Sodium reduction in marinated rabbit meat

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ABSTRACT: This study aimed to evaluate the effect of sodium chloride (NaCl) replacement up to 50% with potassium chloride (KCl) on marination performance and some quality traits of marinated rabbit meat. A total of 100 *L. lumborum* samples were marinated in two separated replicates using solutions with different NaCl:KCl ratios (100:0, 80:20, 70:30, 60:40 and 50:50) to assess marination performance (uptake, purge loss, cook loss and total yield) and meat quality traits (pH, colour and shear force). Overall, only some minor changes were observed among different levels of sodium replacement. Purge loss was significantly higher in 40% KCl-marinated loins in respect to 20% KCl treatment. Moreover, pH and redness (a*) of cooked meat were higher in meat marinated with 40% and 50% KCl if compared with control group. These results demonstrated that it is possible to replace sodium chloride up to 50% with potassium chloride in marinated rabbit meat without impairing main technological properties (processing yields, appearance and texture).

Kew words: Rabbit meat, Marination, Sodium chloride, Technological traits.

INTRODUCTION – In the last years, rabbit industry has started to put on the market some attractive and convenient rabbit meat products like hamburgers, coarse ground sausages, stuffed rolls and baby foods, but this market is still very limited until now due to high price and scarce consumer attitude toward them (Petracci and Cavani, 2012). By the way, there is a potential to exploit good nutritional profile of rabbit meat (i.e. low amount of fat, saturated fatty acids, cholesterol and sodium) to produce healthy processed products (Dalle Zotte and Szendro, 2011; Petracci and Cavani, 2012). Indeed, recently health concerns related to dietary sodium consumption increased demand for sodium-reduced foods (Desmond, 2006). Consequently, NaCl reduction also in processed meat products has become an important challenge (Weiss *et al*., 2010). Potassium chloride has been extensively evaluated and it was found that it can be used as sodium replacer up to certain levels without impacting the sensory and technological quality traits. The objective of the present study was to investigate the effectiveness to manufacture marinated rabbit meat with reduced sodium chloride content by replacing it with potassium chloride (KCl).

MATERIAL AND METHODS – A total of 100 *L. lumborum* muscles belonging to same rabbit batch (11 weeks-old, live weight of 2.7 kg) were obtained at 24 h *post-mortem* from a local commercial plant and stored under freezing conditions for 1 month. Two independent trials separated by 7 days were conducted by using 50 *L. lumborum* muscles/trial. Samples were thawed for 48 h at 0°C, trimmed from external fat and connective tissue, divided into 5 homogenous groups (n=10) according their pH

and tumbled under vacuum for 45 min in a cooler at 4 ± 1°C. Loins were marinated with a 20% solution based on meat weight containing water and one of the five different salt mixtures representing a 0, 20, 30, 40 or 50% replacement of NaCl with KCl, respectively. The total target final concentration of salts (g/100 g of meat) in marinated samples was approximately 1.8%. Meat samples were reweighed immediately after tumbling to measure marinade uptake and placed in covered plastic boxes on sieved plastic racks in a 2 to 4°C cooler for 48 h to determine purge loss. Samples were subsequently vacuum packaged and cooked in an 80°C water bath for 1 h (Combes *et al*., 2003) to measure cook loss and total yield based on non-marinated meat weight was calculated. Finally, cooked samples were used to determine pH and AK-shear force (Bianchi *et al*., 2007). Colour coordinates (CIE L*a*b*) were determined during the different stages of experiment. Data were analysed by two-ways ANOVA considering the marinade solution (100:0, 80:20, 70:30, 60:40 and 50:50 NaCl:KCl ratio) and trial (1 and 2) as main effects as well as their interaction. Means were separated by Tukey's test.

RESULTS AND CONCLUSIONS – The results for meat quality traits and marination performance are presented in Table 1.

Table 1 – Marination performance and quality traits of marinated rabbit meat

Parameter	Marinade solution (NaCl:KCl ratio)[1]					RSE	Prob.[2]
	100:0	80:20	70:30	60:40	50:50		
Non-marinated raw meat							
pHu	5.88	5.88	5.88	5.88	5.89	0.008	0.999
lightness (L*)	47.7	47.8	47.4	48.5	47.8	0.264	0.793
redness (a*)	2.79	2.56	2.58	2.63	2.81	0.064	0.618
yellowness (b*)	-1.06	-1.01	-1.41	-0.86	-0.92	0.109	0.545
Marinated raw meat							
uptake (%)	18.1	18.3	18.2	18.3	18.3	0.274	0.997
lightness (L*)	45.2	45.1	44.6	46.1	44.9	0.188	0.149
redness (a*)	3.76	3.68	3.53	3.60	3.70	0.064	0.851
yellowness (b*)	-0.45	-0.17	-0.64	-0.07	-0.68	0.108	0.274
purge loss (%)	2.27^{ab}	2.25^{b}	2.50^{ab}	2.58^{a}	2.34^{ab}	0.040	0.036
Marinated cooked meat							
cook loss (%)	20.7	20.2	20.8	20.7	20.9	0.224	0.892
total yield (%)	91.5	92.1	92.0	91.0	91.0	0.280	0.623
pH	6.08^{b}	6.10^{ab}	6.12^{ab}	6.15^{a}	6.14^{a}	0.007	0.010
lightness (L*)	73.5	74.2	74.5	74.7	74.6	0.151	0.106
redness (a*)	1.96^{ab}	1.70^{b}	1.92^{ab}	2.10^{a}	2.28^{a}	0.044	0.001
yellowness (b*)	7.46	7.07	7.06	7.18	7.38	0.062	0.157
AK shear force (kg/g)	1.91	2.07	2.04	1.90	2.03	0.026	0.128

[1] n=20/group; [2] No significant differences for "trial" and interaction term were detected.
means within a row followed by different superscript letters differ significantly ($P \leq 0.05$).

Colour and pH before marination were similar among groups and this consistency was important because different meat pH and colour can affect marinade adsorption and cooking yield as found in poultry (Barbut *et al*., 2005).

Overall, replacing NaCl up to 50% by KCl did not significantly modify marination performance (uptake, cook loss and total yield) with the exception of purge loss which was significantly higher in 40% KCl-marinated loins in respect to 20% KCl treatment, while the other groups exhibited intermediate values. As for meat quality traits, marinated raw meat colour (L*a*b*) and shear force of cooked meat were not significantly affected by progressive NaCl replacement with KCl. These results agree with Lee *et al* (2012) who found that replacing NaCl by KCl up to 50% had no effect on shear force and marinade uptake in poultry marinated meat. Moreover, Barbut and Findlay (1991) found that meat treated with KCl showed similar thermal properties of NaCl. This can be explained because the effect of NaCl on meat protein is mainly due to actions of chloride instead of sodium ions. It is well-known that chloride ions tend to bind to the thick (myosin) and thin (actin) filaments and increase the electrostatic repulsive forces between them as well results in a shift of the isoelectrical point towards a more acidic pH value. Both these concomitant effects improve water-binding potential in processed meat (Feiner, 2006). The only significant differences within meat quality traits were observed for pH and redness (a*) of cooked meat which were higher in respect to 0% and 20% KCl respectively. These results were in agreement with Trout (1989) who noticed that a high pH reduced heat denaturation of myoglobin during cooking, thus leading to increased redness.
In conclusion, NaCl can be reduced up to 50% with KCl without any negative impacts on marination performance, appearance (except with minor changes in redness) and texture. Further investigations for the sensory acceptance and microbiological stability would be the next avenue for the future study.

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