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RESEARCH ARTICLE

Textural, Chemical and Sensory Properties of Döners Produced from Beef, Chicken and Ostrich Meat

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Summary

In this study, the chemical, textural and sensory properties of beef, chicken, or ostrich meat döners were compared. Ostrich döner samples had lower (P<0.0001) cholesterol content than beef or chicken döners but higher calorific values. It is observed that beef döners had higher (P<0.0001) Warner-Bratzler shear force (WBSF) than chicken and ostrich döners. According to the texture analyses results it is concluded that hardness measured by Texture Profile Analyzer was found to be a better predictor of sensory tenderness than WBSF. Panelists rated ostrich meat with highest point in terms of sensory properties. Ostrich döners had better overall acceptance than beef or chicken döners. Therefore it is concluded that ostrich döner can be taken into consideration as an alternative protein source to beef or chicken döners.

Keywords: *Ostrich meat, Döner, Texture*

Sığır, Tavuk ve Devekuşu Etinden Üretilmiş Dönerlerin Tekstürel, Kimyasal ve Duyusal Özellikleri

Özet

Bu çalışmada deneysel olarak üretilmiş sığır, tavuk ve devekuşu etinden üretilmiş dönerlerin kimyasal, tekstürel ve duyusal özellikleri karşılaştırılmıştır. Sığır ve tavuk dönerlerine göre devekuşu etinden üretilmiş döner örneklerinin kolesterol içeriği daha düşük, kalori değerleri ise daha yüksek bulunmuştur. Sığır etinden üretilmiş döner örneklerinin daha yüksek Warner Bratzler kesme kuvveti (WBSF) değerlerine sahip olduğu gözlenmiştir (P<0.0001). Yine elde edilen doku analizi bulgularına göre Tekstür Profil Analizi ile ölçülen sertlik değerinin WBSF değerine göre duyusal gevrekliğin daha iyi bir belirleyicisi olduğu sonucuna varılmıştır. Panelistler duyusal özellikler bakımından en yüksek puanla devekuşu etini tercih etmişlerdir. Devekuşu döneri sığır eti ve tavuk etinden üretilmiş döner örneklerinden daha yüksek beğeni almıştır. Sonuç olarak devekuşu dönerinin sığır ve tavuk dönerlere alternatif bir protein kaynağı olarak değerlendirilebileceği kanısına varılmıştır.

Anahtar sözcükler: *Devekuşu eti, Döner, Tekstür*

INTRODUCTION

Döner is a traditional Middle Eastern meat product, which is consumed widely in Turkey and many parts of the world [1-3]. Although döner appeals people who are accustomed to the Anatolian culture, it has become a competitor in the fast-food market [4]. Döner is traditionally made from lamb, veal, beef, or poultry meat or by mixing them at certain proportions in the presence of onion, pepper, tomatoes, and other spices [5]. As an extra flavor, several other spices (white pepper, black pepper, cumin, allspice, curry, and thyme), tomato paste or juice, milk powder, lemon juice, yoghurt, chicken egg and sugar may be added [6-8]. Sauce composition may vary [9]. Based on the production style, döners are classified as leaves, leaves and ground, and ground [10]. After the raw döner on a vertical stick is slowly rotated to roast in an open gas or electric oven, cooked portions are removed as thin slices and consumed in bread with sliced tomato, onions and lettuce [1,10-12].

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Altough döner made from beef, veal, or lamb meat are the most common, the use of chicken meat in döner production has become very popular because it is cheap and digested easily. However some quality problems like non-uniform shaped pieces occured while shaving off, juiciness and texture are not desirable to the consumer [7,10]. Beef döner is a tasty meal but its comparatively high fat content makes it not a very healthy choice. It is suggested that, the higher fat intake increases risk of certain types of cancer, and coronary heart disease. Several health-related organizations, including American Cancer Society and World Health Organization have recommended that fat intake be reduced to less than 30% of total calories received daily [13]. Therefore other meat source like ostrich meat may also be used in place of beef or chicken meat. Ostrich meat has a darker color than beef due to its higher pH and higher myoglobin content. Ostrich meat is considered a healthier choice because it has lower saturated fatty acids and higher polyunsaturated fatty acids than red meats. Moreover, ostrich meat has lower overall lipid content [14-17]. Compared to beef, lower lipid content, lower saturated fatty acid content and higher polyunsaturated fatty acid content of ostrich meat might make it a possible candidate for döners provided that it yields at least similar or better quality döner than beef. Therefore, the goals of this study were to determine and compare chemical, textural, and sensory properties of döners made from beef, chicken, or ostrich meat to develop better quality döner.

