

EFFECT OF CARCASS LEANNESS IN PIGS ON PROTEIN CONTENT AND CHEMICAL COMPOSITION OF PRIME CUTS

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Introduction

In recent years, there have been significant changes in the way of meat raw materials are produced in Poland. These changes mainly concern the choice of breeds and pig fattening methods. Previously dominant pure native breeds of pigs, raised for meat and lard (mainly Polish Large White and Puławska) have been replaced by crossbreds with an increasing percentage of genes from the high-lean breeds Pietrain, Duroc and Hampshire. One positive result has been a relatively rapid increase in pig leanness, estimated in the 1990s to be approximately 1% per year for the whole population. Recently, this growing trend has slowed, and is likely to disappear once uniform and viable fattening methods are introduced. The negative effect of genetic change is a considerable increase in the output of poorer quality meat (mainly PSE and acidic meat). Whether and how the increase in leanness affects the level of protein and intramuscular fat has yet to be established.

Objectives

The objective of this study was to assess the current protein content and chemical composition of lean pork in Poland due to changes in pig leanness.

Methodology

Study material: Taking advantage of an opportunity provided by experiments aimed at testing carcass leanness equipment in slaughter lines, we made detailed analyses of the chemical composition of meat from the prime cuts (ham, shoulder and loin) of 59 carcass sides of pigs (33 gilts and 26 barrows) differing in slaughter weight and leanness. The experimental animals were purchased in two different regions of Poland.

Methods: The carcass sides of the analysed animals were dissected according to Walstra and Markus (1) and the quantity of lean meat from particular elements of the dissected carcass was determined. Protein content was determined according to the Kjeldahl method, fat content using the method of Soxhlet, collagen content according to the Stegemann-Stalder method, and water content using the drying method. All the analytical methods were compliant with ISO standards.

The results were analysed statistically by estimating the distribution of the analysed parameters and their interrelationships in the correlation and regression calculus using Statgraphics Plus v. 3.0 software.

Results and Discussion

The data and range of leanness and weight postmortem are given in Table 1.

The data, frequency, mean $\bar{X}$, standard deviation S_x and coefficient of variance V_x obtained for intramuscular fat content (IFC), crude protein content (PC) and connective tissue protein (collagen) (CC) are given in Table 2. Table 3 presents the relative parameters characterizing the protein content of meat, Feder's number (FN) which is a ratio between the water content and crude protein content of meat, protein fat free (PFF), and the protein content ratio (PCR) percentage of CC in PC.

Comparison of the results obtained and statistical analysis showed that sex difference had no significant effect on the parameters studied, while differences between the mean parameters of particular carcass elements generally proved significant.

The intramuscular fat content of the meat of the analysed carcass elements is not considerably different from that of the meat of Polish Large White pigs tested in the 1970s (2). The protein content of loin and ham is approximately 1.2-2.2% lower and the protein content of shoulder is comparable. We have no comparative data for the content of connective tissue proteins, but it is worth noting the low level of these proteins, especially in ham. It is known that connective tissue proteins bind much less water than do muscle proteins and their reduced level may be reflected in greater quantities of meat and thus a lower meat protein content.

The results of the correlation analyses are illustrated in Table 4. The correlation analysis revealed that increased carcass leanness is accompanied by significant increases in the protein content of meat (PC) and in PFF, and by a decreased, or of Feder's number (FN). This finding contradicts the popular belief among the practitioners that increased carcass leanness reduces the protein content and thus negatively affects the suitability of meat for processing. There was no significant effect of carcass weight on the chemical composition of the meat.

The correlation analysis confirmed the well-known fact that the chemical composition of meat is specific to individual animals, and a high level of a component (e.g. protein) in one carcass element is indicative of a high level in the other elements. This relationship is particularly close for loin compared to ham, and for loin compared to shoulder.

Conclusions

- Pig carcass leanness affects the intramuscular fat content (IFC) of carcass elements to a small degree, but significantly affects the level of crude protein (PC), Feder's number (FN) and the protein fat free (PFF).
- Postmortem carcass weight had little effect on the chemical composition of lean meat in the analysed elements.
- Animal sex was found to have no significant effect on the chemical composition of the lean meat of the elements tested.

- The protein content of the meat of loins and hams in the analysed carcasses was considerably lower compared to carcasses studied at our institute in the 1970s.
- The chemical composition of the lean meat of pigs is specific to individual animals, and the composition of loin is most representative of the chemical composition of the other carcass elements.

References

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Table 1. Number of animals and variation in carcass leanness and weight postmortem.

