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THE EFFECT OF ENHANCEMENT WITH SALT, PHOSPHATE AND MILK PROTEINS ON THE PHYSICAL AND SENSORY PROPERTIES OF PORK LOIN

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Introduction

Tenderness and juiciness rank as two of the top attributes in most consumer surveys (Rust, 1998). However, a lot of fresh pork today is often overcooked producing a tough and dry product (Rust, 1998). The pork industry has taken advantage of injection technology to provide consumers with enhanced, more tender and juicy products (Brewer et al., 2002; Prestat et al., 2002a; Sheard et al., 1999). Non-meat ingredients are used to improve juiciness and/or tenderness, enhance flavour, improve and stabilise colour, increase shelf life or increase water- holding capacity (WHC) in the final product. Additionally, some of these ingredients work synergistically with others to further enhance their functionality. Phosphates, the most common ingredient group used for enhancement, modify the charge environment of the myofibrillar protein, leading to increased WHC, decreased purge loss, improved flavour, colour stability (Prestat et al., 2002b; Sutton et al., 1997, Keeton, 1983; Ockerman et al., 1978) and juiciness (Sheard et al., 1999). Enhancement is not a method for improvement of low quality pork, but a means for the industry to improve the overall quality of fresh pork in the retail display (Miller, 1998).

Objectives

The objective of this study was to determine the effects of enhancement using salt, sodium tripolyphosphate (STPP), beta-lactoglobulin (beta-lg) enriched fractions and whey protein concentrate 80% (WPC80) on the physical and sensory attributes of fresh pork loins and to evaluate the use beta-lg enriched fractions and WPC80 as possible replacement ingredients for STPP, which may lead to the potential reduction of phosphate in the enhancement solution.

Methodology

Three brine solutions were formulated to contain different concentrations of ingredients for comparison with unpumped control loins (Table 1). Fresh pork loins (72 hours *post mortem*) were pumped to 110% of original weight with a brine solution using

a Dorit Model No. PSM-21-4.5 multi-needle brine injector. The effects of enhancement using salt, STPP, beta-lg and WPC80 were analysed in terms of cook loss, drip loss, purge loss and Warner Bratzler shear force (WBSF). Pork loins were weighed immediately after injection (pumping), vacuum packaged and were then allowed to equilibrate at 4^{o}C for 24 hr and re-weighed for % purge determination (Sutton et al., 1997). A sample (2.5cm thick) weighing ~80g, was removed from each sample chop used for drip loss determination and stored under atmospheric pressure at 4^{o}C for 48 hours. The drip loss was expressed as a percentage of the original weight (Honikel, 1987). An 8-member trained panel was employed to evaluate the sensory characteristics of pork chops from each treatment. Results were analysed using The SAS system (SAS, 1985). One-way analysis of variance (ANOVA) was carried out and the mean values were separated using Tukey's Family Error rate. A consumer study (n= 60) comparing enhanced to non-enhanced pork chops was carried out. Two samples were given to each consumer (one enhanced and one non-enhanced) with a questionnaire per pair of samples. The attributes tested for were tenderness and juiciness. The individuals were also asked which sample they preferred and based on their preference, would they be willing to purchase the pork chops. Results for the consumer study were analysed using the software program Statistics Package for Social Sciences (SPSS® Base) Version 9.0 for Windows.

Results & Discussion

The moisture content of the enhanced pork loins increased ($p<0.001$) in comparison to the control as expected (Table 2). The enhancement process had no effect ($p>0.05$) on cook loss (Table 2). This agrees with studies carried out by Brashear et al., (2002) and Sheard et al., (1999). The differences in purge losses were significant but small. Salt/beta-lg recorded the highest purge loss of 1.8% while salt/STPP had the lowest purge loss of 1.2%. Sutton et al., (1997) also reported that STPP decreased purge loss in fresh injected loins. All of the WBSF values decreased by ~13N ($p<0.001$) in the enhanced pork chops compared to the control. All of the enhanced products were similar ($p>0.05$) in peak force values. Prestat et al., (2002b) found that enhancement with 0.4% STPP and 0.4% salt significantly ($p<0.05$) decreased WBSF values. Smith et al., (1984) also noted lower shear force values for pork loins enhanced with 0.48% STPP. However, Sutton et al., (1997) found no differences between controls and pork chops enhanced with 0.4% STPP. Redness (a*) decreased significantly ($p<0.05$) in chops enhanced with salt/STPP at day 1 (Table 1). However redness (a*) at day 7 was increased significantly in chops enhanced with salt/beta-lg and salt/ WPC80. Redness (a*) decreased in all treatments between day 1 and day 7.

