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Investigation of the Potential Usage of Pomegranate Seed Flour in the Beef Patties

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Abstract

In order to determine the potential usage of pomegranate seeds in the beef patties, the effects of pomegranate seed flour (PSF; 0, 1, 2, 3%) on the physical, chemical, and sensory properties of beef patties were investigated. Patties were prepared using beef, beef fat, and spices. They were produced as handmade. Raw beef patties were cooked on a preheated electric grill. Effects of the PSF on the proximate composition, pH and instrumental colour values of raw beef patties were determined. Moreover, dimension reduction, cooking yield and sensory properties of cooked beef patties were studied. Increasing amounts of PSF in the raw beef patties decreased moisture, L and b values. Moreover, the addition of PSF decreased moisture and dimension reduction values of cooked beef patties. The addition of PSF did not cause a significant difference on the sensory properties of beef patties.

Keywords: Beef Patties, Pomegranate Seed, Patty, Colour.

Sığır Eti Köftelerinde Nar Çekirdeği Ununun Kullanım Potansiyelinin Araştırılması

Özet

Sığır eti köftelerinde nar çekirdeğinin kullanım potansiyelini belirlemek amacıyla nar çekirdeği ununun (NÇ; %0, 1, 2, 3), sığır eti köftelerinin fiziksel, kimyasal ve

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duyusal özellikleri üzerindeki etkileri araştırılmıştır. Köfteler, sığır eti, sığır et yağı ve baharatlar kullanılarak elde yapılmıştır. Köftelerin pişirilmesinde elektrikli ızgara türü bir ısıtıcı kullanılmıştır. Çiğ sığır eti köftelerinde, makro gıda bileşenlerinin oranları, pH ve enstrümental renk değerleri belirlenmiştir. Pişmiş köftelerde ise, makro gıda bileşenlerinin oranları, pH, çap küçülmesi, pişirme verimi ve duyusal analizler yapılmıştır. Çiğ köftelerde NÇ oranının artması, nem, L ve b değerlerinin azalmasına neden olmuştur. Ayrıca, NÇ ilavesi pişmiş köftelerin nem değerlerini düşürürken, çap küçülmesini kısmen engellemiştir. Bununla birlikte, NÇ ilavesi sığır eti köftelerinin duyusal özellikleri üzerinde önemli bir farklılığa neden olmamıştır.

Anahtar Kelimeler: Sığır Eti Köftesi, Nar Çekirdeği, Renk.

1. Introduction

During the industrial processing of pomegranate, important amounts of industrial wastes (seeds, peels) are produced, which have a wide range of nutritional values. Pomegranate contains several groups of bioactive compounds that are useful in disease risk reduction [1-5]. The use of pomegranate peel and seed as functional ingredients in foods would not only find an application for a waste product but the resulting product could also provide health benefits.

Pomegranate seed, the by-product of pomegranate juice processing, contains a range of nutritious components. It contains significant levels of oil, protein, fibre, phenolic substances, minerals and vitamins [6]. Oil, proteins and fibre can affect physical, technological and sensory properties of the meat products. Gölükcü et al. [6] reported that oil, protein, ash and total pehnolic contents of 15 pomegranate seed species were changed between 13.95-24.13%, 12.35-21.28%, 1.50-3.96%, 1535-3701 mg/kg dry matter, respectively. They also reported that oleic, lineleic, α-eleostrearic, β-eleostrearic, catalpic and punicic acid contents of the samples ranged between 3.20-5.28%, 3.44-5.27%, 5.94-6.85%, 0.73-1.35%, 3.06-4.40%, 0.42-0.75%, respectively.

Plant-derived products can be used in various meat products [7-10]. The type and the amount of non-meat ingredients in formulations of meat products are the most important factors for product quality, technological properties and health [7, 8, 11-15]. Pomegranate seed products have been studied in meat products to determine their

antioxidant effects [8, 15]. Therefore, pomegranate products influence on meat products has been studied so far by only a very few researchers, so there is very little information available. The objective of this study was to determine the effects of pomegranate seed flour on the physical, chemical, and sensory properties of beef patties.

2. Materials and Methods

Beef (*M. semimembranosus)*, beef fat were obtained from a local meat processor (Adıyaman, Turkey). Pomegranate seed flour was obtained from Natur Foods (Çorum, Turkey).

2.1. Patty Preparation

Beef and beef fat pieces (2-3 cm^3 in size) were mixed and twice minced in a grinder (Tefal, Le Hachoir 1500, France). This minced meat was divided into 4 parts. The following ingredients were added to the each part: 1.5% salt, 1.5% rusk flour, 1.4% red pepper, 0.6% black pepper, 0.6% cumin, and 1.6% onion powder. One kg of each formulation was then kneaded for 6 min by hand to obtain uniform meatball batter. Next, each 25 g of batter was shaped with silicone moulds into 1.4 cm thick and 4.8 cm diameter circular-shaped patties. The patties were cooked on a preheated electric grill (Philips HD4417, Philips, Amsterdam, the Netherlands) for 4 min on each side. The core temperature of patties was reached to 74°C during cooking. Core temperature was measured a digital thermometer with a penetration probe (Testo 926, Testo AG, Lenzkirch, Germany). Four meat patties were used for the analysis of each treatment.

