effects on human health (Viuda-Martos *et al.,* 2010). Previous research with plum juice concentrates in roast beef (Nunez de Gonzalez *et al.,* 2008b) has shown a retention and enhancement of red color during refrigerated storage, a reduction in lipid oxidation and no detrimental effects on sensory attributes of precooked roast beef. Thus, the objective of this study was to determine if the inclusion of different levels of plum puree could improve quality, retain color, texture and sensory attributes.

MATERIALS AND METHODS

Goat meat for the experiments was procured from authorized retail meat shop. The meat was obtained from hind legs of carcasses of good conformation of non-descript adult male goats (9-11 months of age group) slaughtered according to traditional halal method. The required quantity was purchased within 2–3 h of slaughter, packed in low-density polyethylene (LDPE) bags and brought to the laboratory within 20 min. The meat was deboned, trimmed-off separable fat and connective tissue. The samples were kept for conditioning in a refrigerator at 4±1ºC for 6–8 hours and then frozen at -18ºC till further use. The samples were used after partial thawing for 15 hours at 4ºC. Various spices, flours, condiments (onion, ginger, and garlic :: 3:1:1), refined oil and salt were purchased from standard shop of local market of Mathura, UP, INDIA. All the chemicals and media used in the study were of analytical grade and obtained from standard firm. Plum was purchased from local market; the recovered flesh was mixed with distilled water in the ratio of 1:5 in kitchen grinder to prepare puree. Freshly prepared puree was used for each replicate.

Lean meat was cut into smaller chunks and minced in a Sirmen mincer (MOD- TC 32 R10 U.P. INOX, Marsango, Italy) with 6mm plate followed the 4mm plate. Common salt, vegetable oil, refined wheat flour (maida), sodium tripolyphosphate, spice mixture and condiment mix were added to weighed meat according to formulation (Table ?) separately for each treatment group. Meat emulsion for patties was prepared in bowl chopper (MOD C 15 2.8G 4.0 HP, Marsango, Italy). Minced meat was blended with salt and sodium tripolyphosphate for 1.5 minute. Water in the form of crushed ice was added and blending continued for 1 minute. This was followed by addition of refined vegetable oil and blended for another 1 to 2 minutes. This was followed by addition of spice mixture, condiments and other ingredients and again mixed for 1.5 to 2 minutes to get desired emulsion. Adequate care was taken to keep the end point temperature below 18^0C by preparing the emulsion in cool hours of morning, by addition of meat and other ingredients in chilled/partially thawed form and by addition of crushed ice or ice water.

Table 1: Formulation of plum puree incorporated functional chevon patties

Ingredient	Treatments (%)			
	C	**PP_1**	**PP_2**	**PP_3**
Lean goat meat	70.0	70.0	70.0	70.0
Vegetable oil	5.0	5.0	5.0	5.0
Carrageenan	0.6	0.6	0.6	0.6
Ice flakes	14.4	13.4	11.4	9.4
Dry spices mix	2.0	2.0	2.0	2.0
Condiments	3.0	3.0	3.0	3.0
Refined wheat flour	3.0	3.0	3.0	3.0
STTP	0.4	0.4	0.4	0.4
Nacl	1.0	1.0	1.0	1.0
Kcl	0.4	0.4	0.4	0.4
$Cacl_2$	0.2	0.2	0.2	0.2
Plum puree	0.0	1.0	3.0	5.0

C (control) - low fat, low sodium chevon patties without natural antioxidant, **PP_1**- low fat, low sodium chevon patties with 1% plum puree; **PP_2**- low fat, low sodium chevon patties with 3% plum puree and **PP_3**- low fat, low sodium chevon patties with 5% plum puree

