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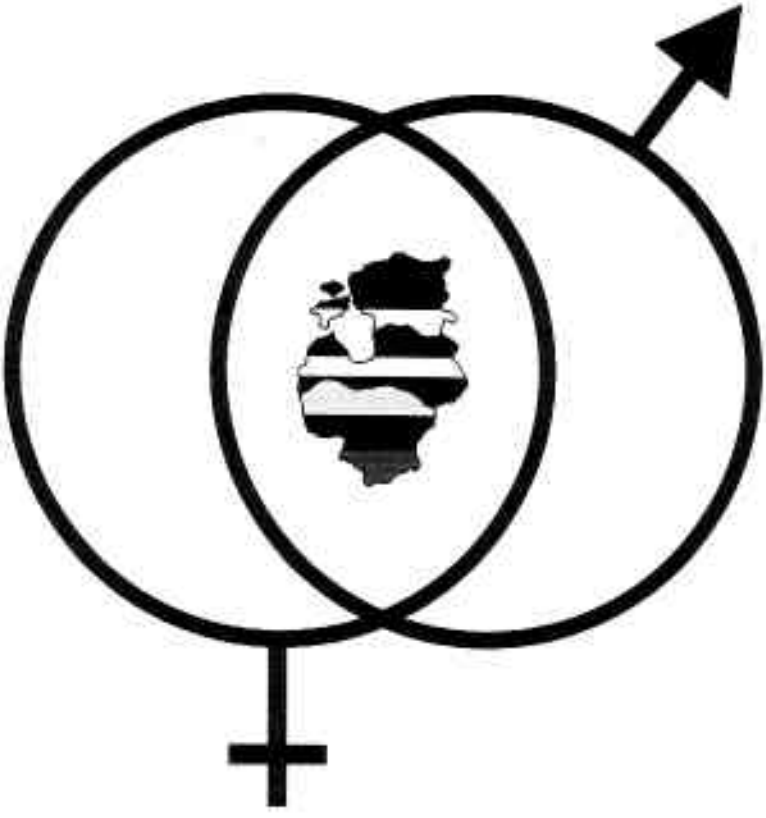

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FACTORS AFFECTING CARCASS QUALITY EVALUATED WITH ULTRAFOM 300

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ABSTRACT

The effects of pig gender on the most important factors for carcass quality were analyzed. In the experiment 15212 pigs (gilts, barrows and young boars) were included. The carcass weight of slaughter pigs was 51.6-99.9 kg. After the slaughter, carcasses were measured with UltraFOM 300. Statistical analysis of data was performed using statistical package SAS with the least square means method where the procedure for general linear models (GLM) was used. Pearson's correlation coefficient was applied to calculate relationships between the traits. The farm from which the pigs originated had a significant effect on all meatiness traits. Young boars at 50-69.9 kg carcass weight showed superiority on meatiness traits. Fatteners (gilts and barrows) at 85-99.9 kg had significantly thicker subcutaneous fat, smaller diameter of longissimus dorsi and lower lean meat content. Higher carcass weight resulted in significantly lower lean meat content. Suggestions were made that carcass weight should be included in the breeding program to ensure uniformity of pig carcasses. It is important to manage pigs according to their gender weight.

***Keywords**: pigs, UltraFOM 300, meat traits*

INTRODUCTION

In Estonia UltraFOM 300 was first introduced in late 2003. This device is currently being used in three largest meat processing companies – Rakvere Meat Processing Plant, Valga Meat Processing Plant, and Saaremaa Meat Processing Plant. A total of 366000 pigs were slaughtered during 2007.

The goals of crossbreeding program Marble Meat [2] were accepted in 1999, whereas several amendments have been made over the last few years, especially concerning the part of meat quality issues. New goals were set for the period 2006-

2013. Driven by major changes in the pig meat market, processors are looking for high quality meat to satisfy the consumer's demands. Pig breeders need adequate information to fulfil the requirements. Slaughter data of the pigs of the members of the Pig Breeding Association have been recorded since August 2007. These data provide farmers and the breeding association with valuable information about the carcass quality.

Uniformity of pig weight facilitates pig management on a farm and allows meat processing companies to improve organization of their work. Gender influences both growth performance and carcass quality. Boars are leaner than barrows and gilts [3].

The objective of the research was to determine the effect of farm, gender and carcass weight on pig carcass quality traits: subcutaneous fat thickness, diameter of *longissimus dorsi* and lean meat percentage.