MATERIAL and METHODS

Sample Preparation

The beef, chicken, and ostrich döner samples provided by a local company in Manisa were formulated for this research and prepared complying with retailer's recipe and cooking conditions. The experiment was repeated 3 times and 9 samples for each treatment were analyzed. Deboned meats were trimmed of skin, connective tissue and visible fat in a processing hall at 4°C. Beef döners had beef, tallow, onion, milk, sunflower oil, black pepper, thyme and salt. Ostrich döners were produced for our research and had the same formula except for that ostrich meat was used instead of beef. Chicken döners had chicken breast meat, skin, sweet pepper paste, curry, paprika, and salt. Prepared döners were spitted on a döner kebap stick and slowly rotated for 2 min in front of a gas oven. Cooked surface was shaved off using automatic knives in the form of thin slices (0.25 cm). About 250 g of sample was packed in polyethylene bags and transferred with use of this retailer's cold chain cars to the laboratory. All analyses were performed at Celal Bayar University Food Engineering Department Laboratories.

Chemical Analysis

Chemical properties of döner samples including moisture, protein, fat, and ash content were determined using official methods [18] and expressed as %. Cholesterol content was determined using the procedure by Naeemi, Ahmad, Al-Sharrah, and Behbahani [19]. The pH was measured in a homogenate prepared by blending 10 g döner samples with 100 ml of distilled water for 30 s. Readings were taken with a WTW model pH 521, digital pH-meter and a WTW, type E56, combination electrode (WTW-Wissensehaftlich-TechnischeWerkstaetten GmbH, Weilheim, Germany). Water activity was measured using a portable hygrometer (AM/Wert-Messer, Germany).

Color Measurement

L*, a*, b* values were determined *with* a digital *Minolta CR300 chromometer* (*Minolta* Co., *Osaka*, *Japan)* The samples were homogenized and transferred to petri dishes before taking the readings. It was ensured that there was no gap between the sample and the petri lid and the lenses of colorimeter touched to the lid of the petri dish. Six readings per sample were taken and mean values were calculated.

Warner-Bratzler Shear Force and Texture Profile Analysis

Samples were sheared using a WSBF head with a load cell of 50 kg with crosshead spead and chart speed of 10 cm/min attached to a Texture Analyzer (Stable 80 Micro Systems, England). The texture profile analysis (TPA) parameters, including hardness (peak force on first compression, N), cohesiveness (ratio of the work done under the second fore-displacement curve to that one during the first compression) and gumminess (force to disintigrate a semisolid sample for swallowing, N) were determined according to the procedure suggested by Bourne [20].

Energy Values

Total calories were calculated taking a 100-g cooked sample as a reference using values for protein (4.02 cal/g), fat (9.3 cal/g) and for carbonhyrate (3.87 kcal/g) and were given as kcal.

Sensory Properties

Panelists from the faculty and research assistants at Food Engineering Department, evaluated overall acceptability, apperance, flavor, juiciness, tenderness, and ease of swallowing of samples by following AMSA quidelines [21]. Unsalted crackers and water (at room temperature) were served to panelists to clean the palate between the samples. No more than two sessions per day was scheduled to prevent fatigue. Panelists evaluated samples using an 8-point hedonic scale.

Statistical Analysis

The design was completely randomized. The treatments

were beef, chicken, and ostrich meat döners. Three replications were done. The analysis of variance was done using the PROC GLM procedure of SAS (version 8.2, SAS Institute Cary, NC 2001). LSMEANS for teatments were generated and separated when significant (P<0.05) using the pdiff statement. Correlation coefficients were calculated using PROC CORR procedure of SAS [22].

