MEAT QUALITY RESEARCH OF PURE- AND CROSSBRED PIGS IN ESTONIA

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Abstract

Characteristics of meat quality are becoming more and more important for pork producers and customers. This work was carried out to study the differences between pig breed combinations and their effect on meat quality. All tests were conducted in Valga Meat and Canning Factory, in Meat and Feed Laboratory of the Estonian Agricultural University. Five groups of pigs were under observation – pure-bred - Estonian Landrace (EL), Estonian Large White (ELW), Finnish Yorkshire (FY) and crossbred - Hampshire♂xELW♀ (H♂xELW♀); H/EL/ELW♂xEL♀. 193 pigs were tested. pH24 and pH48 were measured. Chemical composition of meat i.e. dry matter, protein, fat and ash, were determined. Water capacity of meat was determined and cooking loss was found. Loin eye area was measured by planimeter. The largest loin eye area was in crossbred H/EL/ELW♂xEL♀, smaller in purebred ELW. PSE or DFD meat is very closely related with pH; we have to admit, that such meat quality complex was not found. Water binding capacity was the best in crossbred H♂xELW♀ with value 27.04%, the worst in purebred FY with 18.36%. Cooking loss was highest in crossbreeds of H/EL/ELW♂xEL♀ with 45.67%, the lowest in pure-bred ELW with 42.98%. Breed had no significant effect on pH and boiling loss. Breed combinations with EL and H had a better meat quality than other breeds.

Introduction

Pork production has been leading agricultural activity in Estonia for many years. As nowadays customers are more informed, demand for high quality pork has increased rapidly. BSE problems in West-Europe have more and more negative influence to consumption of beef.

This work was conducted to study the differences between pig breed combinations and their effect on meat quality.

Materials and Methods

All tests were carried out in Valga Meat and Canning Factory, in Meat and Feed Laboratory of the Estonian Agricultural University. Five groups of pigs were under observation – purebred - Estonian Landrace (EL), Estonian Large White (ELW), Finnish Yorkshire (FY) and crossbred - Hampshire♂xELW♀ (H♂xELW♀); H/EL/ELW♂xEL♀. 193 pigs were tested.

Test animals originated from 22 farms over Estonia. All meatiness traits for carcass were measured by ultrasonic equipment ULTRA FOM 100 in Valga Meat- and Canning Factory. Live pig measurements were taken by ultrasonic equipment Piglog 105 and A-Scan Plus (Tänavots, et. al., 2000). pH24 was measured with portative pH metre Metter-Toledo MP120 in the meat processing company. A test slice of meat from loin eye was also taken to determine pH48, chemical composition of meat, water holding capacity and cooking loss of meat.

To determine chemical composition of meat, test slice was groud in microcutter until homogeneous structure of meat was achieved. Chemical composition of meat, dry matter, protein, fat and ash, was determined in Feeding Department of Estonian Agricultural University.

The dry matter of meat was determined by EC Directive 73/EEC Annex 1 from 5th of December 1972 (Feeding Department of Estonian Agricultural University 2001).

Raw fat was determined by Soxtec equipment (Tecator Application Note AN 23/80). Raw protein was determined by using Kjeltec equipment (Tecator Application Note AN 30/81).

The water holding capacity of meat was determinate by methods of R. Grau and R. Hamm (1957), modified by V. Volovinchkaja and B. Kelmani (1961). The principle of this method is based on determination of water quantity, which will demerge from meat. There was following formula used:

$$B = \frac{(\mathrm{A - XV})}{\mathrm{A}}, \text{ where}$$

A - total quantity of water in weighted meat, mg;
X - water content of 1 cm^2 large wet splash (8.4 mg - constant);
V - area of wet splash cm^2.

The water binding capacity was also determined with planimeter by using filter paper. Cooking loss of meat was determined from 20 g meat slice, which was boiled for 45 minutes at 95 ^oC. The difference between meat slice weight before and after cooking was cooking loss in percentages.

Loin eye area was determined by drawing loin eye shape from carcass to test paper and later on this area was measured with planimeter HAFF No 317 E.