MATERIALS AND METHODS

15212 pigs from 11 farms were slaughtered in the meat processing company within five months (August till December) in 2007. According to payment system of slaughterhouses, two gender groups were formed. Gilts and castrates were included in first gender group and classified as fatteners. Second gender group was formed by young boars, which were culled according to the failure on field test. 14998 fatteners and 236 young boars were included in the study. Inside the gender groups, pigs were ranked and divided according to carcass weight – 50-69.9, 70-84.9 and 85-99.9 kg.

Carcasses were weighed and cut in two halves 45 minutes after exsanguinations. Weight of carcasses ranged from 51.60 to 99.90 kg (Table 1). One of the carcass halves was measured with UltraFOM 300 at two points: (1) on the spot of last thoracic and first lumbar vertebra, 7 cm from cutting line of carcass; (2) on the spot of between 3rd and 4th caudal thoracic vertebra, 7 cm from cutting line of carcass. Two estimates of subcutaneous fat thicknesses and diameter of *longissimus dorsi* were registered during this operation. If differences of two subcutaneous fat thicknesses were over 5 mm, the measurements were excluded. Average subcutaneous fat thickness was calculated by using the above two measurements. Lean meat percentage was calculated:

$$\mathbf{Y=64.19701-0.39379*X2+0.08082*X3-0.33910*X4}$$

where

Y – estimated lean meat percentage;

X2 – subcutaneous fat thickness measured on the spot of last thoracic and first lumbar vertebra, 7 cm from cutting line of carcass;

X3 – diameter of *longissimus dorsi* measured on the spot of last thoracic and first lumbar vertebra, 7 cm from cutting line of carcass;

X4 – subcutaneous fat thickness measured on the spot of between 3rd and 4th caudal thoracic vertebra, 7 cm from cutting line of carcass.

Table 1. **Characterization of analyzed dataset (n=15212)**

Traits	Average	Std. Dev. (SD)	Minimum	Maximum
Carcass weight, kg	79.39	6.38	51.60	99.90
Average subcutaneous fat thickness, mm	13.80	2.94	6.50	31.45
Diameter of *longissimus dorsi*, mm	62.02	5.30	34.20	74.90
Lean meat percentage, %	59.12	2.38	45.30	64.90

The GLM procedure was used to analyse the data by analysis of variance [6]. The following formula was used:

$$Y_{ijkn} = \mu + B_i + E_j + W_k + e_{ijkn}$$

where

Y = dependent variable;
B_i = farm (n = 1-11);
E_j = month (n = 1-5);
W_k = gender x weight group interaction (n = 1-6);
e_{ijkn} = random residual effect.

To analyse weight differences, weight as effect was excluded from model:

$$Y_{ijn} = \mu + B_i + E_j + e_{ijn}$$

where

Y = dependent variable;
B_i = farm (n = 1-11);
E_j = month (n = 1-5);
e_{ijn} = random residual effect.

All the results are presented by least square means. Levels of significances are expressed conventionally: a, b, c, d – least square means within each effect with one letter in common do not differ significantly; *** - P<0.001, ** - P<0.01, * - P<0.05.

RESULTS AND DISCUSSION

Fattening pigs are usually slaughtered at the live weight of about 100 kg. Depending on the farm management – feeding, keeping conditions, *etc.* – realization weight may vary. Significantly lower realization weight was observed in pigs raised on Farm 10 as their carcass weight was lighter than that of pigs from other farms (Table 2). Farm 4 pigs' carcass weight was also significantly lighter than that on other farms, but they were 2.32 kg heavier than those on Farm 10. Considerably heavier pigs were marketed from Farm 6 where average carcass weight was 83.01 kg. Lower average carcass weight can be explained by increased demand and higher average carcass weight by decreased demand and difficulties in selling pigs. A. P. Schinckel *et al.* [7] found, that total carcass fat tissue mass will increase as the age at marketing increases.