Tenderness and juiciness were significantly increased ($p<0.001$) with enhancement (Table 3). The enhanced pork chops had a slightly higher overall flavour and overall acceptability to the control pork chops. The differences in overall flavour were small but significant ($p<0.024$). Pork loins enhanced with phosphate and salt had a higher overall flavour rating in comparison to the control ("very good" vs "good"). No difference was recorded between the salt/beta-lg enhanced and the salt/WPC80 enhanced ($p>0.01$). All the treatments were found to have either good or very good overall flavour rating. Sensory analysis results showed that beta-lg and WPC80 could be used as potential replacement ingredients to reduce the amount of phosphate used in enhancement

solutions, as they were comparable to salt/STPP enhancement solution. Enhancement adds value to pork loins, but only if consumers perceive them to be as or more acceptable than control loins (Brewer et al., 2002). Glaeser et al., (2003) found that the overall eating quality of pork was markedly improved by needle injection of a brine solution, containing STPP and salt.

In the consumer study, consumers rated the tenderness, juiciness and taste of the enhanced chops significantly higher then the control chops. Sixty percent of the consumers preferred the enhanced pork chops (Figure 1). Sixty-two percent stated that they preferred the enhanced sample, sixty per cent stating that they would buy the product, while only 2 per cent stating that they would not buy the product (Figure 2).

Conclusions

Beta-lg enriched fractions and WPC80 can be used as potential replacement ingredients to reduce the amount of phosphate used in enhancement solutions, as they were comparable to salt/STPP enhancement solution. In the consumer study, consumers rated the tenderness, juiciness and taste of the enhanced chops significantly higher then the control chops. These findings indicate the potential of pork enhanced meat products to the pork industry.

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Tables and Figures

Table 1: Brine formulation for pork loin enhancement

Treatment	Water	Nitrite Salt (%)	STPP	β-lg	WPC80
Control	-	-	-	-	-
STPP/Salt	92.2	5.5	3.3	-	-
Salt/Beta-lg fraction	89.0	5.5	-	5.5	-
Salt/WPC80	89.0	5.5	-	-	5.5

Table 2: The effect of enhancement on the physical properties of pork loins

Treatment	Moisture (%)	Drip Loss (%)	Purge Loss (%)	Cook Loss (%)	Day 1 a*	Day 7 a*
Control	74.5^{a}	1.7^{ab}	0.0^{a}	31.5^{a}	5.3^{b}	1.8^{a}
STPP/Salt enhanced	77.0^{c}	0.9^{a}	1.2^{b}	30.7^{a}	3.2^{a}	2.2^{a}
Salt/Beta-lg fraction enhanced	76.4^{cb}	2.8^{c}	1.8^{c}	31.4^{a}	5.5^{b}	3.7^{a}
Salt/ WPC80 enhanced	76.0^{b}	2.0^{bc}	1.6^{bc}	30.6^{a}	5.2^{ab}	3.8^{a}
SED	0.19	0.24	0.19	0.62	0.41	0.33

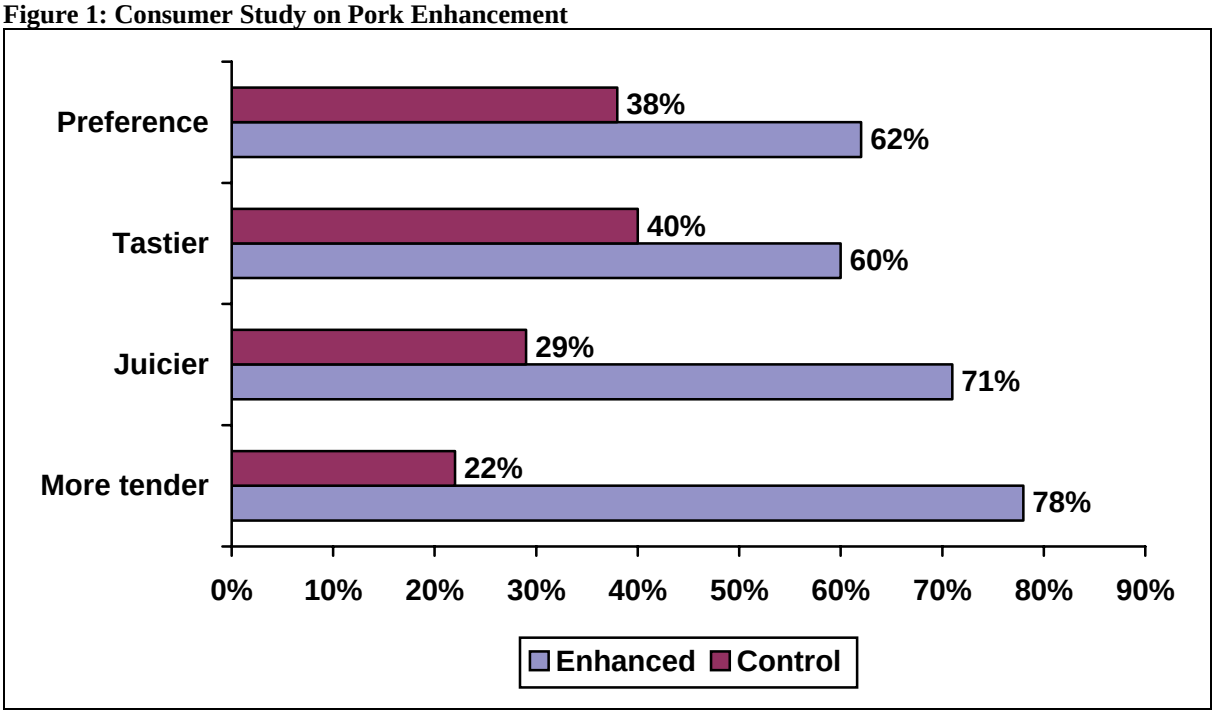
$^{a, b}$ Means in the same column with unlike superscripts are different ($p<0.001$).
SED: standard of the difference of the means error

