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THE PROTEIN CONTENT IN MEAT AT DIFFERENT AGE OF PIGS

SADRŽAJ BJELANČEVINA U MESU KOD RAZLIČITE DOBI SVINJA

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SUMMARY

Knowledge of the protein content in carcass of pigs of different size and age becomes essential since meat is used to feed people and to use in different products for human consumption. As we all know, protein contains appropriate amino acids necessary to optimize cell life and mitosis and life longevity in humans. Experiments were done on two farms on pigs of different body weight: 10-15 kg; 24-30 kg; 55-65 kg, 105 – 115 kg and 125 -140 kg. In each category we analyzed 6 animals from each 2 sires, in total 30 pigs from 12 sires. The meat for analysis was taken at 4 locations: neck, shoulder, MS (*musculus semimembranous*) and MLD *(musculus longisimus dorsi)*. The selection criteria for all were the same. They belonged to Landrace and Yorkshire, mother's line where 69% of selection focused on litter size and milk production. All pigs had adequate feed without fishmeal and sunflower. The basic feed contained: corn, wheat, barley and soybean. The piglets at 10-15 kg had 24.4% of protein; animals of 24-30 kg had 26.6% of protein in meat. Pigs between 55 and 65 kg had 24.1%, pigs between 105 and 115 kg contained 23.2% of protein and the oldest at 125-140 kg had 22.4% of protein. Following world meat quality standards, all animals in different categories were within them. It also means selection criteria we used were efficient. The variations of protein content in each category, although small, were between 11 and 14%. The influence of age and sire on examined traits was highly significant while differences between farms were not. This justify was than use of MME model which can be used in selection to improve certain traits.

Key words: pigs, protein content in meat

INTRODUCTION

Quality evaluation of pig meat and forming prices on the slaughter line is a prerequisite to the establishment of trust between farmers and slaughterhouses. The motive of relationship is the profit for the farmers, gained via selection on meatiness (it is known that pig live weight gain per kg meat should require about 1.7 kg of concentrate, while live weight gain per kg of fat requires consumption of approximately 7.0 kg of feed). This enables farmers to make more money by saving on feed, while slaughterhouses buy more meat from animals of optimum quality (Vidović et al., 2011a; 2011b). Today, the protein contents in pig meat play an important role in pig selection, the same as nutrition. In fact, it is this protein content trait which defines the quality of meat. All pig producers and meat processing companies define improvement of this as the main target. As we all know, proteins contain appropriate amino acids necessary to optimize cell life and mitosis as well as longevity of life in humans. Optimal

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criteria today for good quality meat are that it should contain a minimum of 23% of protein content. Passi and de Luca (1998) stated that in the human nutrition it is possible to consider only 10 amino acids as principal, i.e. essential nutrients, which the humans must obtain from various diets. The remaining amino acids may be synthesized from the products of metabolism and from essential amino acids. Cornet and Bousset (1999) studied the free amino acids and dipeptides in pigs i.e. in the red (*masseter*), white (*trapezius*) and inter-medial (*longissimus dorsi*) muscles. The highest aspartic acid, glutamine and taurine content was in the muscle masseter. The muscle longissimus dorsi showed the highest ß-alanine and carnosin content. The muscle trapezius had the medium the above-mentioned amino acids content. Aristoy and Toldrá (1998) also evaluated the free amino acids and dipeptides in pig meat, i.e. in the muscles of diverse metabolic types (*masseter, trapezius, semimembranosus and longissimus dorsi*).

MATERIALS AND METHODS

The study was conducted at two farms using pigs of the following sizes: 10-15 kg; 24-30 kg; 55-65 kg; 105 – 115 kg and 125 -140 kg. In each category we analyzed 6 animals, each from 2 sires, in total 30 pigs from 12 sires. The meat was sampled at four carcass locations: neck, shoulder, MLD (*musculus longisimus dorsi*) and MS (*musculus semimembranosus*). The selection criteria for all animals were the same. They belonged to genetic crosses as following: F_1 mothers line where 69% of selection pressure focused on litter size and milk production. That F_1 generation was mated with Duroc boars selected by different selection criteria; most weight was put on growth and meat content in carcasses. All examined pigs were product of three way crosses (L x Y) F_1 x D. The feed used was fit for the purpose, without fishmeal and sunflower. The basic feeds contained: corn, wheat, barley and soybean. Standard deviations were used to predict possible improvements. To analyze the influence of age as fixed effect and sire as random one, Mixed Model Equations was used, model 1:

$$Y_{ijkl} = \mu + F_i + A_{ij} + S_{ijk} + E_{ijkl}$$

$\mathbf{Y_{ijkl}}$ – observed traits
$\boldsymbol{\mu}$ - average mean of traits
$\mathbf{F_i}$ – fixed effect of farm
$\mathbf{A_{ij}}$ – fixed effect of age
$\mathbf{S_{ijk}}$ – random effect of sire
$\mathbf{E_{ijkl}}$ – "error"

RESULTS AND DISCUSSION

In older pigs, the average protein content in carcasses was significantly reduced (Table 1). Even the standard deviation did not differ significantly between age groups. Also the protein level was different at different carcass locations. The trend was the same at all locations in terms of the age effect. Standard deviation was high even though this trait is, according to the literature, medium heritability (Table 1). In industrial production and processing of pig meat, priority is given to the technological traits i.e. traits of quality. Campbell et al. (1985) reported that increasing the dietary crude protein level resulted in less fat deposition in the carcass of pigs at a similar metabolizable energy intake. It is apparent that under practical farming conditions, pigs of a particular strain/breed may not achieve their maximal protein gain as determined under almost ideal research/laboratory conditions. The environmental, nutritional and social circumstances of pigs held at most farms are less than optimal (Burrin et al., 2001). Lysine is the first limiting essential amino acid in practical diets for pigs. This is especially true for pigs that are raised by smallholders in an extensive system where local feeds are used. From a survey of pig production at smallholder farms, Pham et al. (2010) concluded that nutrition was the main reason for the low level protein. Sundrum et al. (2000) reported a very high fat content in fattening pigs fed compound diets indicating that the protein to energy ratio of the feed used was unbalanced to allow optimal protein deposition and feed efficiency.

According to world meat quality standards, all animals in the different age categories were acceptable. This means the selection criteria used in this study were effective. The variation of protein content in each category, even in this small example, was defined as between 11 and 14%. This is significant enough so that future selection should enable continued improvement in the protein content of finished carcasses**.**

Industry and consumers will demand the best traits for the meat produced and to be consumed.

Table 1: Protein content (%) in meat of pigs of different live weight and carcass location

Tablica 1. Sadržaj bjelančevina (%) u mesu svinja kod različite tjelesne mase na različitim dijelovima polovica

Weight at slaughter - Tjelesna masa pri klanju (kg)	Neck - Vrat		MLD		Shank - Lopatica		MS		Total in carcass- Ukupno u polovici	
	$\bar{x}$	δ	$\bar{x}$	δ	$\bar{x}$	δ	$\bar{x}$	δ	$\bar{x}$	δ
10 – 15	25.4	11	24.3	11	24.1	7	24.3	10	24.4	11
24 – 30	26.3	11	26.5	11	26.6	7	26.7	11	26.6	11
55 - 65	24.1	12	24.0	11	24.3	9	24.3	12	24.1	11
105 - 115	22.2	14	22.6	13	24.1	9	24.2	15	23.2	12
125 - 140	22.3	14	22.7	14	22.5	13	22.7	15	22.4	14

MS – *musculus semimembranous*; MLD – *musculus longisimus dorsi*

Table 2: Effect of age and sire on average protein level of different carcass locations

Tablica 2. Utjecaj dobi i oca na prosječnu razinu bjelančevina kod različitih dijelova polovica

Effect - Utjecaj	Neck - Vrat		MLD		Shank - Lopatica		MS	
	$\bar{x}$	P	$\bar{x}$	P	$\bar{x}$	P	$\bar{x}$	P
Age - Dob	24.06	0.003**	24.02	0.002**	24.32	0.000**	24.44	0.001**
Sire - Otac		0.000**		0.001**		0.000**		0.000**

P – Probability /vrijednost; P <0.01**- highly significant effect/ visoko značajan utjecaj; P <0.05*- significant effect/ značajan utjecaj; P> 0.05- no significant effect/ nema značajnog utjecaja

Since medium heritability and proper variation will continue to be changed by breeders, the genetic base will naturally depend on market wishes and necessity. The variability of protein content, measured by standard deviation, regardless of criteria of selection, is expressed and balanced. This suggests it should be possible to further improve the protein content within a given population over time, with constant changes of selection criteria.