To prepare patties about 50 g of emulsion was molded on steel plate with circular ring (55 mm diameter and 20 mm height). Height and diameter of the patty was determined by Vernier Callipers. Patties were cooked in a pre-heated convection oven at 180°C for 14 minutes after which they were turned and allowed to cook for 4 more minutes to reach internal temperature of 75°C (Probe thermometer, Labware Scientific, Inc, USA). Developed patties were packed in low-density polyethylene pouches and stored at refrigerated temperature (4±1ºC). Each experiment was replicated thrice and the samples were analyzed in duplicate leading to total observation 6 (n = 6), whereas the sensory attributes were evaluated by a seven member (trained panel) in three sittings (n = 21) for each replicate.

pH was determined by using digital pH meter (WTW, Germany, model pH 330i) by immersing the spear type combination electrode (Sentix®, Germany) directly into minced meat sample.. Emulsion stability was determined by the method of Baliga and Madaiah (1970) with minor modifications. Twenty five grams of meat emulsion was taken in polyethylene bag and heated in thermostatically controlled water bath at 80^0C for 20 min. After cooling and draining the exudates, the cooked mass was weighed. Percentage of cooked mass was expressed as emulsion stability. Cooking yield was calculated as under and expressed as percentage (Murphy *et al.,* 1975).

$$\text{Cooking yield \%} \ \frac{\text{Weight of cooked chevon patties}}{\text{Weight of raw chevon patties}} = \times 100$$

Moisture, protein, fat and ash contents were determined as per AOAC (1995) method. Moisture retention value represents the amount of moisture retained in the cooked product per 100 g of sample and was determined according to equation by El-Magoli *et al.* (1996). Fat retention was calculated based on a modified method of Murphy *et al.* (1975).

Total cholesterol was determined as per Zlatkis *et al.* (1953) with slight modifications. Lipid extract was prepared by mixing one gram of sample with 10 ml of freshly prepared 2:1 Chloroform: Methanol solution and homogenizing it in a blender. Homogenate was filtered using Whatman filter paper No. 42 and 5 ml of filtrate was added with equal quantity of distilled water, mixed and centrifuged at 3000 rpm for 7 min. Top layer (methanol) was removed by suction. Volume of bottom layer (Chloroform) having cholesterol was recorded. The O.D. of standard and sample against blank was taken at 560 nm. Total cholesterol mg percent was recorded as follows:

$$\text{Cholesterol in (mg/100g)} = \frac{\text{O.D.of sample}}{\text{O.D.of standard}} \times \frac{\text{Vol.of choloform (ml)}}{\text{Weight of the sample taken(gm)}} \times \text{Conc.of standard}$$

Thiobarbituric Acid Value (TBA) value was estimated as per procedure given by Tarladgis *et al.* (1960). Ten grams of sample was taken and added to 49 ml of distilled water and 1 ml of sulphanilamide reagent (1 gram of sulphanilamide dissolved in solution containing 40 ml of concentrated HCl and 160 ml of distilled water) and blended with the help of pestle and mortar. After this 48 ml of distilled water was used for washing the mortar and to it 2 ml HCl solution (diluted 1:2 with distilled water) was added. The contents were transferred to Kjeldhal flask after adding several glass beads. This was heated on high heat and 50 ml of distillate was collected into a graduated cylinder. After mixing the distillate well, a 5 ml portion was taken into a 50 ml glass stoppered flask and 5 ml of TBA reagent was added. The contents were mixed and the flask was immersed in boiling water bath for 35 minutes along with blank solution. The blank prepared consisted 5 ml distilled water and 5 ml TBA reagent. The flasks were then cooled under tap water for 10 minutes and the optical density (O.D.) was recorded at 538 nm against blank. The TBA value as mg of malonaldehyde per 1000 gram of sample was calculated using following formula:

$$\text{TBA value (mg of malonaldehyde/1000 g of sample)} = \text{O.D. of sample} \times 7.8$$

