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Effect of processing temperature (70 °C) and high pressure treatment (300 and 600 MPa) on the partition coefficient of sodium (P_{Na+}) in salted pork loins as a new strategy to influence saltiness perception

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INTRODUCTION

- High sodium (Na^+) intake is associated with high blood pressure and cardiovascular diseases [1]. Na^+ intake comes primarily from the consumption of salt (NaCl) and 20 % comes from processed meats [2].
- One of the most important practical limitations in the acceptability of salt-reduced products is a weaker sensory perception of saltiness and overall flavor [3].
- There exists a relationship between [Na^+] in the saliva and perceived saltiness. [Na^+] in the mouth depends on the binding strength of Na^+ to the meat matrix and its release towards the water phase.
- The strength of this interaction can be estimated by calculating the partition coefficient (P), which is the ratio of concentrations of a compound in a mixture of two immiscible phases at equilibrium.
- The application of high pressure processing (HPP) has already been suggested as a tool to increase saltiness perception [4,5].
- The aim of this study was to investigate the effect of processing temperature (70 °C) and HPP treatment (300 and 600 MPa for 5 minutes) on the P_{Na+} of salted pork loins.

Figure 1. Experimental design.

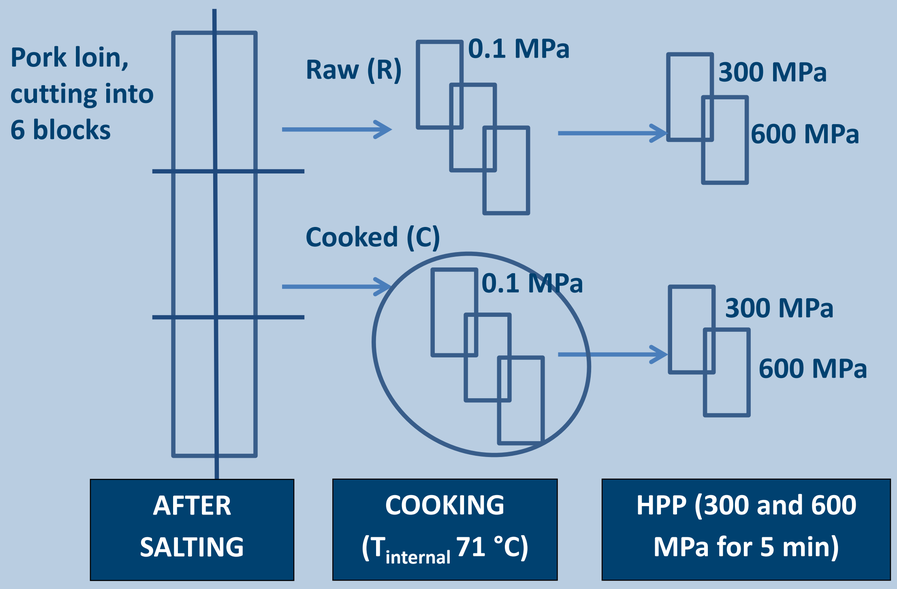
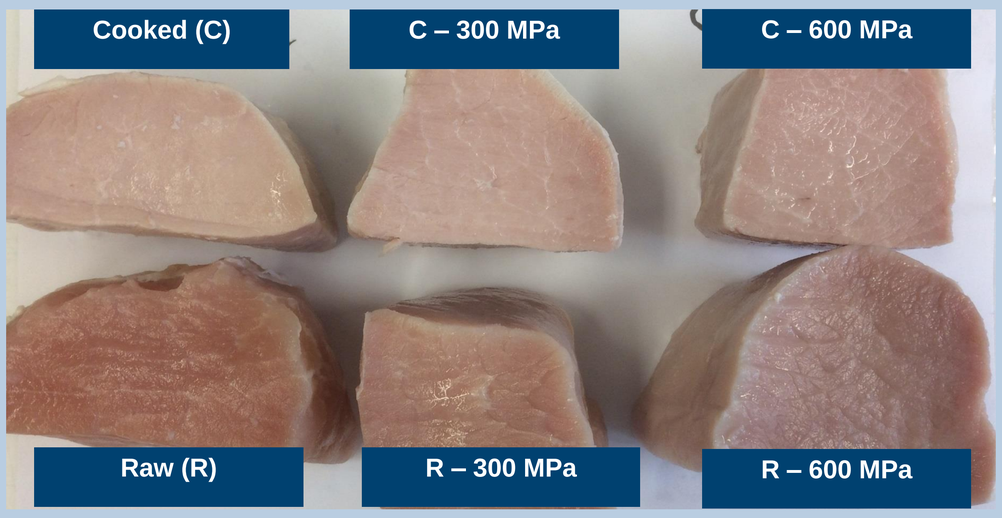


Figure 2. Visual appearance of raw, cooked and high pressure treated salted pork loins.