To improve the current quality of meat, or maintain the same level, a more comprehensive approach is needed, which takes into account the demands of consumers and technology of growing, slaughter and hygiene. Determination traits of meat quality should be effective, exact and measurable using non-destructive methods, which do not disturb carcass appearance and main parts of meat on muscles which are easily available.

From table 2 we can see that age and sire have a highly significant influence on all observed traits. Carcass quality and impact of some factors were studied by Džinić et al. (2006), Kosovac et al. (2002), Petrović et al. (2006) and Lukač et al. (2012). Changes of muscle quality and quality of meat depends on genetics i.e. endogenous factors, and are activated by the impacts of the environment i.e. exogenous factors Džinić et al.(2011), Petrović et al. (2009). Warriss et al. (1983) showed that different genotypes may respond differently to various environmental factors. Growth rate and carcass traits however, were not only influenced by genotype and environment but also by nutrition, especially by dietary protein (e.g. amino acid) content (Pham et al., 2010). Cromwell et al. (1993) found that increasing the dietary protein or lysine level resulted in improved rates of gain and in increased carcass leanness in gilts.

CONCLUSIONS

Protein content was highest in smaller weight categories of pigs. It began decreasing when pigs weighed around 55 to 65 kg, to be lowest at the oldest slaughter age. Possible genetic correlation, at certain weight and age, changed as well.

The protein content of pig carcasses in the current study ranged from 22.4% at heaviest to 26.6% in pigs of average weight of 27.5 kg. Standard deviations were similar across all age groups, but a little higher in the oldest pigs. These differences can sometimes be consequences of small sample of mothers or genetically different sires. Altogether, in terms of selection efficiency, it is possible to improve the traits such as protein content, by proper selection and breeding methods, but also including knowledge in feeding.

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SAŽETAK

Poznavanje sadržaja bjelančevina u trupu svinja različite tjelesne mase i dobi, nužno je u prehrani ljudi, a meso se koristi i za dobivanje različitih proizvoda za prehranu. Kao što svi znamo, bjelančevine sadrže odgovarajuće aminokiseline neophodne da optimiziraju život stanica i mitozu, kao i dugovječnost ljudskog života. Istraživanje je provedeno na dvjema farmama, pri čemu su korištene svinje različite tjelesne mase: 10-15 kg; 24-30 kg; 55-65 kg,105–115 kg i 125-140 kg. U svakoj kategoriji smo analizirali po 6 životinja od 2 oca, ukupno 30 svinja od 12 očeva. Meso

za analizu je uzeto s 4 mjesta na trupu: vratu, lopatici, MS (musculus semimembranous) i MLD (*musculus longisimus dorsi*). Selekcijski kriteriji su bili isti. Kod landras i jorkšir pasmine, selekcijski pritisak majčine linije je 69% usmjeren na veličinu legla i mliječnost. Svinje su koristile hranu za pojedine kategorije, u kojoj nije bilo ribljeg brašna i suncokreta. Osnovne komponente su bile kukuruz, pšenica, ječam i soja. Svinje od 10-15 kg imale su 24,4% bjelančevina, od 24 do 30 kg imale su 26,6% bjelančevina u mesu. Svinje tjelesne mase između 55-65 kg su imale 24,1% bjelančevina, svinje između 105 i 115 kg, imale su 23,2% bjelančevina, dok su svinje između 125 i 140 kg imale 22,4% bjelančevina u mesu. Prateći svjetske standarde o kvaliteti mesa, sve kategorije svinja bile su unutar njih. To znači da su kriteriji koje smo koristili bili efikasni. Varijacije sadržaja bjelančevina u svim kategorijama, iako male, bile su od 11 do 14%. Utjecaj dobi i očeva na promatrane osobine bio je visoko signifikantan, dok razlike između farmi nisu pokazale signifikantnost. Sve ovo opravdava upotrebu MME modela, koji se može upotrijebiti u selekciji radi promjene pojedinih osobina.

Ključne riječi: svinje, sadržaj bjelančevina u mesu