Table 3: Enhancement effects on the sensory characteristics of pork loins

Treatment	WBSF (N)	Tenderness	Juiciness	Overall Flavour	O/F	O/A
Control	38.5^{b}	5.3^{a}	4.8^{a}	4.1^{a}	6.3^{b}	4.0^{a}
STPP/Salt	24.7^{a}	6.7^{c}	6.7^{c}	4.6^{b}	5.4^{a}	4.7^{b}
Salt/Beta-lg fraction	27.7^{a}	6.1^{b}	6.0^{b}	4.3^{a}	5.6^{a}	4.3^{a}
Salt/WPC80	24.9^{a}	6.7^{c}	6.8^{c}	4.3^{a}	5.3^{a}	4.4^{a}
SED	1.63	0.12	0.12	0.09	0.08	0.09

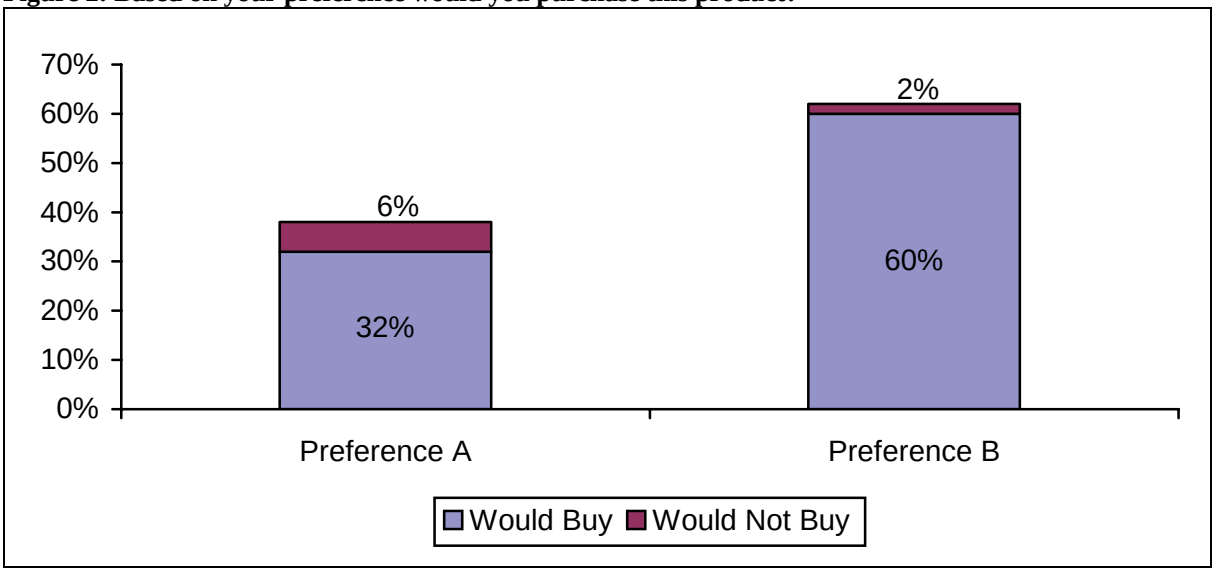
$^{a, b}$ Means in the same column with unlike superscripts are different ($p<0.001$).
O/F= Overall Firmness, O/A= Overall Acceptability, SED: standard of the difference of the means error

Figure 1: Consumer Study on Pork Enhancement



Base: 63 Respondents

Figure 2: Based on your preference would you purchase this product?



Base: 63 Respondents
Preference A: Control (Control); Preference B: Enhanced