EFFECT OF PARTIAL REPLACEMENT OF SODIUM CHLORIDE WITH OTHER SALTS ON PHYSICOCHEMICAL CHARACTERISTICS IN DRY-CURED "LACÓN"

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Abstract – Sodium chloride is the most important ingredient in the dry-cured meat products. However, it has been accepted that salt has several negative effects on human health. Two salt replacers (KCl and k-lactate) were evaluated for their ability to effectively reduce sodium and their effects on physicochemical characteristic of dry-cured lacón. Colour parameters, chemical composition, shear force value and lipid oxidation were evaluated. The partial substitution of NaCl by other salts had effect on pH, color parameters and lipid oxidation. The inclusion of KCl provided the highest levels of luminosity redness and yellowness in the dry-cured "lacón". The replacement with k-lactate showed a beneficial effect reducing lipid oxidation (0.58 *vs.* 1.17 mg malonaldehyde/kg of lacón).

Key Words – Color parameters, Meat products, partial substitution

I. INTRODUCTION

Nowadays, there is a trend to reduce the salt content in meat products because an excessive sodium intake contribute to raised blood pressure and consequently on the risk of cardiovascular diseases and early death in salt susceptible consumers [1]. On the other hand, sodium chloride is the most important ingredient in the processing of dry-cured meat products such as dry-cured ham or dry-cured loin, due to its numerous technological benefits (characteristic color and flavour development and microbial control in cured products). Despite this situation, reducing salt involves a very important target for the food industry [2]. Dry-cured lacón is a salted, dried and ripened meat product manufactured in the NW of Spain by traditional methods that use pork foreleg as the raw material [3]. The aim of this study was to evaluate the effect of the partial substitution by other salts (KCl, and k-lactate) on the physicochemical characteristics of the dry-cured lacón.

II. MATERIALS AND METHODS

In order to carry out this study, three batches of lacón were manufactured. Each batch consisted of four lacón pieces that in the green stage weighed around 4 kg. Lacón from the first batch were salted with the traditional NaCl (100% NaCl, treatment I) and were used as control. The other batches were salted in the same way but with partial substitutions of NaCl by other salts. The second batch was salted with 50% NaCl and 50% KCl (treatment II) and the third batch with 50% NaCl, 50% k-lactate (H3C-CHOH-COOK) (treatment III). The salting stage was carried out in saturated brine (30% for each treatment) for 4 days (1 day of brine per kg of raw material). At the end of the salting period all samples were weighted, and transferred to a post-salting room where they stayed for 14 days at 2-5°C and around 85-90% relative humidity. After the post-salting stage the pieces were transferred to a room at 12°C and 74-78% relative humidity where a drying-ripening process took place for 84 days. For each treatment three samples were analysed. Colour parameters, chemical composition and shear force value were conducted following the methodology proposed by Lorenzo *et al.* [3]. Lipid oxidation were carried out following the procedure described by Lorenzo *et al.* [4]. ANOVA of one way using SPSS package (SPSS 19.0, USA) was performed and LSM were separated using Duncan's t-test ($P<0.05$).

III. RESULTS AND DISCUSSION

The effect of salting formulation on physicochemical parameters are shown in Table 1. There was effect of salting treatment on pH, colour parameters, cooking loss and lipid oxidation expressed by TBARS index. The highest pH values were found in dry-cured lacón treated with K-lactate. The colour parameters (L*, a* and b*) in the dry-cured lacón showed significant differences among salting treatments, since treatment with KCl presented the higher color parameters (37.84, 9.23 and 7.73 for luminosity, redness and yellowness, respectively). This result is in disagreement with those described previously by Lorenzo et al [3] in dry-cured lacón and in dry-cured ham [5].

Table 1. Effect of salting treatment on physicochemical characteristics of dry-cured lacón

	Treatment I	Treatment II	Treatment III	SEM	SIG
Colour parameters					
Luminosity (L*)	34.43[a]	37.84[b]	34.83[a]	0.553	*
Redness (a*)	7.44[a]	9.23[b]	7.97[a]	0.269	*
Yellowness (b*)	6.06[a]	7.73[b]	6.98[ab]	0.264	*
Chemical composition					
pH	5.98[b]	5.75[a]	6.09[c]	0.034	***
Moisture (%)	54.51	57.48	53.75	0.877	ns
Ashes (%)	7.83[a]	7.72[a]	6.63[a]	0.245	ns
Cooking loss (%)	6.69[b]	7.91[b]	5.24[a]	0.326	**
aw	0.90[a]	0.92[a]	0.92[a]	0.005	ns
Texture parameters (WB)					
Raw sample					
Shear force (Kg/cm^2)	6.29	5.87	5.59	0.277	ns
Cooked sample					
Shear force (Kg/cm^2)	7.53	6.40	7.24	0.542	ns
TBARS (mg malonaldehyde/kg)	1.17[b]	1.53[c]	0.58[a]	0.089	***

Treatment I: 100% NaCl; Treatment II: 50% NaCl + 50% KCl; Treatment III: 50% NaCl + 50% K-lactate

Regarding the effect of sodium chloride substitutes on cooking loss, significant ($P<0.01$) differences were noticed among treatments in the final products, although there were no significant differences ($P>0.05$) on moisture content or water activity. This outcome is controversial because some authors have published effects of salt substitution (KCl and $CaCl_2$) on moisture content [3] but others did not find this effect [6]. Shear force values were unaffected by salting treatment ($P>0.05$). In a previous work with lacón, following the traditional process (not brine) Lorenzo et al [3] reported lower values for control treatment (4.77 kg/cm^2) and similar for treatment II (5.99 kg/cm^2) than the presented here. This discrepancy could be explained both by differences in the ions (Na vs K) and by the different salting system employed.

Finally, we noticed significant differences in the degree of oxidation (0.58, 1.17 and 1.53 mg malonaldehyde/kg of lacón for treatment with NaCl, KCl and potassium lactate, respectively). These differences could be explained by the fact of the pro-oxidative effect of salt reduce the endogenous antioxidant activity of endogenous enzymes [3]. From a market perspective, lacón from treatment III were the most interesting, because larger amount of lipid oxidation producing a rejection in consumers.

IV. CONCLUSION

The partial substitution of NaCl by other salts (KCl and potassium lactate) had effect on pH, color parameters and lipid oxidation. Treatments with a 50% reduction of sodium could be interesting as an effective form to reduce the NaCl without affecting product physicochemical or even improving some of them.

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