RESULTS

Chemical Analysis

Chicken and ostrich döners had statistically similar protein contents, but had higher protein contents than beef döner *(Table 1)*. This finding is in agreement with Kayisoglu et al.[23]. Beef döners had the highest ash content, followed by ostrich and chicken döners. Moisture content was not affected by type of döner (P>0.05), or was water activity (P>0.05). pH was not different (P>0.05) among chicken ostrich, and beef döners. Chicken and beef döners were reported to have similar pH values [23]. Ostrich döners had the highest fat content followed by beef and chicken döners. This observation could be attributed to the fact that ostrich döners cooked fastest and there was not enough time for the added fat to be removed from the ostrich meat. On the other hand, beef döners cooked the slowest resulting in removal of fat, thus having the lesser fat than ostrich döners. As for chicken döners, chicken skin rather than fat was used in the formulation, probably leading to the least amount of fat among the type of döners studied. Chicken döners were also reported to have less amount of fat than beef döners in another study [23].

Cholesterol content was the highest in chicken döners because chicken skin was in the chicken döner formulation and it was lowest in the ostrich döner. Similary, other authors [15,17] pointed out that ostrich meat was a healthy red meat due to its low cholesterol content [15,24]. However, other study by Hoffman [25] did not agree and suggested that ostrich meat had similar cholesterol values to other lean type meats. Beef döners had lower cholesterol content than chicken döners, which could be attributed to the fact that on the average beef (muscles) had 60 mg/100 g whereas chicken (muscles) had 80 mg/100 g cholesterol [26].

Color Values

Beef and ostrich döners had similar L* values (P>0.05), whereas they had lower (P<0.001) L* values than chicken döners. The a* (redness) value was the highest for chicken döners (P<0.0001). This could be explained by the chicken döner formulation because chicken döners contained considerable amount of red pepper paste, which probably resulted in redder color. Similarly, chicken döners had higher (P<0.0001) b*(yellowness) than beef or chicken döners. Inclusion of skin and the color of chicken fat in chicken döner formula could have caused this.

Warner-Bratzler Shear Force and Texture Profile Analysis

Beef döners had higher (P<0.0001) Warner-Bratzler shear force (WBSF) than chicken or ostrich döners. Ostrich döners had significantly higher (P<0.01) WBSF (less tender) than chicken döners *(Table 3)*. Hardness followed the same trend with beef döners having higher hardness (P<0.0001) values than ostrich or chicken döners. Chicken döners were found to have the least hardness value. Hardness values for chicken döners were comparable to those reported by Kilic [27]. The type of döner (beef, chicken, or

Table 1. *Chemical properties and color values of beef, chicken, or ostrich döners*
Tablo 1. *Sığır, tavuk ve devekuşu dönerlerin kimyasal özellikleri ve renk değerleri*

Sample	Protein (%)	Ash (%)	Moisture (%)	Fat (%)	pH	aw	Cholesterol	L*	a*	b*
Beef	34.02^{a}	5.15^{a}	51.40^{b}	9.75^{b}	6.37	0.93	49.16^{b}	43.96^{b}	3.65^{b}	5.05^{b}
Chicken	33.73^{a}	2.31^{c}	54.35^{a}	9.25^{b}	6.33	0.95	68.72^{a}	60.23^{a}	8.67^{a}	23.6^{a}
Ostrich	31.56^{b}	3.45^{b}	51.69^{b}	14.68^{a}	6.42	0.93	22.77^{c}	43.14^{b}	3.43^{b}	3.48^{c}
P-value	0.0002	0.001	0.073	0.28	0.37	0.0003	<0.0001	<0.0001	<0.0001	<0.0001

^{a,b,c} *Means in the same row with different letters differ significantly (P<0.05)*

Table 2. *Sensory properties of beef, chicken, and ostrich döners*
Tablo 2. *Sığır,tavuk ve devekuşu dönerlerin duyusal özellikleri*

Sample	Taste	Ease of Swallowing	Appearance	Juiciness	Overall Tenderness	Overall Acceptability
Beef	6.52^{b}	6.05^{c}	6.26^{b}	5.75^{c}	5.73^{c}	5.93^{c}
Chicken	6.28^{c}	6.55^{b}	6.51^{b}	6.30^{b}	6.70^{b}	6.33^{b}
Ostrich	6.80^{a}	7.22^{a}	6.97^{a}	6.98^{a}	7.47^{a}	7.40^{a}
P-value	0.003	<0.0001	0.008	0.0007	<0.0001	<0.0001

^{a,b,c} *Means in the same row with different letters differ significantly (P<0.05)*

Table 3. *WBSF (kg) values of beef, chicken, and ostrich döners*
Tablo 3. *Sığır,tavuk ve devekuşu dönerlerin WBSF (kg) kesme kuvveti değerleri*