2.2. Determination of the pH

10 g of sample was homogenized in 100 ml distilled water and the pH was measured using a pH meter (Orion 3-star, MA, USA) equipped with temperature probe as outlined by Ockerman [16].

2.3. Determination of the Patty Composition

Moisture, fat, protein and ash were determined according to AOAC [17]. Protein was determined as crude protein using the Kjeldahl method. Fat was determined as crude fat using the Soxhelet extraction.

2.4. Determination of the Cooking Yield

Cooking yield was determined as follows:

$$Cooking\ Yield\ (\%) = \frac{w_1 \times 100}{w_0}$$

where w_0 is the weight of patties before cooking and w_1 is the weight after cooking.

2.5. Determination of the Diameter Reduction

Diameter reduction was calculated as follows:

$$Diameter\ Reduction\ (\%) = \frac{(d_0 - d_1) \times 100}{d_0}$$

where d_0 is the diameter of patties before cooking and d_1 is the diameter after cooking.

2.6. Instrumental Colour Analysis

The colour values of the raw beef patties were measured by using a portable colorimeter (Minolta CR-400, Osaka, Japan). The instrument was standardised against a white standardisation plate before each measurement. The colour was measured according to CIELAB systems as L (lightness), a (redness) and b (yellowness) values, as described by Dogan [18]. Eight beef patties were used for the analysis of each treatment.

2.7. Sensory Analysis

The cooked beef patties were cooled to room temperature and coded with geometric shapes. They were served in a random order. Water and bread were served after each sample to remove traces of the previous sample from mouth. Ten trained panel (academic staff of Adıyaman University, Food Process, Food and Beverage, and Cookery Departments) who were selected and trained according to Yetim & Kesmen [19] assessed the sensory properties using a hedonic scale for the appearance, color, odor, texture, flavor, and general acceptance. The values in the scale indicated the following range of reactions: 1: dislike extremely to 9: like extremely.

2.8. Statistical Analysis

The data were subjected to analysis of variance (ANOVA), and the results were expressed as mean ± standard deviation (SD). When there were differences among the samples, the differences were compared by Duncan's multiple-range test.

3. Results and Discussion

3.1. Proximate Composition and pH Values of Raw Beef Patties

The effects of PSF on the pH, fat and protein values of raw beef patties were not found to be significant ($p>0.05$, Table 1). However, the effects of PSF on the moisture and ash values of raw beef patties were found to be significant ($p<0.05$, Table 1). Moisture values of raw beef patties decreased with the addition of PSF. Ash values increased with the increasing PSF. The changes in the moisture and ash values of raw beef patties might be due to lower moisture and higher ash content of PSF compared to beef. El-Nemr et al. [20] reported that dry matter of pomegranate seed was higher than 80%. However, researchers [20, 21] reported that pomegranate seed is an important source of minerals.

Table 1. Proximate composition and pH values of raw beef patties

PSF (%)	pH	Moisture (%)	Fat (%)	Protein (%)	Ash (%)
0.0	5.62±0.01	61.99±0.17 ^{b}	13.67±0.51	19.02±0.02	1.44±0.01 ^{a}
1.0	5.61±0.00	61.05±0.45 ^{a}	14.12±0.64	18.58±0.39	1.47±0.02 ^{a}
2.0	5.62±0.01	60.60±0.10 ^{a}	13.41±0.07	18.70±0.05	1.48±0.02 ^{ab}
3.0	5.63±0.01	60.32±0.28 ^{a}	13.26±0.30	19.22±0.51	1.53±0.02 ^{b}
SL	NS	S	NS	NS	S

SL: Significance level. NS: Non-significance. S: Significance. Mean values within a row followed by different letters are significantly ($p<0.05$) different. Values are means ± SD. PSF: Pomegranate seed flour.

3.2. Instrumental Colour Values of Raw Beef Patties

The effects of PSF on the colour of raw beef patties were found to be significant ($p<0.01$). As can be seen in Table 2, L and b values of raw beef patties decreased with the addition of PSF. The differences in the colour values of beef patties might be due to

the colour pigments of PSF. Legua et al. [22] reported that anthocyanins play an important role in the colour of the pomegranate seeds. Moreover, the decreasing moisture content (Table 1) might be decreased L values.

Table 2. The effects of pomegranate seed flour on L, a, b values of raw beef patties

PSF (%)	L	a	b
0.0	32.34±0.07 [b]	11.22±0.74	11.89±0.11 [b]
1.0	31.61±0.23 [a]	10.58±0.22	11.26±0.17 [a]
2.0	31.19±0.18 [a]	10.19±0.02	11.12±0.06 [a]
3.0	31.62±0.32 [a]	10.32±0.10	11.55±0.22 [ab]
SL	S	NS	S

SL: Significance level. NS: Non-significance. S: Significance. Mean values within a row followed by different letters are significantly ($p<0.05$) different. Values are means ± SD. PSF: Pomegranate seed flour.

