ASSESSMENT OF ULTRASOUND EFFECTS ON PORK MEAT BRINING

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I. INTRODUCTION

Curing by salting is one of the most traditional methods of meat preservation. Sodium chloride performs an important role in the processing of meat, contributing to functional properties, such as water retention capacity, color, flavor, texture and as an increase in shelf life by reducing water activity [1]. The acceleration of the absorption of salt as well as its uniform distribution in the meat is desirable for the industry and for the product quality [2]. Alternative technologies, such as ultrasound, have been studied aiming to promoting functional properties of food products. Ultrasound can be useful to accelerate and intensify the diffusion of salt because of cavitation and, thus reducing the processing time [3]. Therefore, the objective of this study was to investigate the ultrasound effect on the final content of sodium chloride in pork brining.

II. MATERIAL AND METHODS

Pork (*Semimembranosus and adductor muscles*) was obtained from a local market (São Jose do Rio Preto, Brazil). All visible fat was removed from each muscle manually prior to brining. Samples were cut into slices of similar weight (approximately 100 g) and size (60 x 100 x 20 mm length x width x height). Brine was prepared at a concentration of 50 g L^{-1} NaCl (Synth, Brazil). The ratio of meat to brine weight was set at 1:10. Brining experiments were carried out in 5% NaCl solution at 10 °C. Two treatments were carried out: Control (C) and Ultrasound (US) in triplicates. For each treatment, 5 samples were placed in the salty water and samples were withdrawn at a regular interval of 30 min. In both treatments, the total brining time was 120 min. Samples were rinsed in deionized water, blotted and stored at 4 °C for subsequent analysis. For the US treatment the probe was immersed in the brine and the system comprised a VCX-1500 ultrasound processor using 600 W nominal power (Sonics & Materials Inc., Newtown, USA) which emits waves at a frequency of 20 kHz. The processor was equipped with a Ti-6Al-4V titanium probe that emits ultrasound in both the axial and radial directions (Sonics & Materials Inc, Newtown, USA). NaCl content of pork samples was measured using the Mohr method [4]. The content of NaCl was expressed in terms of the mean values and the standard error of the replicates. Each triplicate was considered as the random factor and the time as the fixed factor. The data were analyzed statistically using mixed model ANOVA and the means were compared using the Tukey test at 5% level of significance. The software used was Statistica 7.0 (Statsoft Inc., USA).

III. RESULTS AND DISCUSSION

Table 1 shows the values of the means of the NaCl content in pork according to the brining time for the two treatments (C and US). It can be observed that for both treatments (C and US), there is an increase in the NaCl content of the pork slices with brining time, up to 90 minutes ($P < 0.05$). However, above 90 minutes salt content tends to stabilize for both treatments ($P > 0.05$), thus showing a tendency to reduce salt penetration. Investigating the diffusion of salt in pork, McDonnell et al. [5] reported a decrease in the Fick's diffusion coefficient of salt in the pork meat with increasing brining time, which may explain the stabilization of the pork salt content at 90 and 120 minutes brining.

US treatment showed a pork with higher content of salt for all brining time. Figure 1 shows the salt content of pork as a function of brining time for both treatments control and ultrasound assisted.

Table 1. NaCl content in the pork as a function of brining time for control (C) and ultrasound assisted (US) treatments.

Time (min.)	Control - C (% salt in pork)	Ultrasound - US (% salt in pork)	SEM	*P value*
0	0.032^{bD}	0.067^{aD}	0.008	<0.01
30	0.800^{bC}	0.961^{aC}	0.037	<0.01
60	0.873^{bB}	1.313^{aB}	0.074	<0.01
90	1.249^{bA}	1.514^{aA}	0.059	<0.01
120	1.415^{bA}	1.433^{aA}	0.079	<0.01
P value	<0.01	<0.01		

$^{a-b}$ Mean values in the same line not followed by a common letter differ significantly ($P < 0.05$).
$^{A-D}$ Mean values in the same column not followed by a common letter differ significantly ($P < 0.05$).
C: Control samples (without ultrasound). US: Ultrasound assisted treatment. SEM: standard error of the mean.

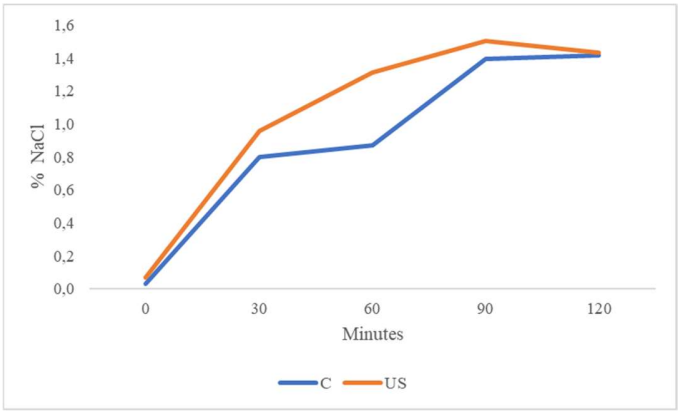

Figure 1. Salt content of pork for C and US as a function of brining time.

Ojha et al. [6] observed a similar behavior by using ultrasound in brining of pork. The authors concluded that ultrasound can enhance salt diffusion into the meat matrix compared to the brining treatment without ultrasound. Cavitation caused by the ultrasound opens channels between the myofibrils, which facilitate the penetration of brine [7].

IV. CONCLUSION

Brining time influences the increase in salt content in pork meat slices up to 90 minutes in 5% NaCl solution at 10 °C. Ultrasound can assist pork meat salting in order to reduce processing time. The results implied that the ultrasound technology can be an alternative for assisting curing in the pork meat industry.

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