FACTORS DETERMINING THE CHEMICAL COMPOSITION OF PORK MEAT

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Keywords: pork meat, lean meat percentage, fat, water, protein

Introduction

The basic components of meat are: fat (F), water (H) and proteins (P), which aggregate to 100%, if we disregard mineral substances of minor importance for this balance. The fat content may be treated as the main independent factor of chemical composition variety, since fat appears in the volume (quantity) from several percent in lean meat up to over 90% in fat tissue. The water to proteins ratio in meat is more or less stable and it amounts to *ca* 4 grams of water to 1 gram of proteins. This ratio is called the Feder Number (FN). In previous work (Tyszkiewicz *et al.*, 2005) we confirmed that FN is different for various carcass elements and for lean meat it depends on its leanness /lean meat percentage (LMP), and not on the post mortem carcass weight (PCW). In the present work we would like to present the results of tests which took into account the role of proteins of fat tissue and connective tissue in the forming of the chemical composition of pork meat.

Materials and Methods

The subject of the test comprised 57 pork carcasses of animals of both sexes (27 gilts and 30 barrows) and of the different body weight (PCW from 61kg to 99kg) and different lean meat percentage (LMP from 42% to 59%). The carcasses have been parted into elements and dissected using the Walstra and Markus method (Walstra and Markus, 1995). From three carcass elements, loin, ham and shoulder, three tissue fractions have been separated namely: meat, intra-muscle fat and external fat with skin, their weights have been measured and samples for chemical trials taken. The fat content (F) has been determined with the Soxhlet method, that of water (H) – with the dryer method, then of protein nitrogen (N) - with the Kjeldahl method and that of collagen (C) - with the hydroxyproline method. Assuming that for collagen the recalculation ratio of nitrogen into proteins is 5.36, the collagen nitrogen (NC) quantity has been calculated and then deducted from protein nitrogen N. The difference (NP), on multiplying by 6.25, resulted in the muscle protein (PM) content. All the analytical methods were in compliance with ISO standards. The derivative parameters were also calculated: total protein (PT)=PM+C and Feder Number FN=H/PT. Multiplying the chemical component content by the weight of particular tissue fractions of particular carcass elements, the chemical composition of all the tested meat was calculated (balanced).

Results and Discussion

The influence of the carcass weight PCW and its leanness LPM on the content of particular chemical components and on the calculated Feder Number has been checked. Since no substantial influence of sex of the animals on the chemical composition of meat has been found, the total material has been treated as uniform. In Table 1 the values of coefficients of the linear correlation have been given, marking their significance with the following numbers: at 1 $p \leq 0.05$, at 2 $p \leq 0.01$ and at 3 $p \leq 0.001$. The mark 0 means significance at $p \leq 0.05$ in multiple correlation.

Table 1.

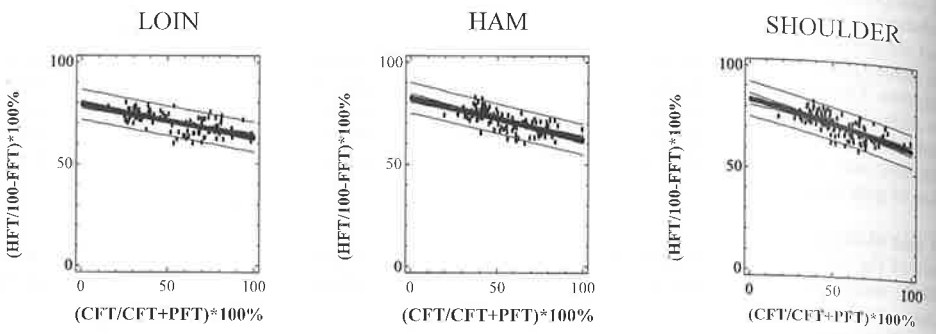
Factors	Chemical Components					
	Fat F	Water H	Muscle Protein PM	Collagen C	Total protein PT	Feder number FN
Carcass Leanness LPM	-0.875^{3}	0.836^{3}	0.911^{3}	-0.058	0.883^{3}	-0.329^{1}
Carcass Weight PCW	0.408^{2}	-0.450^{2}	-0.169	-0.124	-0.200	-0.231^{0}
Both agents LPM and PCW	0.922^{3}	0.902^{3}	0.912^{3}	0.145	0.885^{3}	0.432^{3}

From the regression equations describing the dependence of the particular chemical component or of the FN on carcass leanness LPM, the values corresponding to limit LPM values in EUROP classification have been calculated and presented in Table 2.

The dependence of water content on the fat free mass of fat tissues (HFT/100-FFT) 100% on the ratio of the collagen content to total protein of fat tissues (CFT/CFT+ PFT)100% has been analysed and, on that basis, the degree of hydration of collagen and other proteins of fat tissue has been determined, obtaining highly significant correlation coefficients – 0.677 for fat tissue on loin, - 0.715 for fat tissue of ham and – 0.660 for fat tissue of shoulder. See Figures.

Table 2.

Factors	Carcass Leanness (Lean Meat Percentage – LMP)				
	40%	45%	50%	55%	60%
Fat F [%]	37.7	32.6	28.0	23.4	18.8
Water H [%]	48.0	51.4	54.9	58.3	61.7
Muscle Protein PM [%]	11.1	12.4	13.7	15.0	16.4
Total Protein PT [%]	13.2	14.5	15.7	17.0	18.3
Feder Number FN [-]	3.64	3.56	3.49	3.43	3.38



The calculated water to protein ratios in fat tissues is presented in Table 3.

Table 3.

Factors	Degree of protein hydratation g H_2O/g		
	Loin A	Ham B	Shoulder C
Muscle Protein (1)	3.36 ^{BC}	3.66 ^{AC}	3.80 ^{AB}
Collagen of Fat Tissue	1.71	1.64	1.60
Other Then Collagen Protein of Fat Tissue	3.80 ^{BC}	4.73 ^{AC}	5.07 ^{AB}

ABC Significant difference at $p \leq 0.01$

Conclusions

The fat and water content depend mostly on carcass leanness and, to the smaller extent – on carcass weight. The content of muscle proteins and total proteins correlates and not with carcass weight. The content of collagen depends neither on carcass leanness nor on carcass weight. The protein content in meat determined with the Feder Number depend on carcass leanness and carcass weight. Both the factors result in a decrease of the Feder Number, *i.e.* on increasing the relative protein content in meat. Neither chemical composition nor protein content in meat depends on the sex of the pigs. The protein content in meat depends on the differentiated degree of hydration of proteins contained in muscle tissue, intra-muscular fat tissue and outer fat tissue. The degree of hydration of collagen is more or less stable and it amounts to about 1.6 grams of water to 1 gram of proteins. The degree of hydration of other proteins of fat tissue is variable and different for different carcass elements. Performed investigations allowed for estimation of the mechanism of observable depletion of degree proteins' hydration, accompanied by an increase in lean meat in the pig carcass. It was stated that the content of low-hydrated collagen in fat-tissue is constant, independent of fat-tissue content. Therefore, together with diminishing of fat-tissue content in the carcass, the content of highly-hydrated other proteins must become lower.

References

Tyszkiewicz, S., Wawrzyniewicz, M., Strzelecki, J., Borys, A. and Foltyn M. (2005). Effect of carcass leanness in pig on protein content and chemical composition of prime cuts. 51st ICoMST, Baltimore USA.

Walstra, P. and Marcus, G.S.M. (1995). Procedure for assessment of the lean meat percentage as a consequence of the new EU-reference dissection method in pig carcass classification. DLD-Research Institute for Animal Science and Health (ID-DLD), February.