EFFECT OF SEX AND DIETARY LECITHIN ON EATING QUALITY OF PORK

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Abstract – This study involved 210 pigs (in 30 pens) of three sexes (female, entire male, immunocastrated male) and two dietary treatments (0 or 8 g/kg dietary lecithin) for 4 weeks prior to slaughter. Loins from the 2 median weight pigs from each pen ((total of 10 loins per sex x dietary treatment cell) were obtained at slaughter for objective meat quality and consumer preference studies. Loins were cooked to a 75°C endpoint temperature for consumer studies. Immunocastration resulted in increased slaughter weight, carcass weight and backfat. Pork from immunocastrated males had a lower shear force. In general, pork from entire males had a higher pH and was darker than pork from the other sexes. There were very few effects of sex or diet on consumer assessed eating quality, perhaps due to high variability in many of the scores. The exception was that flavour tended to be lower in pork from entire males and be more likely to fail consumers. While there were very few effects of dietary lecithin on objective or consumer eating quality, pork from pigs consuming lecithin was less likely to fail to meet consumer expectations. Overall liking of pork was influenced, in order of importance, by flavour, tenderness, juiciness and aroma.

I. INTRODUCTION

The impact of key production, processing and post-slaughter factors on the eating quality attributes of fresh pork has been investigated [1] However, it was identified that this approach had limitations in that only the effect of singular factors on eating quality could be effectively quantified due to the nature of the data available. Also, it was highlighted that there are gaps in our understanding of the effects of sex and diet on eating quality of pork, and in particular the effect of immunocastration and dietary supplements.

The presence of boar taint remains a significant issue for Australian consumers. Recent consumer research conducted by Australian Pork Limited identified that the bad taste and smell were more likely to cause a reduction in purchase frequency of pork than other meats whilst one in three consumers buy pork less frequently due to a bad product experience. Boar taint cannot be effectively managed by slaughtering animals at 64 ±5 kg [2]. Options to address this include physical castration of males and the use of the boar taint vaccine to result in immunocastration of entire males. For example, the juiciness, flavor and overall liking of pork from the *M. longissimus* (loin) of surgical castrates was preferred over that from either females or entire males [3]. However, there is still a relative lack of consumer preference data on the effect of immunocastration on pork eating quality.

Dietary lecithin has been shown to reduce collagen synthesis in loin muscle from pigs fed between 4 and 80 g/kg soyabean phosphotidylcholine [4]. Also, dietary lecithin reduced pork chewiness [4,5] and hardness [5], suggesting that improved chewiness may be due to decreased collagen content. However, dietary lecithin had no effect on shear force or cohesiveness [4,5].

We hypothesized that entire males (EM) would produce pork of lower eating quality than females (F) or immunocastrated males (IC) and that dietary lecithin would eating quality. The objective of this study was to determine both the influence and effect

size of gender and dietary lecithin and any interactions, on consumer acceptability of pork.

II. MATERIALS AND METHODS

A total of 210 finisher pigs (Large White x Landrace) (PrimeGro™ Genetics, NSW, Australia) were identified at 17 weeks of age and transferred to finisher accommodation with a total of 30 pens. Each pen consisted of a total of seven pigs of the same sex. Pen weights were recorded at entry to the finisher pens (pig average start weight of 71.3 ± 0.61 kg) and pens randomly allocated to a 2 x 3 factorial experiment with the respective factors being dietary lecithin supplementation (0 or 8 g/kg) and sex (F, EM and IC pigs). The priming Improvac® (CSL Pty Ltd, VIC, Australia) vaccination was administered to male pigs at 13 weeks of age and the second vaccination at 17 weeks of age. All diets were formulated to contain 0.061 g available lysine/ MJ DE and 14.2 MJ DE/kg. Diets were pelleted and fed to pigs from 17 weeks of age through to slaughter at 21 weeks of age. Dietary lecithin was administered for a total of four weeks prior to reaching a final slaughter live weight of 102.4 ± 2.16 kg. Carcase weight and fat depth at the P2 site was obtained on the slaughter floor and following chilling at 4°C for 24 h, carcases were boned at 24 h post-slaughter.