Free fatty acid value was determined by modified AOCS method (Koniecko, 1979). Five gram of sample of different treatments was blended with the help of pestle and mortar in 30ml chloroform in presence of anhydrous sodium sulphate. Then it was filtered through whatman's filter paper no.1 in to 150 ml conical flask. About 2-3 drops of phenolphthalein indicator (0.2%) was added to the filtrate, which was titrated against 0.1N alcoholic potassium hydroxide to get the pink color end point. The free fatty acid content of the sample was calculated as:

$$\text{\% FFA as Oleic acid} = \frac{0.1Xml\ of\ 0.1alcohalic\ KOH\ used\ in\ titration \times 0.282}{sample..weight(g)} \times 100$$

The peroxide value was measured as per procedure described by AOCS (1992**)** with suitable modifications. Five gram of sample was blended with 30 ml acetic acid and chloroform solution (3:2) in 250 ml glass stoppered Erlenmeyer flask. Slurry obtained was gently swirled to extract lipid and then 0.5 ml saturated potassium iodide solution was added and allowed to stand for 1 min with occasional shaking (swirling), 30 ml of distilled water and 0.5 ml of freshly prepared 0.5 percent starch solution were added. Flask contents were titrated immediately against 0.01N sodium thiosulphate until intense blue colour disappeared. The peroxide value (meq/kg of the meat) was calculated as per the following formula.

$$\text{PV (meq/kg sample)} \frac{\text{N of sodium thiosulphate} \times \text{ml sodium thiosulphate used}}{\text{Wt. of sample (g)}} = \times 1000$$

Mineral contents were estimated as per method described by Horowitz (1965). Digested samples were then analyzed on Atomic Absorption Spectrophotometer (AAS 400 Perkin Elmer, USA) for Calcium (Ca), Iron (Fe), and Zinc (Zn) estimation, while Sodium (Na) and Potassium (K) were estimated by a Flame Photometer for which the volume was made up to 1000 ml.

Texture profile analysis (TPA) was performed as per Bourne (1978) using homogeneous sample (1.5mm × 1.5mm × 1.5mm) in Texturometer (stable micro system TA.XT-2i-25) for each treatment which was compressed to 10 mm (1cm) of original height through miniature Ottowa and Kramer shear cell platen probe. Cross head speed of 2.00 mm per second, post test speed 10.00 mm per sec. target mode distance 10.00 mm was used. The following parameters were determined viz; Hardness(N/cm^2) = maximum force required to compress the sample(H); Adhesiveness (Ns/g sec)=work necessary to pull the compressing plunger away from the sample; Springiness (cm/mm)=ability of sample to recover its original form after a deforming force was removed (S); Cohesiveness (Ratio) = Extent to which samples could be deformed prior to rupture (A2/A1, A1 being the total energy required for first compression and A2 total energy required for second compression); Gumminess (N/cm2 or g/mm^2) = force necessary to disintegrate a semi solid sample for swallowing (H x Cohesiveness); and Chewiness (N/cm or g/mm) = work required to the sample for swallowing (S × Gumminess).

Colour profile was measured using Lovibond Tintometer (Model: RT-300, UK) set at 2 of cool white light (D65) and known as *L*, *a**, and *b** values. *L* value denotes (brightness 100) or lightness (0), a* (redness/greenness), b* (yellowness/blueness) values. The instrument was calibrated using a light trap (black hole) and white tile provided with the instrument. Then the above colour parameters were selected. The instrument was directly put on the surface of functional chevon patties (Hunter and Harold, 1987). This replicated thrice and the samples were analyzed in duplicate leading to total observation 6 (n = 6).

Sensory evaluation was carried out by an experienced seven member trained panel in the morning session at 11.00 A.M. Three sittings (n = 21) were conducted for each treatment. Panel members were either faculty or post graduate students of the Deen Dayal Upadhyaya Veterinary and Animal Science University. Four training sessions were held to familiarize the panelists with the developed product characteristics to be evaluated and the scale to be used. Panelists were asked to evaluate the samples for general appearance, flavor, texture, saltiness, juiciness, mouth coating and express their overall acceptability using 8-point hedonic scale (Keeton, 1983), where 8 denoted extremely desirable and 1 denoted extremely undesirable. Chevon meat patty samples were internally cooked to 75°C and were served in random order at a temperature of approximately 60°C. At a time total of four samples (one from each treatment) were served to each panelist to compare the products.

