INFLUENCE OF SODIUM REDUCTION AND ULTRASOUND TREATMENT ON THE SENSORY ACCEPTANCE OF COOKED HAM

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Abstract – Reducing sodium in food is necessary in order to minimize the damage that this excess nutrient causes in the body. This study evaluated the influence of sodium reduction and ultrasound use on the sensorial acceptance of cooked hams. Four treatments were produced: T1 (control - 100% NaCl), T2 (75% NaCl), T3 (50% NaCl) and T4 (50% NaCl and ultrasound). Sensory acceptance tests were conducted to evaluate the color, taste, texture and overall acceptance. For all the attributes, the reduction of 50% of NaCl decreased the acceptance. However, in the treatment with 50% of NaCl subjected to ultrasound, the taste, texture and overall acceptance were better. Ultrasound is an alternative to reduce sensory damage in cooked hams with reduced sodium content.

Key Words – Pork, sodium chloride, ultrasonic.

I. INTRODUCTION

Cooked ham is one of the most popular processed meat products [1]. Sodium chloride, the highest sodium source ingredient in this product, provides desirable sensorial characteristics and stability of the product [2]. However, excess sodium in the diet is associated with the development of chronic non-transmissible diseases [3]. Reduction of sodium in meat products is a challenge and should not occur without proper studies, especially with regard to sensory acceptance [4]. Alternative technologies, such as ultrasound, have been studied in order to improve the technological properties of food products [5]. The objective of this study was to evaluate the influence of sodium chloride reduction by 25% and 50% and the use of ultrasound on the sensorial acceptance of cooked hams.

II. MATERIALS AND METHODS

Four treatments of cooked ham were tested (T1: Control – 100% NaCl, T2: 75% NaCl, T3: 50% NaCl and T4: 50% NaCl with ultrasound (10 minutes at a nominal intensity of 600 $W.cm^{-2}$). Lean pork meat cut into 30 mm discs was added to the brine, composed of the homogenization of all other ingredients, according to the standard formulation: 62.50% lean pork meat; 1.5% soybean isolate protein (Bremil, Brazil), 0.94% California condiment without sodium (Fego, Brazil); 0.1% monosodium glutamate; 0.02% cochineal carmine dye (Christian Hansen); 0.28% curing salt (Kraki, with 10% sodium Nitrite and 90% sodium chloride); 0.19% sodium erythorbate; 0.47% sodium tripolyphosphate; 0.47% refined sugar; 0.24% carrageenan (Indukern) and 0.28% maltodextrin; 31.52% water and 1.5% NaCl in T1, 31.89% water and 1.12% NaCl in T2 and 32.27% water and 0.75% NaCl in T3 and T4. After mixing the ingredients, T1, T2 and T3 were massaged in a tumbler for 60 minutes (15 revolutions/min), and T4 was submitted to ultrasound and massaged in a tumbler under the same conditions as the other treatments. To application the ultrasound in T4, the mixture of the ingredients were packed in a stainless steel cylindrical vessel (21 cm diameter, 42 cm high). The system consisted of a VCX-1500 ultrasound generator (Sonics & Materials Inc., USA), which emits waves at the frequency of 20 kHz. The generator was equipped with a titanium probe that emits ultrasound in the axial and radial direction Ti-6Al-4V (Sonics & Materials Inc, Newtown, USA). The probe was immersed in the mixture and positioned in the center of the vessel. Then, 0.8 kg portions of each treatment were put into plastic casings, caliber 95 (Viscofan, Brazil) and put into stainless steel molds for ham. They remained for 60 minutes at 4°C for the curing process. Subsequently the molds were immersed in the cooking tank. The cooking cycle ended as soon as the samples reached 72°C in their geometric center, being promptly cooled. The samples were stored at 4°C until the beginning of the evaluations. Sensory analysis was conducted on the fifteen days of product storage. One hundred and fifteen untrained judges, using a structured 9-point hedonic scale, evaluated the following attributes: color, taste, texture and overall acceptance. And, on a 5-point scale, the judges presented their intent to purchase the product. The sodium content was analyzed using dry digestion [6]. The data were submitted to Analysis of Variance ANOVA ($p<0.05$) and the means obtained were

compared using the Tukey test. The statistical software used was MINITAB v.16.

III. RESULTS AND DISCUSSION

The results for sensory acceptance and sodium content are shown in Table 1.

Table 1. Average values (± standard deviation) of the sensory evaluation and sodium content of cooked hams.

	T1	T2	T3	T4
Color	7.83±1.09^{a}	7.69±1.26^{ab}	7.30±1.22^{b}	7.32±1.35^{b}
Taste	7.53±1.27^{a}	7.32±1.31^{a}	6.66±1.50^{b}	7.20±1.16^{a}
Texture	7.66±1.21^{a}	7.40±1.46^{ab}	6.97±1.53^{b}	7.31±1.22^{ab}
Global acceptance	7.56±1.11^{a}	7.36±1.32^{a}	6.76±1.33^{b}	7.27±1.15^{a}
Purchase intention	4.06±0.84^{a}	3.94±0.85^{a}	3.48±0.97^{b}	3.97±0.71^{a}
Na (mg/100g)	996.52±34,81^{a}	837,59±17,5^{b}	676,83±10,53^{c}	715,34±19,8^{c}

Averages followed by the same letter in the same line do not show significant difference (p>0.05) in the Tukey test. T1: standard control treatment – 100% NaCl; T2: 75% NaCl; T3: 50% NaCl; T4: 50% NaCl and ultrasound treatment.

Regarding color, T1 was more accepted ($p<0.05$) than T3 and T4 and did not differ ($p>0.05$) from T2 in acceptance. The reduction of 50% NaCl reduced the sensory acceptance regarding the color in cooked ham. Ultrasound treatment (T4) did not promote color improvement in cooked ham compared to T3, with the same NaCl content. In relation to taste, T1, T2 and T4 did not differ in their sensory acceptance ($p> 0.05$) and presented greater acceptance ($p<0.05$) than T3, that is, the sensorial acceptance of cooked ham with 50% reduction of chloride of sodium under ultrasound provided sensory acceptance similar to cooked ham without sodium reduction. In the texture parameter, T4 did not differ ($p<0.05$) from T1, however T3 showed less acceptance ($p<0.05$) than T1. Regarding global acceptance, T1, T2 and T4 did not differ ($p>0.05$) from each other, showing more acceptance than T3. The reduction of sodium chloride in meat products reduces the extraction of myofibrillar proteins due to the reduction of the ionic strength and, consequently, reduces the water retention capacity of the system. In this way, it can also increase the exudation losses during storage affecting the texture of the product [4]. The ultrasonic treatment in the present study raised the sensorial acceptance of the attributes of taste, texture and global acceptance and increased the intention to buy cooked hams with 50% reduction of sodium chloride. McClements [7] reported that ultrasound also facilitated the extraction of myofibrillar proteins, which have properties of binding to water, thereby increasing the water retention capacity. The results for the analysis of the sodium content show a significant decrease ($p < 0.05$) between T1, T2 and T3. And T3 and T4 did not differ ($p>0.05$) from each other, since both had the same percentage of NaCl in their formulations. T2 showed a reduction of 16% of sodium, T3 of 32% and T4 of 28.5%. Therefore reductions of 25 and 50% NaCl in the formulations provided products with reduced sodium content.

IV. CONCLUSION

The use of ultrasound in cooked hams with 28.5% sodium reduction has improved sensory acceptance and may be an alternative process for the meat industry in sodium reduction formulations.

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