Table 2. **Effect of farm on carcass quality traits**

Traits	Farm										
	1	2	3	4	5	6	7	8	9	10	11
n	152	2394	1958	2262	1071	3201	408	667	330	2125	644
Carcass weight, kg	81.87^{ag}	79.00^{h}	80.35^{e}	77.16^{d}	80.88^{af}	83.01^{c}	78.67^{b}	80.37^{cf}	79.81^{c}	74.84^{h}	81.65^{g}
Average subcutaneous fat thickness, mm	14.17^{af}	13.46^{b}	13.80^{a}	12.72^{c}	12.08^{d}	13.99^{f}	13.76^{afg}	14.95^{e}	13.44^{bg}	13.71^{ag}	13.76^{ag}
Diameter of *longissimus dorsi*, mm	62.61^{acd}	62.24^{ad}	62.21^{a}	63.09^{cd}	64.09^{h}	62.55^{cg}	62.05^{ae}	60.76^{f}	62.83^{dg}	61.17^{f}	62.60^{aeg}
Lean meat percentage, %	58.89^{a}	59.39^{b}	59.14^{a}	59.99^{c}	60.55^{d}	59.02^{a}	59.16^{ab}	58.17^{e}	59.45^{b}	59.11^{a}	59.19^{ab}

Carcass weight differences between farms were large, reaching to 8.17 kg between Farm 10 and Farm 6. Production practices that improve pig uniformity should be adopted. Variability of carcass weight (SD=6.38) must be a part of carcass quality evaluation as it shows the uniformity of pig population. High variation in carcass weights shows the insufficient uniformity of the pig population. In order to reduce the variability in carcass weight, the paying system should award the uniformity of pig carcasses which can be achieved by including carcass weight as an additional criterion in the payment system on the basis of uniformity.

Significantly fatter pigs were on Farm 8, where average subcutaneous fat thickness was 14.95 mm, 2.87 mm thinner subcutaneous fat was measured on pigs from Farm 5, and 2.23 mm thinner on pigs from Farm 4. Overall trend showed, that heavier pigs were fatter, as correlation between carcass weight and average subcutaneous fat thickness was positive and highly significant ($p<0.001$) (Table 3). These results agree with the author(s)' previous findings [8, 9, 10]. Also Beattie *et al.* [1] found, that as carcass weight increased, there were significant ($p<0.001$) increases in subcutaneous fat content.

Diameter of *longissimus dorsi* was quite even (difference 1.04 mm) on different farms, except Farms 8 and 10, where diameter of longest muscle was 60.76 and 61.17, respectively, and Farm 5 where diameter of *longissimus dorsi* was largest (64.09 mm). The relationship between diameter of *longissimus dorsi* and carcass weight (ns) showed,

Table 3. **Phenotypic correlations between meatiness traits of pigs**

Traits	Average subcutaneous fat thickness, mm	Diameter of *longissimus dorsi*, mm	Lean meat percentage, %
Carcass weight, kg	0.196***	0.013	-0.175***
Lean meat percentage, %	-0.986***	0.587***	
Diameter of *longissimus dorsi*, mm	-0.446***		

that the longest muscle does not depend on pig weight as much as subcutaneous fat thickness.

As the lean meat content was calculated on the basis of subcutaneous fat thickness and diameter of *longissimus dorsi*, the highest lean meat content was found in pigs originating from Farms 4 and 5 and the lowest from Farm 8. Due to intensive selection, the difference between lean meat content of pigs on the other farms was only 0.56%. However, despite even lean content, results showed that lean content decreased ($p<0.001$) with increasing carcass weight, which corresponds with the findings reported by Beattie *et al.* [1]. A marked increase in live and carcass weight during fattening occur principally due to an increase in fat deposition [4]. Therefore, it is important to find optimal slaughter weight to get maximum benefit from fattening pigs.

The thickest average subcutaneous fat (15.22 mm) was found in fatteners at the weight of 85-99.9 kg and the thinnest in young boars at the weight of 50-69.9 kg (Table 4). A strong negative relationship between subcutaneous fat thickness and diameter of *longissimus dorsi* ($p<0.001$) indicated that diameter of *longissimus dorsi* was both largest and smallest in the same groups as subcutaneous fat thickness (Table 3).

Lean meat content difference between gender x weight groups was 2.56%, being significantly higher in young boars' 50-69.9 kg group (60.60%) and lower in heavier fatteners' group (58.04%). Ryszard *et al.* [5] found that there was a significant difference ($p<0.05$) in the meatiness of boars' carcasses compared with the meatiness of gilt and barrow groups. Carcasses of fatteners were characterized by the highest fat content and their average subcutaneous fat thickness was statistically significantly different ($p<0.05$) from the subcutaneous fat thickness of the boars' group. Virgili *et al.* [11] research findings showed that carcasses of older pigs had lower ($P< 0.01$) lean content than those of younger pigs.

Figure 1 clearly indicates that heavier pigs have higher subcutaneous fat thickness and lower lean meat content than lighter ones. Compared to different gender groups, young boars show superiority over fatteners on meatiness traits.