Data were subjected to one way analysis of variance using homogeneity and Duncan's Multiple Range Test (DMRT) for comparing the effects between samples using the SPSS software of windows (version 16.0). Each experiment was replicated thrice and the samples were analyzed in duplicate leading to total observation 6 (n = 6), whereas for sensory attributes, evaluation were done by 7 members and replicated thrice for each experiment leading to total observation 21(n = 21). The statistical significance was expressed at ($p<0.05$).

RESULTS AND DISCUSSION

The mean values for various physicochemical parameters of low fat low sodium chevon patties incorporated with different levels of plum puree as antioxidants are presented in Table 2. Mean emulsion stability decreased marginally with addition of plum puree in low fat low sodium functional chevon patties. Similar results were also observed by Garcia, *et al.* (2009) when 6% dried tomato puree was added to a hamburger formulation. Cooking yield was decreased gradually with addition of plum puree in low fat low sodium functional chevon patties and lowest value in treatment PP_3 was estimated. Yıldız-Turp and Serdaroglu (2010) also demonstrated that beef patties formulated with plum puree had lower cooking yields than control samples. (Nunez de *et al.,* 2008) also reported lower cooking yield with incorporation of plum in roasted beef. Moisture, protein, fat and ash contents of low fat low sodium functional chevon patties were not significantly ($P>0.05$) affected by the incorporation of plum puree. This might be due to these contents either absent or present in very minute quantity that was not able to affect proximate composition of chevon patties. However, moisture content were marginally increased with the addition of plum puree might be due to higher moisture retention capacity of plum puree. Moisture retention in ground meat products is an important cooking parameter, since retained moisture in the product affects eating quality. Moisture retention was increased gradually with the addition of plum puree. The highest moisture retention was obtained in patties extended with 5% plum puree. Similarly Yıldız-Turp and Serdaroglu (2010) also reported highest moisture retention at 5% plum puree in beef patties and formulations with higher plum puree levels showed lower moisture retention than control samples. Addition of plum puree at higher level added to the batter blocking the water binding of meat protein, ultimately lowering moisture retention. Serdaroglu *et al.* (2005) recorded moisture retention values of 50.9–56.4% for meatballs extended with various legume flours. Keeping fat within the matrix of meat products during cooking and storage is necessary to ensure sensory quality and acceptability (Anderson and Berry, 2001). Fat retention in chevon patties were not affected significantly (P>0.05) by incorporation of plum puree. Control samples had also similar fat retention as 5% or 10% plum puree added patties (Yıldız-Turp and Serdaroglu, 2010). However, they also reported that at 15% addition of plum puree resulted in a weakening of the emulsion structure resulting in less fat retention in the patties.

The mean pH values of cooked chevon patties incorporated with plum puree were significantly lower compared to control. However, in between treatments no significant (P>0.05) difference was observed. This might be due slightly acidic nature of plum puree. Similar findings were also reported by Yıldız-Turp and Serdaroglu (2010) with increasing plum puree in cooked patties. Similar results were recorded by Candogan (2002) in meatballs formulated with different amounts of tomato puree.

Table 2: Physico-chemical properties of chevon patties incorporated with different levels of plum puree (Mean±SE)

