EATING QUALITY for pure boars of Duroc, Berkshire, and Hampshire

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Abstract: Current study was conducted to assess difference and variation in objective and subjective meat quality traits between pure boars of Duroc, Berkshire and Hampshire. Breed had significant effects on intramuscular fat content, moisture, pH and color ($p<0.05$). The three breed did not differ significantly with persentage cooking loss and protein solubility. Duroc produced most palatable meat while Yorkshire had high level of polyunsaturated fatty acids which negatively correlated the flavor.
Keywords: Pork, Breed, Intramuscular fat, pH

I. INTRODUCTION

Consumers ideally desire attractive, economically priced products which are nutritious, tender, juicy, tasty and flavorful. Therefore defined targets for each of these characteristics as well as knowledge of important factors such as breed and pH that affect variation in these characteristics are important (Jeremiah & Miller 1998; Grawford et.al., 2010; Sheard et al 2005). The reports have demonstrated the highest ratings for overall palatability from pork chops with high intramuscular fat content (Laack et al 2001), higher ultimate pH 5.5-5.8 (Cho et al., 2009), bright color, low moisture content (70.1%), low protein content (19.4%), and low cooking losses (Hodgson et al.,1991). The main determinants of pork tenderness are intramuscular fat level and ultimate pH which may have originated from pigs different genetic backround (Laack et al 2001). Newcom et al., (2004) found significant differences in meat color, while assessing different breeds that used 1 to 6 color scales. However Edwards et al.,(2003) found no significant differences between same sire line including Chinese breed also Duroc and Pietrain breeds respectively. Berkshire has been known to have a higher ultimate pH than other more commercial breeds and Duroc had higher concentration marbling fat and overall liking score were higher than Large White (Wood et al., 2004, 1996).

We therefore sampled three commercial breeds (Yorkshire, Duroc, Berkshire) from a commercial breeding farm which are the principle breeds for the production of commercial cross breeds in Korea, and assessed difference and variation in objective and subjective meat quality traits between the pure boars.

II. MATERIALS AND METHODS

A total of thirty purebred boars (Duroc, n=10; Berkshire, n=10; Yorkshire, n=10) were sampled from a commercial breeding farm and slaughtered at a commercial abattoir at a live weight of 90-100.2 kg. 24 hours after slaughter *Longissimus dorsi* were taken from the right side of the carcasses, vacuum packed and moved to the meat science laboratory of the Chonbuk National Universtiy , and frozen at -20^{0}C until analysis before 50 days. Samples were prepared for meat color, cooking loss and WBSF as the protocols reported by Cho et al. (2009). Meat color was measured with a Konica Minolta Spectrophotometer CM-2500 d with D65 illuminant and 10^0 observers. Following cooking samples removed excess moisture and weighed to determine cooking loss. Then chilled samples at 4^{0}C overnight and was cut into six replicates core samples with 0.5 inch diameter and WBSF values measured on an Instron, Model 3342. The crosshead speed was 400mm/min and 40 kgf load cell was used. The pH was determined following the procedure of Bendall (1973) using a portable pH meter.

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The crude fat was analyzed using the Soxhlet method with petroleum ether. Fatty acid determined by the procedure developed by Rule (1998) and extract was analyzed by GC-MS Agilent 6890N by using fused silica capillary column (30m x 0.25mm x 0.25um film thickness). Carrier gas; helium, Split ratio of 100:1, temperature 280^0C and total running time was 35 min. Sensory evaluation was done following protocols reported by Hwang et al.(2008). Consumer panels consisted of 48 non trained male and female students. A total of 288 sensory samples were randomly allocated in 12 sets of four sessions; each session had 12 panelists and each panelist evaluated 6 samples. The statistical analysis was performed using general linear model (SAS Institute, Cary, NC, 2007).

III. RESULTS AND DISCUSSION

The results showed a significant difference in intramuscular fat level ($p<0.05$) between breeds, where Duroc LD muscles contained the highest concentrations of intramuscular fat (3.41%) with the lowest water level. Similar to other study (e.g., Wood, 1996), the higher concentration of IMF improved eating quality of juiciness, flavor, overall liking and ratings in Duroc breed (64.2, 64.5 and 2.3, respectively) than other two breeds (Table 1). The pork loin chops with 3.46% IMF were more flavor than containing 1.05% IMF (Brewer et al., 2001).

Table 1. Effect of breed on objective quality and sensory attributes of pork loin

Parameters	DD[1]	BB[2]	YY[3]	Std Dev	F value
Moisture (%)	70.94	72.07	72.68	0.85	9.7**
Protien soluility (mg/g)	39.06	39.42	37.96	1.55	0.22
IMF (%)	3.41	2.18	2.17	0.55	11.7**
Cooking loss (%)	17.48	17.26	17.59	1.94	0.26
pH	5.71	5.71	5.58	0.11	4.09*
Hunter L	51.97	49.78[c]	53.76[c]	2.63	5.1*
Hunter a	4.24	3.77	2.66[c]	1.22	3.77*
Hunter	12.29	11.58	11.97	1.16	0.77
WSF, N	21.72	21.54	21.3	1.28	0.26
Tender	56.15	60.32	53.55	9.63	1.22
Juicy	64.26	59	62.77	10.44	0.63
Flavor	63	62.35	61.85	7.23	0.06
Overall liking	64.57	56.82	55.35[c]	7.47	3.7*
Overall rating	2.31[c]	2.02	1.9[c]	0.37	3.03*

