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MARINATION IMPROVES PALATABILITY OF PSE AND NORMAL PORK LOIN ROASTS

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INTRODUCTION:

Pale, soft, exudative (PSE) pork is considered a problem in both domestic and export markets, with an economic cost to the Canadian pork industry in excess of $20 million annually. Presently, loin meat from PSE animals enters domestic markets but is not appealing to consumers because of the excessive drip in the retail packages and poor texture and juiciness on cooking. Overcooking of today's leaner pork can lead to toughening and dryness. Food service establishments often cite a reluctance to menu pork due to its potential to be dry and its inability to be held for long periods. Innovations in marination and ingredient technology can help to ensure tenderness and juiciness of pork for both retail and food service markets. Milk proteins have been used in meat products for their water holding and color whitening effects. Xanthan gum is an effective water holding agent and has been reported to have tenderizing effects in meat products (Miller and Gray, 1988). Recent introductions of new microwave succeptor materials to promote browning could lead to new interest by consumers in microwave cooking. The objective of this research was to investigate marination systems for lean pork of varying quality. A secondary objective was to investigate the effect of marinates and microwave cooking on PSE pork.

EXPERIMENTAL METHODS:

Weekly, fresh boneless pork loins (one day postmortem) were selected from the boning line of a local pork processor (Intercontinental Packers Ltd). Loins were returned to the University of Saskatchewan Meat Laboratory and the pH (probe) was evaluated at four muscle locations. For each replicate, one loin from each quality group (normal and PSE) was selected based on size and pH. The next day, loins were cut into four pieces (500-550 grams each) and each piece was assigned to one of four treatments based on latin square designs. Sixteen loins were tested in each experiment (8 normal and 8 PSE).

The first factorial experiment included: meat quality (normal vs PSE), and brine components - milk protein hydrolysate (0 vs 5%) and xanthan gum (0 vs 0.20%). The control brine contained 2.75% sodium chloride, 2.25% sodium tripolyphosphate and 2.25% sucrose. Ice (20% of the water) was used to chill the brine. Test brines also contained 5% milk protein hydrolysate (Quest International) and/or 0.20% xanthan gum (Keltrol TF, Kelco). Loin sections were injected to 115% of green weight, allowed to drain (20 min) and reweighed to determine brine retention. Loin roasts were then individually packaged and additional brine was added to achieve 115% of green weight. After 30 min of tumbling, samples were stored at -1°C for 4-6 days before cooking. After storage, roasts were weighed to determine purge losses. Roasts were individually cooked at 163°C to 71°C, cooled, weighed and refrigerated overnight.

Factors in the second experiment included: meat quality (normal vs PSE), effect of brine addition (0 vs 15%) and cooking method (conventional roasting vs microwave oven). The brine included xanthan gum (as above). After injection, 2 ml of caramel color (Maillose; Red Arrow Products Co. Inc.): water (1:1) was pipetted into each package. (exp 1). One half of the roasts were conventionally cooked at 163°C to 73°C. The remaining roasts were wrapped in a paper-backed stainless steel succeptor (Printpack Inc., Atlanta, GA) to promote browning and cooked at 50% power in a 700 W microwave oven to 60-62°C. On standing, internal temperatures reached 75-76°C within 15 min.

A ten-member trained panel evaluated warm 1.3 cm cubes from each roast. In addition, they scored visual properties of pork slices. For the second experiment, a separate untrained six-member viewing panel evaluated external and slice color of each roast. Slice color (Hunter L*, a*, b*), shear values and pH of cooked meat (20 g : 80 ml water) were also determined.

Each experiment was treated as a split plot design with a factorial arrangement of treatments. During initial statistical analyses, roast position had a significant effect on most variables, thus position was included in the model. Most higher level interactions among main effects were not significant ($P>0.05$).

RESULTS:

The selected boneless pork loins had an average pH of 5.4 (range 5.1 to 5.7) and were very lean (1-2.5 % fat). Brine addition increased meat pH by 0.25-0.30 units. In preliminary work, it was determined that higher levels of phosphate addition and longer tumbling times resulting in products with a cured ham-like texture. In the first experiment, cooked pork from PSE loins was whiter in color and had lower juiciness scores and greater off-flavor intensity than pork from normal loins ($P<0.05$; data not presented). Milk protein hydrolysate was of little benefit. Addition of milk hydrolysate resulted in a slightly shorter cooking time (17.4 vs 18.2 min/100 gr; $P<0.05$) but higher shear values (5.2 vs 4.6 kg; $P<0.001$). This toughening effect was confirmed by the trained panel which found that samples with milk protein were more firm and less tender than controls. Xanthan gum improved pork palatability. Xanthan decreased purge during storage, and influenced both texture and juiciness of roasts. Samples with added xanthan were less firm, more tender, more juicy and had less perceptible mealiness than those without xanthan. However, xanthan did not affect shear values. Most interactions among main effects were not significant indicating that milk protein and xanthan had similar effects on both normal and PSE pork loins.