3.3. The Composition and pH Values of Cooked Beef Patties

The effects of PSF on the composition of cooked beef patties were not found to be significant ($p>0.05$), with the exception of moisture. As shown in the Table 3, the addition of PSF decreased moisture values of cooked beef patties. However, the effects of differences in the additional PSF levels (1%, 2% and 3%) on the moisture values were not found to be significant. These changes in the moisture values of cooked beef patties were similar to the changes of raw beef patties. This similarity demonstrated that the addition of PSF in the beef patties did not lead to significant differences in the effects of cooking process. However, the patty cooking process increased protein and ash values and decreased the moisture values when Table 3 is compared with Table 1. The moisture loss during cooking process increased dry matters including protein and minerals. Also, such increasing in the protein and ash values might be resulted from fat content. When raw beef patties compared with cooked beef patties, the differences in the fat contents were not found to be significant. The cooking process can lead to fat loss due to melting. Therefore, increasing dry matters were not increased fat values of the cooked beef patties.

The effects of PSF on the pH values of cooked beef patties were not found to be significant ($p>0.05$). However, the patty cooking process increased pH values when Table 3 is compared with Table 1. Increasing pH values of beef patties might be resulted from basic compounds released during the cooking process.

Table 3. The composition and pH values of cooked beef patties

PSF (%)	pH	Moisture (%)	Fat (%)	Protein (%)	Ash (%)
0.0	5.85±0.04	54.14±0.02 [b]	13.35±0.27	24.94±0.45	1.72±0.06
1.0	5.84±0.04	53.17±0.13 [a]	13.55±0.09	24.89±0.77	1.76±0.09
2.0	5.84±0.05	52.65±0.07 [a]	13.67±0.01	24.89±1.16	1.91±0.08
3.0	5.82±0.01	52.61±0.38 [a]	13.27±0.01	24.38±0.10	2.09±0.07
SL	NS	S	NS	NS	NS

SL: Significance level. NS: Non-significance. S: Significance. Mean values within a row followed by different letters are significantly ($p<0.05$) different. Values are means ± SD. PSF: Pomegranate seed flour.

3.4. The Size and Cooking Yield of Beef Patties

The addition of PSF resulted in a significant ($p<0.01$) difference on the size of beef patties. As can be seen in Table 4, the addition of PSF decreased dimension reduction values. This effect was found to be significant at 2% and 3% levels of PSF. The size of cooked beef patties changed with PSF addition. The decline in diameter values might be considered to be associated with the fibrous structure of PSF. Mir et al. [23] reported that pomegranate seeds were a rich source of crude fiber. Moreover, El-Nemr et al. [20] reported that crude fiber of pomegranate seed was higher than 35%.

The effects of PSF on the cooking yield values of beef patties were not found to be significant ($p>0.05$). Although the cooking yield values of beef patties decreased with increasing PSF levels (Table 4), such decreasing was not found to be significant ($p>0.05$).

Table 4. The effects of PSF on the technological properties of cooked beef patties

PSF (%)	Dimension Reduction (%)	Cooking Yield (%)
0.0	17.35±0.05 [b]	74.91±0.22 [a]
1.0	16.78±0.42 [b]	74.73±0.17 [a]
2.0	15.96±0.06 [a]	74.78±0.26 [a]
3.0	15.59±0.06 [a]	74.67±0.27 [a]
SL	S	NS

SL: Significance level. NS: Non-significance. S: Significance. Mean values within a row followed by different letters are significantly ($p<0.05$) different. Values are means ± SD. PSF: Pomegranate seed flour.

3.5. Sensory Properties of Beef Patties

The effects of PSF on the sensory properties of beef patties were not found to be significant ($p>0.05$; Table 5). Although the addition of PSF decreases instrumental colour values (L and b, Table 2) of raw beef patties, this difference was not found to be significant on the cooked beef patties by the panellists (Table 5). The sensory scores of the parameters were above 6. Such scores were higher than average value of hedonic scale. Pomegranate seed flour with the addition of up to 3% could be possible, in terms of sensory quality of beef patties.

Table 5. The effects of PSF on the sensory properties of cooked beef patties

PSF (%)	General appearance	Colour	Odour	Texture	Flavour	General acceptance
0.0	6.75±1.20	6.95±0.64	6.95±1.06	6.85±0.45	7.20±0.42	7.20±0.71
1.0	7.05±0.50	7.05±0.50	7.20±0.28	7.10±0.71	7.15±0.78	7.35±0.64
2.0	6.95±0.21	7.20±0.14	7.35±0.50	7.00±0.14	6.90±0.14	7.15±0.35
3.0	7.25±0.21	7.20±0.99	6.70±0.14	6.65±0.50	6.30±0.57	6.80±0.71
SL	NS	NS	NS	NS	NS	NS

SL: Significance level. NS: Non-significance. Values are means ± SD. PSF: Pomegranate seed flour.

4. Conclusion

Although the addition of PSF decreased moisture and instrumental colour values of beef patties, the effects of PSF were not found to be significant on the sensory scores of beef patties. However, PSF decreased dimension reduction values of cooked beef patties. We concluded that pomegranate seed flour addition into the beef patties up to the level of 3% can be recommended.

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