For objective meat quality and consumer studies, the *M. longissimus* (loin) were collected from one side of the carcasses of the 2 median final live weight pigs per pen (total of 10 loins per sex x dietary treatment cell). From each loin, four 2.5 cm thick steaks were sliced from the caudal end of each loin, de-rinded and denuded of subcutaneous fat. All labeled and individually vacuum packaged steaks were boxed and frozen to -20°C at 1 day post-slaughter, depending on treatment allocation. Frozen cuts were then transported to the sensory facility via truck for sensory assessment. Each steak was evaluated by one consumer, resulting in 40 evaluations per sex x dietary treatment cell and 240 total evaluations across all six treatments. A 0-100 continuous line scale was used by consumers to evaluate each sample for aroma, tenderness, juiciness, flavour and overall liking (0=like extremely, very tender, very juicy to 100=dislike extremely, not tender, not juicy). Each sample was also assessed for quality grade score on a 1-5 scale (1=unsatisfactory, 2=below average, 3=average, 4=above average and 5=excellent). Fail rate refers to the percentage of consumer evaluations for quality grade that scored either a 1 or a 2. Sensory data was analysed using the statistical package, R. Genstat 15 was used for analysis of carcase and meat quality data.

III. RESULTS AND DISCUSSION

All carcass and eating quality data are presented in Table 1. IC males were heavier at slaughter ($P<0.001$) and had greater carcass weight ($P=0.002$) and P2 backfat ($P<0.002$) than either F or EM. Dressing percentage was greater for F ($P<0.001$) than either EM or IC. These results are consistent with the findings of from a large meta-analysis of the effects of IC on carcass characteristics [6]. Dietary lecithin had no impact on carcass characteristics although in a previous study where dressing % was increased [4].

Loin muscle pH was lower in IC than EM at 45 min ($P=0.036$) with F intermediate. At 24 hrs there was no difference in pH between F and IC which however were both lower ($P=0.004$) than for EM. Pork from EM was darker (lower L* value) ($P=0.011$) and tended to be more blue (lower b* value) ($P=0.063$) than pork from IC and F. Cooking loss was higher ($P=0.035$) while shear force was lower ($P=0.042$) in pork from IC than from F and EM. Dietary lecithin had no impact on objective eating quality.

There were very few effects of sex or diet on consumer assessed eating quality, perhaps due to high variability in many of the scores. The exception was that flavour tended to be lower ($P=0.069$) in EM than in F or IC. On the other hand there was no effect of sex or dietary lecithin on aroma, tenderness, juiciness, overall liking, quality grade and intention to re-purchase.

Overall liking was highly correlated with flavour ($R=0.912$, juiciness ($R=0.737$), tenderness ($R=0.801$) and aroma ($R=0.589$). The strong relationship between these variables was evidenced by the prediction equation for overall liking included the other four key variables (across all treatments): Overall liking= -0.2 + 0.601 x Flavour + 0.173 x Tenderness+ 0.180 x Juiciness + 0.060 x Aroma

($P<0.001$; $R^2=0.855$, SD 7.8). Overall liking of pork was therefore influenced, in order of importance, by flavour, tenderness, juiciness and aroma. The importance of flavour on overall liking of pork concurs with earlier studies with a variety of pork cuts and cooking variables [1]. Also, the consistency in magnitude of the coefficients for the main factors provides confidence in their contribution to overall liking. Although there was no significant effect of sex on overall liking, the trend towards lower flavour scores suggests that pork from EM should not be included as part of an eating quality system to deliver pork of guaranteed high eating quality to consumers.

Although there was no effect of dietary lecithin on quality grade (Table 1,) there was a decrease in pork that scored below average (ie. quality score ≤ 2) and therefore failed to satisfy consumers (37.5 vs 27.5% for control and lecithin diets respectively, $\chi^2=6.19$, 1 df, P=0.013). Similarly, there was no effect of sex on quality grade (Table 1) or on the number of pork samples that failed to satisfy consumers (20.0 vs 27.5 vs 20.0% for F, EM and IC respectively, $\chi^2=3.10$, 2 df, P=0.21). However, when scores for pork from EM was compared to pooled values for F and IC, there was a trend for a higher failure rate for pork from EM (27.5 vs 20.0% for EM and non-EM respectively, $\chi^2=3.10$, 1 df, P=0.078).