Animals	Frequency/n/	Leanness [%]			Carcass weight postmortem [kg]		
		maximum	mean	minimum	maximum	mean	minimum
gilts	33	59.8	52.3	43.5	92.0	77.1	61.4
barrows	26	59.5	51.5	42.0	99.3	79.2	62.2

Table 2. Data obtained for intramuscular fat (IFC), crude protein (PC) and connective tissue protein – collagen (CC)

parameter	n	Loin			Ham			Shoulder		
		$\bar{X}$	Sx	Vx	$\bar{X}$	Sx	Vx	$\bar{X}$	Sx	Vx
Fat content (IFC) %										
gilts	33	5.0	1.4	28.0	3.9	1.0	26.0	4.5	2.5	35.0
barrows	26	5.1	2.1	41.4	4.0	1.3	31.1	4.2	1.1	26.6
total	59	5.0	1.7	34.5	4.0	1.1	28.2	4.3	1.4	31.9
Weighted mean	59	4.34				1.05				24.21
Crude protein content (PC) %										
gilts	33	21.6	1.3	5.9	20.5	1.2	5.6	19.7	0.9	4.5
barrows	26	21.4	1.3	6.2	20.1	1.3	6.5	19.5	0.9	4.7
total	59	21.5	1.3	6.0	20.3	1.2	6.0	19.6	0.9	4.6
Weighted mean	59	20.5				1.1				5.2
Content of connective tissue protein (CC)%										
gilts	33	0.99	0.23	23.2	0.76	0.16	21.4	1.07	0.16	14.7
barrows	26	0.95	0.14	14.7	0.75	0.11	14.0	1.09	0.24	21.6
total	59	0.97	0.19	20.0	0.75	0.11	15.9	1.08	0.20	18.0

Table 3. Relative parameters of meat protein content

elements		loin			ham			shoulder		
Parameter	animals	$\bar{X}$	Sx	Vx	$\bar{X}$	Sx	Vx	$\bar{X}$	Sx	Vx
Feder's number (FN) [-]	gilts	3.35	0.25	7.5	3.63	0.23	6.4	3.78	0.17	4.6
	barrows	3.38	0.26	7.6	3.71	0.29	7.8	3.83	0.20	5.3
	total	3.36	0.25	7.5	3.66	0.26	7.1	3.80	0.19	4.9
Protein fat free (PFF) [%]	gilts	22.8	1.4	6.1	21.4	1.1	5.4	20.7	0.8	4.0
	barrows	22.5	1.4	6.1	20.9	1.4	6.7	20.3	1.0	4.7
	total	22.6	1.4	6.1	21.2	1.3	6.0	20.5	0.9	4.4
Protein content ratio (PCR) [%]	gilts	4.58	1.14	24.9	3.69	0.90	24.4	5.28	1.22	23.2
	barrows	4.45	0.70	15.8	3.75	0.62	16.5	5.62	1.22	21.6
	total	4.52	0.96	21.3	3.62	0.64	17.6	5.52	1.04	18.9

Table 4. Correlation coefficients between carcass leanness and weight and parameters of chemical composition of meat for carcasses, gilts and barrows in total (n=59)

	Parameters elements	fat content (IFC)	protein content (PC)	Feder's number (FN)	Protein fat free (PFF)	Protein content ratio (PCR)
Lean ness	loin	- 0.238	0.570 ***	- 0.460 ***	0.487 ***	- 0.342 **
	ham	- 0.275 *	0.459 ***	- 0.408 **	0.393 **	- 0.187
	shoulder	- 0.206	0.438 ***	- 0.376 **	0.393 **	- 0.194
Carc ass weight	loin	0.202	0.144	- 0.255 *	0.208	- 0.316 *
	ham	- 0.266 *	0.266 *	- 0.336 *	0.316 *	- 0.114
	shoulder	0.009	0.086	- 0.148	0.096	0.025

*** significant at probability level (spl.)0.001, **spl. 0,01, * spl. 0,05

Table 5. Correlation coefficients between parameters of chemical composition of meat of particular elements for gilt and barrow carcasses in total (n=59)

Parameters elements	Fat content (RFC)	Protein content (PC)	Feder's number (FN)	Protein fat free (PFF)	Protein content ratio (PCR)
Loin/ham	0.555 ***	0.782 ***	0.840 ***	0.835 ***	0.333 **
Loin/shoulder	0.336 **	0.652 ***	0.632 ***	0.624 ***	0.295 **
Ham/shoulder	0.251	0.589 ***	0.609 ***	0.586 ***	0.174