A second experiment was performed to further explore the effect of marination, and cooking methods on normal and PSE pork. Negative effects of PSE on meat palatability were somewhat greater than that observed in the first experiment, possibly due to the slightly lower pH observed in fresh PSE meat which influenced the pH of cooked roasts (Table 1). PSE loin samples were tougher, drier and had less desirable flavor than samples from loins of normal quality. Marination had large effects on pork loin palatability. Shear values were 30% lower due to marination. In addition, panelists found that marinated pork loin was softer, more tender, more juicy, less mealy with greater pork flavor intensity and higher flavor desirability than unmarinated controls. Marinated samples were considered to be slightly salty. Eating quality (tenderness, juiciness) of microwaved pork loin roasts was similar to that of conventionally cooked products (Table 1). However, microwaved roasts had slightly higher cooking losses than conventionally cooked loins. The microwave succeptor system did aid in browning in the 15-18 minutes of microwave cooking, but browning was still inferior to oven roasted samples.

In these experiments, palatability of pork loin varied considerable with anatomical location (Table 1). This data serves to reemphasize the importance of controlling or balancing the effects of sample location in meat research.

CONCLUSIONS:

Marination improved tenderness, juiciness and flavor of lean PSE and normal pork loin roasts and should help to ensure a consistent, positive eating experience. Xanthan gum was a useful addition to the salt/phosphate-based marination system; while milk protein was of little benefit. In general, effects of marination were greater than the difference in palatability between PSE and normal muscle, indicating that marinated PSE meat would be of equal or higher eating quality than nonmarinated meat of normal quality. Further investigations of microwave succeptor systems are needed.

REFFRENCES:

Miller, R. and Gray, D.I. 1988. Process for the tenderization of meat cuts. U.S. patent 4,786,515. Nov. 22.

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TABLE 1: Effect of meat quality, marination and cooking method on properties of lean pork roasts.

	Effect of Meat Quality			Effect of Marination			Effect of Cooking Method			Effect of Loin Position				
Attribute	Normal	PSE	Prob	0 %	15%	Prob	Conv	Micro wave	Prob	1 (Ant)	2	3	4 (Post)	Prob
Purge, %	4.0	5.8	0.001	4.6	5.2	0.17	4.9	4.9	0.92	4.0	3.9	5.6	6.1	0.001
pH, cooked	5.78	5.59	0.02	5.56	5.81	0.001	5.69	5.67	0.40	5.70	5.71	5.70	5.63	0.02
Final temp, °C	75.1	75.7	0.50	76.0	74.8	0.02	75.0	75.8	0.11	76.0	76.4	75.0	74.2	0.02
Cook time, min/100 gr	10.6	10.9	0.27	10.6	10.9	0.47	18.4	3.2	0.001	11.2	10.4	10.9	10.6	0.28
Cooking loss, %	29.9	31.2	0.39	30.2	30.9	0.24	29.3	31.7	0.001	28.6	30.5	31.3	31.8	0.004
Shear, kg	5.8	7.3	0.006	7.7	5.3	0.001	6.4	6.6	0.55	6.1	6.3	7.0	6.8	0.10
Outside color [1]	3.9	3.8	0.39	3.9	3.9	0.96	5.2	2.6	0.001	4.0	4.0	3.8	3.7	0.27
Slice color [1]	3.2	3.3	0.64	3.3	3.3	0.76	3.4	3.1	0.07	3.3	3.2	3.1	3.5	0.31
Overall appearance [1]	3.7	4.2	0.001	3.8	4.0	0.20	4.5	3.4	0.001	3.5	3.9	4.0	4.3	0.02
Firmness [2]	4.4	5.1	0.04	5.4	4.1	0.001	4.7	4.8	0.96	4.1	4.6	5.1	5.1	0.004
Tenderness [2]	5.0	4.4	0.05	4.1	5.4	0.001	4.8	4.7	0.55	5.2	4.8	4.4	4.5	0.02
Initial juiciness [2]	5.2	4.4	0.008	4.3	5.4	0.001	4.7	4.9	0.32	5.4	4.9	4.6	4.5	0.01
Overall juiciness [2]	4.9	4.2	0.009	4.0	5.1	0.001	4.5	4.6	0.59	4.9	4.6	4.4	4.1	0.009
Mealiness [1]	4.6	4.4	0.16	4.2	4.7	0.005	4.5	4.4	0.73	4.8	4.5	4.4	4.2	0.08
Pork flavor intensity [2]	5.1	5.0	0.47	4.7	5.4	0.001	5.1	4.9	0.03	5.0	5.0	5.1	5.0	0.29
Flavor desirability [2]	5.0	4.5	0.04	4.3	5.2	0.001	4.8	4.7	0.18	4.7	4.8	4.8	4.7	0.53

1 Six point scales: 6= very brown, white, acceptable, no detectable mealiness; 1=light beige/grey, very grey/beige, very unacceptable extremely mealy.

2 Eight point scales: 8= extremely firm, tender, juicy, intense pork flavor, desirable flavor; 1= extremely soft, tough, dry, bland, undesirable.