

CHEMICAL, MICROBIOLOGICAL AND SENSORY CHARACTERISTICS OF DONER KEBAB MADE FROM SUCUK DOUGH, DRY FERMENTED TURKISH SAUSAGE

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Background

Recently, consumption of processed meat and poultry products sold in fast food markets has been gaining popularity. The doner known by some other names, such as gyro, dona-kebab, doner-kebab, chawarma or shawirma is a traditional Middle East meat product which is consumed widely in many areas of the world (Bryan *et al.*, 1980; Jockel, and Stengel, 1984; Stolle *et al.*, 1993; Bartholoma *et al.* 1997; Kayisoglu *et al.*, 2003). In the production of doner, lamb, veal, beef, or poultry meat is seasoned with onion, pepper, tomatoes, and some spices. The meat and some animal fats are shredded or ground, then mixed with seasoning materials and molded to give a cone like shape. The mass is refrigerated to allow the meat and fat particles to cohere. Raw doner is fixed on a vertical spit and slowly rotated to roast the surface evenly in front of a heating element powered by electric, gas, or charcoal. It is cut into thin slices as it is gradually broiled. The kebab (doner) slices is served to the customer either on a plate (in restaurants) or in bread-like sandwiches (in fast food units) with additional herbs, salads, or dressings (Todd *et al.*, 1986; Kayahan and Welz, 1992; Digrak *et al.*, 1995; Moeller *et al.*, 1994; Acar and Ciftcioglu, 1997; Kayisoglu *et al.*, 2003).

Researchers have studied the hygienic and/or chemical quality of doner kebabs since these types of meat products are popular as fast food and are sold in many areas of the world. However, developments of the novel doner type foods have not been extensively studied, and the research is necessary because of the limited information on composition and hygienic quality to inform consumers regarding public safety (Todd *et al.*, 1986; Stolle *et al.*, 1993; Kayisoglu *et al.*, 2003). The development of novel meat products might be a strategy to increase the consumption of meat. For example, Turkish-style dry fermented sausage known as sucuk has become one of the most popular meat products in Middle Eastern countries and Europe. This product has been produced with various types or treatments, e.g. in some places in Turkey, the sausage (sucuk) dough before fermentation is incorporated into the doner kebab formulation, and then the mix is molded, refrigerated, and cooked. The research on these types of products has been extremely limited. Therefore, this study objective was to determine some quality characteristics of the cooked doners made from sucuk dough and beef.

Materials and Methods

The sucuk (dry fermented Turkish sausage) dough was prepared as described by Turkish sucuk standard TS, 9298, and the doner preparation was also based on Turkish standard TS, 11658 for uncooked doner producing rules (Anon. 1991; Anon. 1995). Then, approximately one kilogram of the sucuk doners was prepared from 50% sucuk dough and 50% shredded beef doner materials which was fixed on a kebab spit as described, utilizing a uniform distribution of meat slices and sausage dough. Then, the raw doners were molded, trimmed, refrigerated, and grilled by rotating the spit slowly in front of an electric heating element. It was cut into thin slices as it was gradually broiled. Samples were obtained before and after cooking for the analysis of the doners.

Total bacteria, psychrotrophic bacteria, yeast and mould, total coliforms, staphylococcus/micrococcus and anaerob counts of the raw and cooked doner samples were determined according to the BAM (1998) procedure and reported as log cfu/g. Chemical properties of the raw and roasted doner samples, such as pH and TBA values, as well as total nitrogen, total fat, moisture, and ash contents were determined by AOAC (1990) methods. Organoleptic characteristics of the grilled doner and sausage samples were evaluated using a 10-point hedonic scale for: flavor/aroma, texture, color, and general appearance. For this purpose, five to seven panelists were used to evaluate the grilled doner samples as described by AMSA (1978).

Results and Discussion

Quality characteristics of the doners made with sucuk dough, a dry and traditionally sliced meat, are summarized in Table 1. There were statistically significant differences between the traditional doners and sausage (sucuk) doners in terms of the chemical, microbiological, and sensory analysis results, not only in raw products, but also cooked. For example, pH, present protein, ash and TBA values of the sausage doner were higher than that of the raw and cooked but they had lower present moisture and fat. As could be expected, the higher present ash content in the raw/grilled sausage doner is most probably due to the curing ingredients that have not been regularly placed in the traditional doners. Again, uncooked sausage doners had significantly higher APC, yeast/mold, and psychrotrophic count, while no differences were determined in coliform, total staphylococcus/micrococcus, and anaerobes count between the raw sausage doners and traditional doners (Table 1). However, cooked sausage doners had significantly higher microbial counts in all of the tested microorganisms except total Staphylococcus/Micrococcus when compared to the traditional doners. These results might be due to the textural and compositional differences of the doners, because the sausage doners were prepared from ground meat and fat materials, which contained various curing ingredients this would be expected. Additionally, texture and/or composition of the sausage doners might create a better environment for protecting the microorganisms from the cooking effect.