Parameter	Treatment			
	C	PP_1	PP_2	PP_3
Emulsion Stability (%)	91.86±0.60	90.68±0.98	90.41±1.16	90.11±1.25
Cooking Yield (%)	91.88±0.61	89.94±1.14	89.75±1.10	89.63±1.14
Moisture (%)	62.98±0.32	63.15±0.61	63.29±0.62	63.47±0.64
Protein (%)	16.42±0.42	16.41±0.53	16.39±0.53	16.39±0.45
Fat (%)	9.00±0.28	8.98±0.30	8.97±0.19	8.95±0.23
Ash (%)	2.89±0.11	2.90±0.10	2.92±0.08	2.94±0.11
Moisture retention %	57.87±0.50	56.79±0.80	56.80±0.77	56.88±0.91
Fat retention (%)	93.52±0.59	93.38±0.88	93.32±0.59	93.35±0.74
Cholesterol (mg/100gm)	106.08±0.80	106.01±1.09	105.95±0.75	105.90±0.65
pH	6.12^{b}±0.01	6.02^{a}±0.02	6.00^{a}±0.03	6.00^{a}±0.03
TBA (mg malonaldehyde/kg)	0.51^{c}±0.007	0.46^{b}±0.012	0.41^{a}±0.011	0.41^{a}±0.010
FFA (% oleic acid)	0.35±0.010	0.34±0.012	0.32±0.014	0.32±0.016
V (meq/kg)	1.72±0.03	1.70±0.02	1.66±0.03	1.66±0.03

Means bearing different superscripts (a, b, c, d, …) in a row differ significantly (P<0.05) n=6

C (control) - low fat, low sodium chevon patties without natural antioxidant, **PP_1**- low fat, low sodium chevon patties with 1% plum puree; **PP_2**- low fat, low sodium chevon patties with 3% plum puree and **PP_3**- low fat, low sodium chevon patties with 5% plum puree

Table 3: Mineral profile (Mean±SE) of chevon patties incorporated with different levels of plum puree

Minerals (mg/100gm)	Treatments			
	C	PP_1	PP_2	PP_3
Sodium	445.54 ±9.92	447.98±13.26	453.76±11.34	446.13±12.67
Potassium	452.41 ±18.76	452.68±12.98	453.98±15.65	454.07±14.44
Calcium	61.26 ±1.67	61.72±1.46	62.16±1.39	62.78±1.56
Iron	2.96 ±0.10	2.98±0.12	3.03±0.13	3.06±0.11
Manganese	0.089±0.003	0.089±0.002	0.090±0.004	0.089±0.003
Zinc	2.41±0.08	2.42±0.09	2.40±0.08	2.41±0.11

n=6

C (control) - low fat, low sodium chevon patties without natural antioxidant, PP1- low fat, low sodium chevon patties with 1% plum puree; PP2- low fat, low sodium chevon patties with 3% plum puree and PP3- low fat, low sodium chevon patties with 5% plum puree

Table 4: Texture profile (Mean±SE) of chevon patties incorporated with different levels of plum puree

Parameter	Treatments			
	C	PP_1	PP_2	PP_3
Hardness (N/cm^2)	40.72±0.86	41.24±0.44	41.93±0.54	42.61±0.59
Adhesiveness (Ns)	-4.09±0.28	-3.96±0.13	-3.81±0.14	-3.81±0.15
Springiness (cm)	0.873±0.007	0.875±0.020	0.867±0.030	0.850±0.100
Cohesiveness (Ratio)	0.703±0.009	0.701±0.013	0.710±0.016	0.723±0.015
Gumminess (N/cm^2)	33.97±0.59	34.24±0.48	34.58±0.62	34.93±1.29
Chewiness (N/cm)	27.63±0.74	27.92±1.05	28.10±0.45	28.37±0.83

n=6

C (control) - low fat, low sodium chevon patties without natural antioxidant, **PP_1**- low fat, low sodium chevon patties with 1% plum puree; **PP_2**- low fat, low sodium chevon patties with 3% plum puree and **PP_3**- low fat, low sodium chevon patties with 5% plum puree