Although there was no effect of dietary lecithin on intention to re-purchase (Table 1) there was a tendency for a decrease in pork that scored below average (ie. intention score ≤ 2) and therefore meant that consumers wouldn't re-purchase (31.7 vs 21.7% for control and lecithin diets respectively, $\chi^2=3.07$, 1 df, P=0.080). Similarly, there was no effect of sex on intention to re-purchase (Table 1) or on the number of pork samples that failed to persuade consumers to re-purchase (27.5 vs 25.0 vs 27.5% for F, EM and IC respectively, $\chi^2=0.17$, 2 df, P=0.92).

IV. CONCLUSION

This study found that IC results in increased slaughter weight, carcass weight and P2 backfat thickness. Pork from IC males had a lower shear force, although this didn't translate to any differences in tenderness or juiciness. In general, pork from EM had a higher pH and was darker than pork form F and IC. Pork from EM also tended to have a lower flavour score and be more likely to fail consumers. While there were very few effects of dietary lecithin on objective or consumer eating quality, pork form pigs consuming lecithin was less likely to fail to meet consumer expectations.

Further work is still required to better understand the effects of dietary lecithin on muscles and cuts that have a greater collagen content than loin muscle. This is currently being addressed by the authors.

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Table 1. Influence of dietary lecithin and sex on carcass characteristics and objective quality and consumer eating quality of loin muscle from females (F), entire male (EM) and immunocastrated male (IC) pigs.

	Control			Lecithin			SED	P-Value		
	F	EM	IC	F	EM	IC		Diet	Sex	Diet x Sex
Final live weight (kg)	98.1	100.6	108.2	98.8	101.1	107.9	2.16	0.80	<0.001	0.94
Carcass weight (kg)	76.8	75.8	81.3	76.4	77.1	81.5	1.97	0.77	0.002	0.82
Dressing percentage (%)	78.5	75.4	75.2	77.3	76.2	75.6	0.84	0.92	<0.001	0.24
P2 backfat (mm)[1]	11.5	9.8	12.8	10.5	9.0	13.0	0.91	0.32	<0.001	0.62
Objective quality										
pH (45 mins)	6.33	6.37	6.24	6.33	6.41	6.14	0.106	0.71	0.036	0.65
pH (24 hrs)	5.51	5.72	5.52	5.46	5.63	5.45	0.082	0.17	0.004	0.94
L*	55.4	52.0	55.0	54.7	53.9	55.9	1.16	0.32	0.011	0.30
a*	6.45	6.51	6.25	6.11	6.58	6.29	0.318	0.68	0.40	0.60
b*	14.5	13.8	14.5	14.7	14.4	14.8	0.37	0.23	0.063	0.90
Cooking loss (%)	23.7	23.5	24.4	22.5	23.4	25.4	0.010	0.91	0.035	0.30
Shear force (kg)	2.82	2.84	2.41	3.06	2.90	2.37	0.098	0.72	0.042	0.83
Eating quality										
Aroma	62.9	61.3	63.2	63.8	59.3	63.1	1.83	0.41	0.79	0.65
Tenderness	58.2	52.1	47.8	59.5	55.7	55.6	3.38	0.89	0.74	0.098
Juiciness	52.7	49.6	48.4	54.2	48.7	49.1	3.38	0.69	0.73	0.55
Flavour	58.0	53.6	61.3	64.9	60.1	61.4	7.05	0.80	0.069	0.25
Overall liking	57.5	54.6	58.2	61.8	57.8	61.2	3.53	0.76	0.55	0.30
Quality grade	3.23	3.02	3.05	3.45	3.25	3.35	0.13	0.64	0.79	0.70
Re-purchase intention	3.30	2.90	3.20	3.58	3.27	3.40	0.27	0.96	0.51	0.14