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Physicochemical properties of low sodium goat kafta

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ABSTRACT

The effect of partial replacement (25 and 50%) of sodium chloride (NaCl) by potassium chloride (KCl) on physicochemical parameters of kafta prepared with goat meat was assessed. It was observed that the influence of sodium reduction on the physicochemical traits of goat kafta depends on the percentage of NaCl substitution. As expected, the partial substitution of NaCl by KCl in goat kafta formulations caused a reduction in sodium levels and increased potassium values. The percentage of NaCl substitution by KCl also had an influence ($p < 0.05$) on increased water activity, pH and shear-force of kafta samples. Although there was no modification in water-holding capacity between treatments ($p < 0.05$), it was observed an increasing trend of cooking loss with the percentage of NaCl substitution. Low-sodium samples showed low values of lightness and redness. Goat kafta prepared with 25% NaCl substitution had lower TBARs value compared to other treatments ($p < 0.05$). In conclusion, considering the occurrence of minor changes in the physicochemical characteristics of samples and the low sodium content, 25% substitution of NaCl by KCl in goat kafta formulations seems to be feasible.

1. Introduction

Sodium chloride (NaCl) is highly important to the human organism and is widely used both to enhance salty taste and to increase food preservation. In fact, NaCl plays an important role in the processing of meat products, increasing the water-holding capacity and decreasing cooking loss, which guarantees a better juiciness and tenderness of the product (Lawrie, 2005; Vandendriessche, 2008). On the other hand, excessive sodium intake can result in health problems, in particular cardiovascular diseases (CVD), such as arterial hypertension. According to the World Health Organization (WHO), arterial hypertension is one of the ten leading causes of human death worldwide (Ministério da Saúde, 2002). Overall, the reduction of sodium intake by the population has been one of public health priorities. In Brazil, the Ministry of Health together with the National Health Surveillance Agency (ANVISA) has established an agreement with the food industry to reduce the sodium content in processed foods (Ministério da Saúde, 2002).

Several studies have demonstrated strategies to reduce the sodium content in meat products such as dry-cured lacón (Lorenzo et al., 2015), marinated rabbit meat (Soglia et al., 2014), dry-cured loin (Aliño et al., 2010), and dry-cured ham (Armenteros, Aristoy, Barat, & Toldrá, 2012). The partial replacement of NaCl by non-sodium salts such as potassium chloride (KCl) is one of the most applied methods to reduce sodium content in meat products (Gelabert, Gou, Guerrero, & Arnau, 2003). Potassium chloride has antimicrobial efficiency equivalent to NaCl and its consumption is inversely proportional to the level of blood pressure, consequently reducing the risk of arterial hypertension (Bidlas & Lambert, 2008; Campagnol, Santos, Morgano, Terra, & Pollonio, 2011; Kawano, Minami, Takishita, & Omae, 1998; Ruusunen & Puolanne, 2005). However, it has been postulated that high KCl concentrations in meat products formulation provide bitter taste (Armenteros et al., 2012), being necessary to control its concentration in meat products formulations.

The intake of low-sodium products reduces the risk of arterial hypertension, bringing benefits to consumer's health. At the same time, some studies have shown that potassium intake is inversely proportional to blood pressure levels and, consequently, the risk of cardiovascular diseases is reduced (Campagnol et al., 2011; Kawano et al., 1998; Ruusunen & Puolanne, 2005). However, high potassium intake may cause toxic effects in addition to cardiac arrhythmia (Kes, 2001; Sood, Sood, & Richardson, 2007; IOM, 2004).

Goat meat has a great market potential and has been considered

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as a protein source of high biological value, with 97% digestibility (Webb, Casey, & Simela, 2005). In addition, quality of goat meat is also directly related to its sensory characteristics, particularly aroma and flavor, which have a great impact on consumer acceptability (Rodrigues & Teixeira, 2009). These advantageous characteristics of goat meat promoted an increase of original research articles focusing on the use of goat components to developing differentiated meat products such as smoked blood sausage (Silva et al., 2013), mortadella (Guerra et al., 2011), salted meat (Costa et al., 2011) and pâté (Dalmás, Bezerra, Morgano, Milani, & Madruga, 2011). However, the technological use of goat meat has been little explored and the supply of goat-origin meat products in the open market has not been satisfactory compared to beef, pork and poultry products (Cosenza, Williams, Johnson, Sims, & McGowan, 2003) requiring greater investment in meat processing plants. Kafta is a typical Arab restructured meat product prepared with minced meat and formulated with salt and a variety of spices (Souza et al., 2015). In Brazil, consuming kafta is relatively common in southern cities. Therefore, preparation of kafta from goat meat may be a viable alternative to improve goat industry.

Considering the importance of producing meat products from goat origin to meat industry, and the lack of studies that emphasizes the effect of sodium reduction on the quality parameters of goat meat products, the aim of this study was to develop a new meat product from goats (kafta) and evaluate the effect of partial replacement of sodium chloride by potassium chloride on the physicochemical parameters of the final product.