The TBA value of chevon patties were decreased significantly (P<0.05) with the increasing level of plum puree compared to control. Ulu (2004) reported that heating of samples during distillation promotes further oxidation leading to additional malonaldehyde and other TBA reacting substances. It is indicated that plum puree may be heat stable and withstands meat processing temperatures. Das *et al.* (2011) also reported addition of curry leaf powder, into minced goat meat at a concentration of 0.2% resulted in a significant (P<0.05) reduction of TBARS, FFA and PV values compared to the control. FFA value is a measure of hydrolytic rancidity in foods. Free fatty acids are the products of enzymatic or microbial degradation of lipids and determination of FFA gives information about stability of fat during storage (Das *et al.,* 2008). The FFA also decreased with the increasing level of plum puree, but the difference was non-significant. The peroxide value (PV) represents the total hydroperoxide content and is one of the most common quality indicators of fats and oils during production and storage (Ruiz *et al.,* 2001). The peroxide value is a useful method to determine the early stages of fat oxidation and the product is considered rancid when PV of 20-40 meq/ kg is reached (Economou *et al.,* 1991). The peroxide value also decreased with the increasing level of plum puree, but the difference was non significant. Pandey *et al.* (2016) also recorded lower TBARS value in treated samples than control while using BHA in pork sandwich.

Plum puree incorporation up to 5% added level in chevon patties did not show significant (P>0.05) difference in any of the estimated mineral in this experiment (Table 3). However, marginal increment in sodium, calcium and iron contents was recorded with addition of plum puree. This might be due to presence of these contents in plum puree. The mineral composition of plum is Sodium 10.40 mg/100gm, potassium 16.5 mg/100gm, calcium 30.27 mg/100gm and iron 5.20 mg/100gm (Vunchi *et al.,* 2011).

Table 5: Instrumental color (Mean±SE) of chevon patties incorporated with different levels of plum puree

Parameter	Treatments			
	C	PP_1	PP_2	PP_3
Lightness (*L*)	43.74 c±0.81	42.53 bc±0.57	41.32 ab±0.46	40.14 a±0.67
Redness (*a**)	3.26 a±0.22	3.53 a±0.20	4.15 ab±0.33	4.88 b±0.36
Yellowness (*b**)	10.28 a±0.44	10.74 a±0.34	11.13 ab±0.32	12.15 b±0.52

Means bearing different superscripts (a, b, c, d, …) in a row differ significantly (P<0.05) n=6

C (control) - low fat, low sodium chevon patties without natural antioxidant, **PP_1**- low fat, low sodium chevon patties with 1% plum puree; **PP_2**- low fat, low sodium chevon patties with 3% plum puree and **PP_3**- low fat, low sodium chevon patties with 5% plum puree

Plum puree addition had no effect on the texture profile of chevon patties. Plum puree addition slightly increased hardness, gumminess and chewiness value in chevon patties. Adhesiveness, springiness and cohesiveness value also slightly influenced but the differences were very small and not consistent (Table 4). Zhu *et al.* (2004) reported that the cross linking of amino acid was also important for the texture profile. These findings are in close agreement with the observations of Lee and Ahn (2005) who reported that texture of turkey breast rolls was not influenced by addition of plum extract.

The mean values for instrumental color analysis of low fat low sodium chevon patties incorporated with different levels of plum puree are presented in Table 5. Plum puree addition had significant (P<0.05) effect on the color profile of chevon patties. Lightness (*L**) value was decreased significantly (P<0.05) with plum puree addition. However, there was no significant difference was recorded in PP_1 compared to control. The redness (*a**) value and yellowness (*b**) value increased significantly (P<0.05) with addition of plum puree in chevon patties. However, there was no significant (P>0.05) difference in PP_1 compared to control and between PP_2 and PP_3. This color improving effect of plum puree can be attributed to the anthocyanins in red plum. Similar results were also reported by Lee and Ahn (2005) observed that irradiation and storage had no effect on color lightness (*L**), redness (*a**) and yellowness (*b**) values, but plum extract increased redness (*a**) value and yellowness (*b**) value and decreased lightness (*L** value) in turkey breast rolls. In cooked patties, control samples were slightly lighter than the other formulations, however no significant differences were found in lightness (*L**) values. Samples with 15% PP were redder than other groups with no significant differences in redness (*a**) values in the other groups (Yıldız-Turp and Serdaroglu, 2010). García *et al.* (2009) reported similar results, for hamburgers with added dried tomato powder and concluded that these