MATERIALS AND METHODS

- Pork loins (n=6) within a pH range of 5.4-5.6
- Salting by immersion using industrial curing salt (99.5 % NaCl and 0.5 % $NaNO_2$) for 2 weeks at 2 °C.
- Estimation of P_{Na+} at the equilibrium between liquid (water) and solid phase (meat product) by determination of [Na+] using inductively coupled plasma - mass spectrometry (ICP-MS).

CONCLUSION

- This preliminary data showed that some cooked meat products had a higher Partition Coefficient (P_{Na+}) than their equivalent raw counterparts.
- The higher is P_{Na+}, the lower will be the affinity for the ion (Na^+) to remain in the product.
- This property could have important implications, as raw meat products submitted to a heat treatment could result in a product with an enhanced perceived saltiness. This could allow the use of lower salt concentrations while keeping saltiness perception and flavour intensity.

RESULTS AND DISCUSSION

- Comparing raw to cooked salted loins, it can be observed that cooked products had a tendency for the P_{Na+} to be higher than for their raw counterparts (Table 1). Indeed, P_{Na+} of cooked control sample for r = 3.4 was significantly higher (*P*-value < 0.05) than that of the raw control sample (Table 1). In addition, the averaged P_{Na+} was also significantly higher for two product cases, cooked control and cooked sample treated by HPP at 300 MPa in comparison to the respective raw samples, confirming a higher P_{Na+} in this type of meat product when cooked.

Table 1. Effect of processing temperature (70 °C) and high pressure treatment (300 and 600 MPa for 5 min) on the partition coefficient of sodium (P_{Na+}) of salted pork loins (mean ± standard deviation)

	Raw			Cooked		
r#	Control	HPP		Control	HPP	
	0.1 MPa	300 MPa	600 MPa	0.1 MPa	300 MPa	600 MPa
2.3	$1.2^{A} \pm 0.2$	$1.2^{A} \pm 0.2$	$1.6^{A} \pm 0.5$	$1.8^{A} \pm 0.2$	$1.7^{A} \pm 0.4$	$1.3^{A} \pm 0.2$
3.4	$1.2^{A} \pm 0.2$	$1.2^{A} \pm 0.3$	$1.6^{AB} \pm 1.5$	$2.4^{B} \pm 0.5$	$1.8^{AB} \pm 0.5$	$2.0^{AB} \pm 0.3$
4.6	$1.9^{A} \pm 0.5$	$1.4^{A} \pm 0.2$	$2.3^{A} \pm 0.8$	$1.8^{A} \pm 0.4$	$1.7^{A} \pm 0.5$	$2.0^{A} \pm 0.7$
5.7	$1.3^{A} \pm 0.3$	$1.4^{A} \pm 0.2$	$1.4^{A} \pm 0.9$	$3.0^{A} \pm 1.6$	$2.8^{A} \pm 1.4$	$2.1^{A} \pm 1.0$
Average	$1.4^{AB} \pm 0.5$	$1.3^{A} \pm 0.2$	$1.7^{AC} \pm 0.7$	$2.2^{C} \pm 0.8$	$2.1^{BC} \pm 1.0$	$1.8^{ABC} \pm 0.7$

Different superscripts within the same row mean a significant difference at *P*-value < 0.05.
#: r = mass (liquid phase) / mass (solid phase)

- Looking at the effect of HPP treatment, it can be observed a trend for the P_{Na+} to be higher for the raw products that were treated with HPP, though this trend was not statistically significant (Table 1). In contrast, this trend was not observed for cooked products, which had already a higher P_{Na+} than raw products (Table 1). This fact would be coherent with a stronger interaction of ions to the meat matrix in raw products in comparison to cooked products. Cooked products will have a greater degree of protein denaturation and disruption of the muscle structure, which possibly leads to less electrostatic interactions and restrictions to the mobility of ions in the meat product. In fact, this will be favoring their transfer to the water phase.

- Overall, this work could not conclude the existence of a larger P_{Na+} after HPP treatment, though a tendency could be observed, but did show a higher P_{Na+} for some cooked meat products.

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