As mentioned above, research has been conducted on raw and cooked doners that were collected from local fast food units, and the researchers found similar results with what were determined in this study (Table 1). For example, Kruger *et al.* (1993) found an average of 60.4% water, 20.1% fat, 17.4% protein in the chemical analysis and 5.3-6.2 log cfu/g Staphylococci in the bacterial analysis of 40 traditional doner samples. Seeger *et al.* (1986) reported that 80% of raw and cooked doners had less than 35.3 % fat and more than 12.2% protein, while the water content varied between 37.9 to 68.1% for raw and 14.5 to 63.8% for the cooked doners. Again, Todd *et al.* (1986) studied 34 doner samples, and total bacteria count was between 10⁵-10⁷ cfu/g. Stolle *et al.* (1993) evaluated 44 cooked doner samples obtained from different establishments in Munich/Germany, and reported the average total bacteria count as 10⁵ cfu/g. In another study on the doner kebabs sold in Erzurum/Turkey, an average of 1.7 to 3.0 x 10⁵ cfu/g total aerobic bacteria count and 1.0-8.4 x 10² cfu/g *E. coli* were determined (Kupeli, 1996).

The most significant observation made in this research was the organoleptic analysis results. As could be followed from Table 1, the sausage doners were rated better by the evaluators in terms of the sensory characteristics that were asked in this research. For example, sausage doners received significantly higher scores for flavor, texture, color, and overall appearance when compared to traditional counterparts. This result might be related to

the eating preferences of Turkish people and especially, the regional consumers who have been known as sucuk (the Turkish sausage) prefer this type of product in Kayseri, Turkey where the research was conducted. This is one of the regions that is known as a meat products industry center and has higher meat product consumption recorded in Turkey (Yetim, 2000). Dry fermented Turkish sausage (sucuk) having specific taste and aroma is very popular meat product in Middle-east and Europe areas (Bozkurt and Erkmen, 2002). Besides, sucuk dough is also a very aromatic food when cooked due to its composition. These facts might be the reasons for higher preferences in sensory analysis.

Conclusions

Statistically significant differences were observed between the traditional and sausage doners in terms of the chemical, microbiological, and sensory analysis results, not only in raw condition, but also in cooked condition which might require additional sanitation or higher cooking temperature. The sausage doners were preferred by the judges in terms of the rated sensory characteristics. These results could be the starting point for a novel doner which has a world-wide reputation. Additionally, some sausage in doner kebab formulation has already been used in some areas of Turkey as fast food. Therefore, in conclusion, it can be speculated that the doner kebab from sucuk (sausage dough) will have a prospering future in the fast food sector since sucuk is a traditionally middle-east product and its taste is well-recognized by the people of this region.

Table 1. Some Quality Characteristics of Raw and Grilled Doner Samples ($X \pm SX$)

Chemical Analysis						
Raw Doners	pH	% Moisture	% Protein	% Fat	% Ash	TBA
Sausage Doner	5.83 ^a \pm 0.009	63.83 ^b \pm 0.217	19.27 ^a \pm 0.111	12.60 \pm 0.060	4.08 ^a \pm 0.050	0.390 ^a \pm 0.003
Traditional Doner	5.64 ^b \pm 0.024	67.57 ^a \pm 0.115	17.18 ^b \pm 0.146	12.90 \pm 0.036	2.27 ^b \pm 0.053	0.337 ^b \pm 0.002
Cooked Doners						
Sausage Doner	6.18 ^a \pm 0.009	55.34 ^b \pm 0.048	25.33 ^a \pm 0.190	14.47 ^b \pm 0.099	4.27 ^a \pm 0.046	0.460 ^a \pm 0.004
Traditional Doner	6.08 ^b \pm 0.009	58.26 ^a \pm 0.094	24.11 ^b \pm 0.154	15.33 ^a \pm 0.202	2.50 ^b \pm 0.022	0.390 ^b \pm 0.004
Microbiological Analysis						
Raw Doners	APC	Coliforms	Staph./Mic.	Anaerobes	Yeast & Mold	Psychrotrophs
Sausage Doner	7.44 ^a \pm 0.015	5.16 \pm 0.086	5.98 \pm 0.064	5.21 \pm 0.007	5.08 ^a \pm 0.066	5.13 ^a \pm 0.025
Traditional Doner	5.03 ^b \pm 0.024	5.23 \pm 0.028	5.72 \pm 0.015	5.27 \pm 0.004	4.19 ^b \pm 0.021	4.26 ^a \pm 0.215
Cooked Doners						
Sausage Doner	6.25 ^a \pm 0.086	3.92 ^a \pm 0.009	5.12 ^b \pm 0.007	4.42 \pm 0.008	4.01 ^a \pm 0.002	4.69 ^a \pm 0.020
Traditional Doner	4.62 ^b \pm 0.011	1.96 ^b \pm 0.067	5.66 ^a \pm 0.077	4.35 \pm 0.051	3.31 ^b \pm 0.012	3.74 ^b \pm 0.068
Organoleptic Analysis						
Cooked Doners	Flavor*	Texture**	Color***	Overall****		
Sausage Doner	9.50 ^a \pm 0.342	9.00 ^a \pm 0.258	9.00 ^a \pm 0.365	8.83 ^a \pm 0.307		
Traditional Doner	8.50 ^b \pm 0.482	7.83 ^b \pm 0.307	8.83 ^b \pm 0.307	8.33 ^b \pm 0.333		

^{ab}: Different letters in a column shows significant difference between the groups ($P < 0.05$); APC: Aerobic Plate Count; TBA: mg malon aldehyde/kg sample; Staph./Mic. : Total Staphylococcus/Micrococcus; * 1= Atypical flavor and aroma 10= Typical flavor and aroma; ** 1= Very coarse 10= Very fine texture; *** 1= Undesired color 10= desired color; **** 1= Undesirable appearance 10= Very desirable appearance.

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