Table 6: Sensory attributes (Mean±SE) of chevon patties incorporated with different levels of plum puree

Attributes	Treatments			
	C	PP_1	PP_2	PP_3
General appearance	6.72±0.08	6.84±0.07	6.82±0.08	6.80±0.06
Flavour	7.06 b±0.07	7.04 b±0.07	7.00 b±0.08	6.76 a±0.07
Texture	6.75±0.06	6.87±0.06	7.00±0.09	6.72±0.09
Saltiness	7.11 b±0.08	7.07 b±0.08	7.00 b±0.06	6.75 a±0.06
Juiciness	7.08±0.07	7.12±0.08	7.14±0.07	7.19±0.07
Mouth coating	6.89 b±0.06	6.81 b±0.06	6.96 b±0.06	6.61 a±0.07
Overall acceptability	7.08 b±0.08	6.96 ab±0.09	6.98 ab±0.06	6.77 a±0.06

Means bearing different superscripts (a, b, c, d, …) in a row differ significantly (P<0.05) n=21

C (control) - low fat, low sodium chevon patties without natural antioxidant, **PP_1**- low fat, low sodium chevon patties with 1% plum puree; **PP_2**- low fat, low sodium chevon patties with 3% plum puree and **PP_3**- low fat, low sodium chevon patties with 5% plum puree differences could be a consequence of the color changes caused by the Maillard reaction during cooking.

The mean scores for general appearance, flavor, texture, saltiness, juiciness, mouth coating and overall acceptability of low fat low sodium chevon patties incorporated with different levels of plum puree as anti oxidants are presented in Table 6. According to the sensory panelist the general appearance scores was slightly increased with addition of plum puree in chevon patties. This might be due to increased color intensity. The dark color in plum puree added chevon patties was caused by the original dark purple color of plum puree. No significant differences (P>0.05) were seen in appearance and color scores (Yıldız-Turp and Serdaroglu. 2010). Similarly, Nunez de *et al.* (2008) reported that injection of plum ingredients up to 5% into beef roast had minimal effect on sensory color and appearance. Mean scores of flavor, saltiness and mouth coating of PP_3 were significantly (P<0.05) lower compared to control. However, flavor, saltiness and mouth coating scores for PP_1 and PP_2 were comparable to control. Yıldız-Turp and Serdaroglu (2010) reported that texture and flavor scores of 10% PP samples were significantly (P<0.05) higher than other treatments in beef patties. Nunez de *et al.* (2009) reported that the inclusion of 5% plum increased plum aromatic notes and sweetness of hams. Texture score was slightly higher but the differences were very small and not consistent with addition of plum puree. Juiciness value was gradually increased with addition of plum puree but no significant (P>0.05) difference was observed in between treatments and control. Lee and Ahn (2005) observed that plum extract decreased hardness at >2% level and increased juiciness at 3% level in irradiated turkey breast roll. This might be because of plum extracts sorbitol, a known humectant, which naturally binds moisture and thus improves the texture of turkey breast roll from "dry" mouth-feel in low fat contents meat.

Likewise in a study performed by Candogan (2002) tomato puree addition at concentrations of 10% and 15% increased juiciness of patties, with juiciness particularly increasing with concentration from 5% to 10%. The overall acceptability score was significantly (P<0.05) lower for PP_3. However, the score of PP_1 and PP_2 were comparable to control and PP_2 was most acceptable by the sensory panelist among the plum puree added variants.

CONCLUSION

On the basis of results obtained for various physico-chemicals, mineral profile, textural properties color analysis and sensory attributes and discussion made in light of finding of other workers, formulation containing 3% plum puree (PP_2) may suitably be used in low sodium reduced fat functional chevon patties without affecting quality and sensory attributes of the product.

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