The GLM procedure was used for analysing the data by analysis of variance (SAS Inst. Inc., 1991). The following formula was used:

$$\boldsymbol{Y}_{\mathbf{ijkl}} = \mu + \boldsymbol{W}_t + \boldsymbol{F}_{\mathrm{i}} + \boldsymbol{T}_{\mathrm{j}} + \boldsymbol{S}_{\mathrm{k}} + \boldsymbol{e}_{\mathbf{ijkl}},$$

where: F - searched character;
μ - average;
$\boldsymbol{W}_t$ - pork weight;
$\boldsymbol{F}_i$ - farm (1...22);
$\boldsymbol{T}_{\mathrm{j}}$ - breed (1...5);
$\boldsymbol{S}_{\mathrm{k}}$ - season (1...4);
$\boldsymbol{e}_{\mathbf{ijkl}}$ - residue.

All the results are presented by least square means where essential differences between breeds are shown with different letters like a, b, c (Parring *et al.*, 1997).

Results and Discussion

The largest loin eye area was found in crossbreds H/EL/ELW♂xEL♀ with 41.97 cm^2 (Figure 1) and in crossbreds of H♂ x ELW♀ with value 39.96 cm^2. The smallest loin eye area was in purebred ELW with 33.42 cm^2.

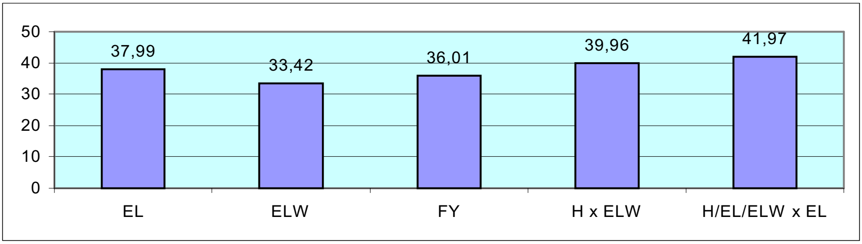

Figure 1. Loin eye area (cm^2)

The pH of meat is showing possible meat quality complexes like DFD (dark, firm, dry) or PSE (pale, soft, exudative). PSE-meat can arise if intra-muscular lactic acid will accumulate into the muscles with in one hour and when temperature of carcass is still high. In some extremal cases of PSE -meat pH can fall 0.02 or even 0.1 unit per minute (Essen-Gustavsson, 1993; Swatland, 1993).

Normal process of glycolyse can stop if pH will be one the level 5.6...5.8. DFD-meat can arise if pH level will not fall as level of glycogen in muscles is too low. In such cases pH will stand on the level 6.8...7.0. Test results of pH24 and pH48 are presented in Table 1.

Table 1. pH24 and pH48 values of pork in different breed combinations

Trait	EL	ELW	FY	H♂ x ELW♀	H/EL/ELW♂ x EL♀
n	137	38	7	7	4
pH 24	5.57[a]	5.57[a]	5.51[a]	5.49[a]	5.41[a]
pH 48	5.54[a]	5.55[a]	5.37[a]	5.77[a]	5.50[a]
pH difference	0.05	0.03	0.16	-0.03	-0.08

PSE or DFD meat is very closely related with pH; we have to admit, that such meat quality complex was not found.

The results of cooking loss were showed, that the smallest cooking loss (42.98%) was in purebreds ELW. The biggest cooking loss (45.67%) was found three breed cross H/EL/ELW♂ x EL♀. Cooking loss is a very important factor for meat-processing factories, as the further use of meat will depend on this.

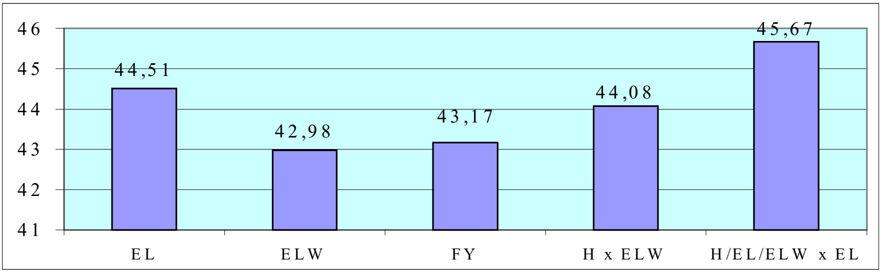

Figure 2. Cooking loss by different breeds

The highest water binding capacity was in crossbreds of H♂ x ELW♀ with 27.04 % and the lowest water binding capacity was in FY with 18.36 %.