2. Material and methods

2.1. Experimental design

The effect of partial replacement of sodium chloride (NaCl) by potassium chloride (KCl) on the physicochemical properties of goat kafta was performed using a completely randomized design (CRD). Three formulations were processed: T1 (3.0% NaCl and 0.0% KCl); T2 (2.25% NaCl and 0.75% KCl) and T3 (1.5% NaCl and 1.5% KCl). All kafta samples were processed in three different batches and the experimental procedure in laboratory was conducted in triplicate, totaling 27 samples.

2.2. Production of goat kafta

The meat was obtained from a native goat breed and purchased on a slaughterhouse located in João Pessoa, Paraiba, Brazil. All ingredients and additives were obtained in local market. Goat kafta treatments were displayed in Table 1. Regarding to the processing of goat kafta, initially, all tendons, visible connective tissues and blood clots were removed from fresh goat meat. Then, the meat was ground in a semi-industrial grinder (CAF, CAF10, Rio Claro, Brazil) and homogenized with the ingredients and additives according to the treatments designed in Table 1. Goat kafta were formed in plastic bags using a manual filler (SIEMSEN LTDA, ES-08, Santa Catarina, Brazil). All samples were stored at −18 °C during 24 h before analysis.

Table 1
Description of goat kafta treatments according to their formulation.

Raw material	Formulation					
	T1 (%)	T1 (g)	T2 (%)	T2 (g)	T3 (%)	T3 (g)
Goat meat	100	1500	100	1500	100	1500
Ingredients[a]						
Soy oil	5.0	75.0	5.0	75.0	5.0	75.0
Starch	4.0	60.0	4.0	60.0	4.0	60.0
Flavor enhancer	0.20	3.0	0.20	3.0	0.20	3.0
Black pepper	0.20	3.0	0.20	3.0	0.20	3.0
Onion powder	8.0	120.0	8.0	120.0	8.0	120.0
Garlic powder	0.20	3.0	0.20	3	0.20	3.0
Sodium Chloride	3.0	45.0	2.25	33.76	1.5	22.5
Potassium Chloride	0.0	0.0	0.75	11.24	1.5	22.5

[a] The ingredients were added in relation to the total weight of goat meat.

2.3. Analytical methods

2.3.1. Chemical composition

Moisture, protein, sodium and potassium were determined according to AOAC (2005) methods. Lipid content was measured by extraction with chloroform:methanol (2:1) following Folch, Less, & Stanley (1957) procedure.

2.3.2. Water activity and pH measurements

The water activity (aw) was measured using a hygrometer aw analyzer (Decagon Devices, AquaLab PRE, Washington, USA). A digital pH meter (MARCONI, Mapa 200, Piracicaba, Brazil) was used to determine pH values.

2.3.3. Water-holding capacity (WHC) and cooking loss analysis

The water-holding capacity (WHC) was determined by the method of Awad and Diehl (1975) with some modifications. Briefly, 1.0 g of ground kafta samples were weighed on a filter paper, which had been previously preconditioned by standing overnight in a drying chamber at 105 °C. The filter paper with kafta samples were submitted to a 10.0 kg pressure for 1 min. The water-holding capacity results were expressed in percentage. The weight loss after cooking process of goat kafta samples was performed according to Cason, Lyon, and Papa (1997) method. The samples were placed in polyethylene bags and cooked in a water bath (90 °C) until an internal temperature of 75 °C. The percentage of cooking loss was calculated from differences in the weight of uncooked and cooked samples, expressed as percentage of initial weight, as follows: cooking loss [%] = [(before cooking weight − after cooking weight)/(before cooking weight)] × 100.

2.3.4. Color measurements

The instrumental color of goat kafta samples was determined by measuring lightness (L*), redness (a*) and yellowness (b*) values, using a digital colorimeter (Konica Minolta, CR-400, Tokyo, Japan). Five measurements per sample were randomly made on the surface of the goat kafta using aperture size of 8 mm, illuminant source C at a 0° standard observer.

2.3.5. Shear-force (SF) measurements

SF value was measured in goat kafta after cooking loss treatments. Goat kafta samples were cut in seven rectangular blocks (4.0 cm × 3.0 cm × 1.0 cm). SF was performed using a TA.XT plus Universal Texture Analyzer (Stable Micro Systems®, Surrey, England) equipped with a Warner-Bratzler rectangular shear blade (2.0 mm/s test speed), which cut the sample perpendicular to the fiber direction. The results were registered in Stable Micro Systems® software (Version 4.0, Surrey, England) and expressed in Newtons (N).

2.3.6. Determination of thiobarbituric acid-reactive substances (TBARs)

Lipid oxidation was evaluated in fresh goat kafta (final product) by measuring thiobarbituric acid reactive substances (TBARs) according to Rosmini et al. (1996). Briefly, 5.0 g minced goat kafta were homogenized in 1.0 mL sulfanilamide 0.5%, 10 mL trichloroacetic (TCA) 10% and 5.0 mL distilled water using a Ultra Turrax