* $p<0.5$ ** $p<0.01$ DD[1] Duroc reed [2]ekshire reed YY[3] Yorkshire reed

[ac] Means in the same row with different superscripts differed differed significantly ($p<0.5$)

Tale 2. Effect of reed on ojective quality and sensory attriutes of pork loin

Fatty acids	DD	BB	YY	Std Dev	F value
C8:0	0.03	0.02	0.03	0.01	0.09
C10:0	0.21	0.22	0.17	0.24	2.39
C12:0	0.18	0.18	0.13	0.04	3.95*
C14:0	2.23	2.27	1.81	0.43	3.36*
C16:0	29.04	34.85	26.96	6.04	4.23*
C16:1	4.5	5.13	4.33	1.47	0.67
C18:0	14.95	17.33	14.07	3.21	2.63
C18:1	41.16	29.85	38.18	7.87	4.8*
C18:2	6.44	8.21	12.87	6.41	2.58
C18:3	0.56	0.76	0.59	0.24	1.78
C20:0	0.21	0.21	0.2	0.05	0.4
C22:0	0.15	0.28	0.18	0.1	4.14*
C22:1	0.03	0.06	0.05	0.01	4.09*
C24:0	0.34	0.68	0.48	0.21	5.24*

We noticed that high level of polyunsaturated fatty acids in YY breed (i.e., 13.47%), which negatively correlated the flavor. Total of mono unsaturated fatty acids were 45.69, 35.04 and 42.56 for DD, BB and YY, respectively. This finding agreed with those of Cameron et al (2000) showed that high level of PUFA was linked to poor flavor but a positive correlation with the mono unsaturated fatty acids. Overall correlation IMP with tenderness score and WSF (r=0.5, r= -0.06) was same as De Vol et al. (1988) which reported that intramuscular fat was most highly related to tenderness and negatively related to shear force values (-0.29) of all the traits which they evaluated. We observed a low (but positive) relationship between IMF levels and overall liking & ratings of pork however flavor related negatively. This is not agreement with those Channon et al., (2004). Also with juiciness correlations were low (r=0.11) and that correlations usually no higher than aout r=0.3 (Eikelenoom (1996). The significant difference on pH between reeds ($p<0.05$) and pH=5.71 was for Duroc and Berkshire breeds, which was higher than Yorkshire (5.58) values within the appropriate range. Correlation coefficient etween pH and IMF was r=-0.17 hovewer Cho et al. (2009) noticed that significant ($p<0.05$) linear increase in intramuscular fat content from lower to higher pH group.

Table 3. Correlation coefficient etween selected sensory and ojective measurements of pork quality

	Crude fat	pH	a*	*	WSF	Tender	Juicy	Flavor	Overall liking	Overall rating
Moisture	-0.25	0.03	-0.03	-0.31	-0.06	-0.2	-0.24	0.03	-0.09	-0.33
IMF		-0.17	0.20	0.08	-0.06	0.5	0.15	-0.30	0.11	0.4
pH			0.03	-0.17	0.38	-0.30	0.14	0.32	-0.11	0.02
Hunter a*				-0.03	-0.16	0.46	0.03	-0.09	-0.16	0.005
Hunter *					0.58	0.12	0.32	0.07	-0.11	0.17
WSF						-0.09	0.21	0.07	-0.16	0.21
Tender							0.17	-0.03	0.06	0.06
Juicy								0.29	0.3	0.6
Flavor									0.1	0.5
Overall liking										0.51

No significant difference between breeds and WSF, there was a tendency to have a higher value for a pH similar to our previous data(Cho et al., 2009). The pHu relationship etween with tenderness was (r=0.38) and Laack et al., (2001) suggests this relationship dependent on genetics. WSF value negatively correlated with overall liking (r=-0.07). The color of samples otained for the 3 breeds showed an average value of a*=4.24 for Duroc, a*=3.77, for erkshire and lower level was a*=2.66 and slightly paler for a Yorkshire breed, being statistically equal values ($p<0.05$). We agree with Pearson & Dutson (1985) which reported that lower muscle pH (Yorkshire pH 5.58) believed to increase free water at the cell surface resulting in an increased reflectance giving the meat a lighter appearance (Pearson & Dutson 1985). Cooking losses of three breeds were not significant different. However the highest was YY (17.59%) and the had the lowest (17.26%) cooking loss and more tender (60.32) of other reeds. Crawford et al. (2010) reported chops from Berkshire pigs were tender than Landrace and also they suggested the shrinking collagen would force more water from the muscle, thus influenced cooking loss which may indicate a reed–specific relationship. Furthermore the class with the lowest pH (Yorkshire pH 5.58) had the highest cooking loss (Aaslyng et al.,2003). Juiciness little correlated to IMF (r=0.15). We agree with Eikelenoom et al.,(1996) which reported that juiciness is slightly correlated to IMF (r=0.15) but even more correlated to pHu (r=0.68 0.14) hovewer our pHu (r=0.14). Moreover Aaslyng et al., (2003) suggested that juiciness experienced initially in the chewing process depended only on the water content of meat, whereas juiciness experienced later in the chewing process was determined y a comination of the water and intramuscular fat content and a saliva production during chewing.

IV. CONCLUSION

The factors such as breed, intramuscular fat, ultimate pH, and color are the main technical attributes that drive consumer purchasing decisions. Consumer panels had higher preference for Duroc meat because chops were juicy and flavor which concomitantly occurred with a higher level of IMF.

Higher level of polyunsaturated fatty acid for YY was related to undesirable flavor for consumer panels.

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