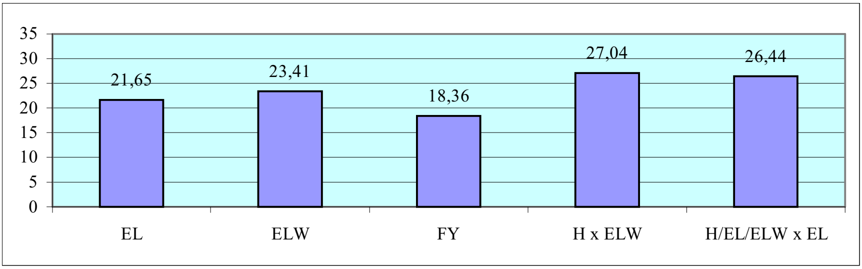

Figure 3. Water binding capacity of tested breeds

Good result in water binding capacity was also obtained in crossbreds of H/EL/ELW♂ x EL♀ with 26.44%.

Table 2. The chemical composition of meat

Trait	Breeds				
	EL	ELW	FY	H♂ x ELW♀	H/EL/ELW♂ x EL♀
n	137	38	7	7	4
Dry matter	25.60	27.69	27.10	26.65	27.41
Protein	22.73	23.22	23.27	22.58	22.99
Fat	1.59	3.22	2.51	2.80	3.15
Ash	1.28	1.25	1.32	1.27	1.28

The content of lean meat showed, that the best protein content was in meat of FY with 23.22% from dry matter. The lowest protein content was observed in meat of crossbreds H♂ x ELW♀ with – 22.58 %. The highest fat content was in meat of purebred ELW with 3.22 % and the lowest fat content was in meat of purebred EL with 1.59 %.

Table 3. Meat quality characteristics of differed breeds combinations and purebreds

Trait	Breed combinations					F	Pr>F
	H/EL/ELW ♂ x EL ♀	H♂ x ELW ♀	EL	FY	ELW		
pH24	5.405[a]	5.491[ab]	5.567[b]	5.515[ab]	5.571[ab]	1.95	0.0051**
pH48	5.506[a]	5.770[a]	5.542[a]	5.372[a]	5.555[a]	0.68	0.8931
Water binding capacity	26.449[a]	27.042[a]	21.646[a]	18.361[a]	23.407[a]	1.42	0.0891
Cooking loss	45.669[a]	44.075[a]	44.508[a]	43.170[a]	42.983[a]	2.61	0.0001***
Dry matter	27.410[a]	26.651[ab]	25.602[b]	27.098[ab]	27.691[a]	3.75	0.0001***
Protein	22.986[a]	22.584[a]	22.730[a]	23.273[a]	23.219[a]	0.97	0.4264
Fat	3.147[ac]	2.790[abc]	1.594[b]	2.506[abc]	3.221[ac]	2.73	0.0001***
Ash	1.279[a]	1.276[a]	1.277[a]	1.319[a]	1.251[a]	1.47	0.0701

As shown in Table 3 there was no significant effect of pH on meat quality of different purebreds and crossbred, as PSE or DFD meat was not determined. There was significant difference in value of pH24 between H/EL/ELW♂ x EL♀ and EL.

No significant differences in pH48, protein content, water binding capacity, cooking loss and ash content were found. The dry matter content of meat showed that there was a significant difference between breeds of H/EL/ELW♂ x EL♀ and EL versus ELW.

The fat content of meat showed, that there is a significant difference between H/EL/ELW♂ x EL♀ and EL versus ELW.

Summary

From current research work we can conclude that with regard to meat quality (loin eye area, chemical composition of meat) the best results were obtained from crossbred H/EL/ELW♂ x EL♀. Very important was also the fact PSE or DFD meat was not found.

From the point of technological quality of meat like water binding capacity or cooking loss we have to admit that the meat from cross-breeds of H/EL/ELW x EL had highest cooking loss. The smallest cooking loss was in pure-breeds meat of ELW. Good water binding capacity was in meat of H♂ x ELW♀ crossbred and the lowest water binding capacity was in meat of FY.

Our conclusion is that for meat production is best way to use crossing of differences breeds like H/EL/ELW x EL. Pure-breeds are not effective for production of meat and can be used for production of crossbreeds.

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