These results suggest that pigs should be managed according to their gender, and more attention should be paid to the traits influenced by weight.

Table 4. **Effect of gender x weight group on carcass quality traits**

Traits	Gender x weight group					
	Fatteners 50-69.9 kg	Fatteners 70-84.9 kg	Fatteners 85-99.9 kg	Young boars 50-69.9 kg	Young boars 70-84.9 kg	Young boars 85-99,9 kg
n	985	13268	745	45	160	9
Average subcutaneous fat thickness, mm	13.24^{a}	13.92^{b}	15.22^{c}	11.97^{d}	13.28^{a}	14.11^{abc}
Diameter of *longissimus dorsi*, mm	61.97^{ac}	62.13^{a}	61.51^{c}	63.87^{b}	61.89^{ac}	62.92^{abc}
Lean meat percentage, %	59.53^{a}	59.04^{b}	58.04^{c}	60.60^{d}	59.49^{a}	58.97^{abcd}

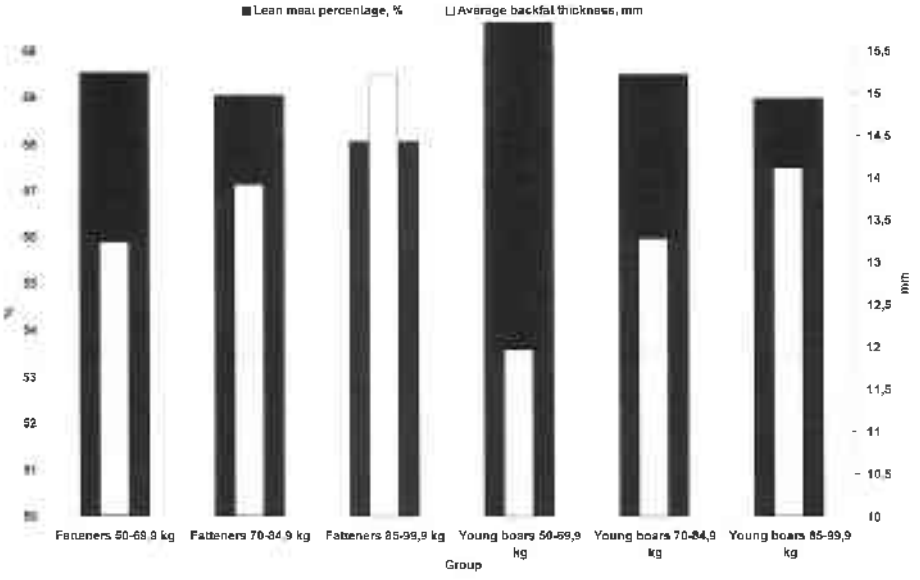

Fig. 1. **Gender x weight effect on carcass quality traits**

CONCLUSIONS

To reduce variability in carcass weight, the paying system should award the uniformity of pig carcasses which can be achieved by including carcass weight as an additional criterion in the payment system on the basis of uniformity.

Further investigation is needed to find optimal slaughter weight to achieve maximum benefit from fattening pigs. It is important to manage pigs according to their gender weight.

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ФАКТОРЫ ВЛИЯЮЩИЕ НА КАЧЕСТВО ТУШИ СВИНЕЙ, ВЫЯВЛЕННЫЕ ПРИ ОЦЕНКЕ ULTRAFOM 300

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Резюме

Результаты исследования показали, что пол животного имеет большое влияние на качество свинины. В исследовании обработали данные 15 212 свиней (свинки или боровы и хряки). Свиней забивали на мясокомбинате при массе примерно 100 кг. После забоя туши измеряли аппаратом UltraFOM 300. Статистический анализ производился при помощи статистического пакета SAS - методом наименьших квадратов, с использованием общей линейной модели (GLM). Для нахождения соотношений между признаками, использовался коэффициент корреляции Пирсона (Pearson). Ферма происхождения свиней имела большое влияние на их мясные признаки. Молодые хряки с массой туши 50-69,9 кг имели перевес по мясным показателям, причем у откормочных свиней с массой туши 85-99,9 кг был толще шпик, меньше площадь «мышечного глазка» и ниже содержание постного мяса в туше. Было рекомендовано включить массу туши в программу разведения, чтобы добиться равномерности туш свиней. Также было отмечено, что важно выращивать свиней соответственно их полу и живой массе.

Ключевые слова: свиньи, UltraFOM 300, мясные признаки

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