Sample	WBSF (kg)
Beef	6.05[a]
Chicken	1.58[c]
Ostrich	3.16[b]
P-value	0.0002

[a,b,c] *Means in the same row with different letters differ significantly (P<0.05)*

significantly correlated (P>0.05, r=-0.63) to cohesiveness. Safari et al.[28] also found significant correlation between WBSF and sensory tendemess [28]. Correlation coefficient between hardness and sensory tendernes was higher (P<0.05) than that between WBSF and sensory tendernes. Huidobro et al.[29] similarly reported texture profile analysis parameters as better predictors of sensory tendemess as compared to WBSF, agreeing with our findings. Ease of swallowing was significantly correlated to hardness (P<0.01, r=-0.89), cohesiveness (P<0.05, r=-0.67), and gumminess (P<0.01, r=-0.83), but was not significantly

Table 4. *Texture profile analysis parameters of beef, chicken, and ostrich döners*
Tablo 4. *Sığır,tavuk ve devekuşu dönerlerin tekstür profil analiz parametreleri*

Sample	Hardness	Chewiness	Cohesiveness	Gumminess
Beef	5.74[b]	1.54[b]	0.75	2.52[b]
Chicken	4.52[b]	1.23[b]	0,80	2.74[b]
Ostrich	5.12[a]	2.18[a]	0.82	4.21[a]
P-value	0.0002	<0.0001	<0.21	0.0005

[a,b,c] *Means in the same row with different letters differ significantly (P<0.05)*

ostrich) did not affect (P>0.05) cohesiveness value. Beef döners had higher (P<0.0001) gumminess values than chicken or ostrich döners. However, chicken and ostrich döners yielded similar (P>0.05) gumminess values *(Table 4)*.

Energy Values

Beef and chicken döners had about 232 kcal, and 226 kcal (100-g cooked), respectively, whereas ostrich döners had approximately 262 kcal. The higher caloric content of ostrich döners might poise a problem from nutritional point of view.

Sensory Properties

Ostrich döners had better taste (P<0.01), ease of swallowing (P<0.01), overall appearance (P<0.01) higher juiciness (P<0.01), higher overall tendemess (P<0.01), and better overall acceptability (P<0.01)than beef or chicken döners *(Table 2)*. Beef döners had higher (P<0.05) taste, but lower (P<0.05) ease of swallowing, lower overall tendemess (P<0.0001), lower juiciness (P<0.05) and lower (P<0.05) overall acceptability than chicken döners. Beef and chicken döners had similar (P>0.05) appearance. Overall, panelists clearly chose ostrich döners over beef or chicken döners *(Table 2)*.

Correlation Coefficients

Flavor was not correlated (P>0.05) to any of the textural parameters. Appearance was not highly (P>0.05, r=-0.46) correlated to WBSF, but was highly negatively correlated to hardness (P<0.05, r=-0.72), cohesiveness (P<0.01, r=-0.82), or gumminess (P<0.05, r=-0.79). Overall tenderness was negatively correlated (P<0.05, r=-.710) to WBSF, hardness (P<0.01, r=-0.89), gumminess (P<0.01, r=-0.9), but was not correlated (P>0.05, r=-0.6) WBSF. Similarly, juiciness was negatively correlated to hardness (P<0.01, r=-0.82), cohesiveness (P<0.05, r=-0.74), and gumminess (P<0.01), but not to WBSF (P>0.05, r=-0.56). Overall acceptability followed the same trend. Overall acceptability was negatively correlated to hardness (P<0.05, r=-0.72), cohesiveness (P<0.05, r=-0.71), and gumminess (P<0.05, r=-0.76), but was not significantly correlated to WBSF (P>0.05, r=-0.44).

Ostrich meat in place of beef or chicken meat can successfully be used in the production of a traditional product (döner) without significantly affecting its eating quality. Ostrich meat was found to produce better döners in terms of sensory properties, and textural characteristics, which further justifies its use in processed meat products although ostrich meat döners were found to have the highest fat content. Moreover, cholesterol content of the ostrich meat döners was the lowest making it as an alternative fast food for the people who suffer from cholesterol related diseases. Our results suggest that ostrich meat döners will be a novel product and will have a promising future in the fast food sectors provided that use of ostrich meat in processed meat products become a common practice in the meat industry.

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