Chemical composition of the pork meat of the pigs from the mass production in Poland. Situation and Determining factors

Tyszkiewicz S., Wawrzyniewicz M., Strzelecki J., Borys A.
Meat and Fat Research Institute, Jubilerska 4, 04-190 Warsaw, Poland

Key words: pork meat, humidity, proteins, collagen, fat

Introduction

Progress in pig breeding in Poland has resulted in the increase of meatiness and changes in chemical composition of pork meat (1). We may notice such desirable phenomenon as decrease of fat content in the meat, with a simultaneous high increase of protein content and somewhat lower rise of humidity. The present communication shows the results of the studies on chemical composition of the nine most important elements of pig carcass dressing, and the results of statistical analysis of relationship between chemical composition of meat and carcass meatiness and slaughter weight of animals.

Materials and methods

The research material included the meat of 37 pig carcasses (23 gilts and 16 boars), coming from the purchase and slaughter in two meat factories, situated in different parts of Poland. Carcasses with the known post-slaughter weight (PSW) were subject to dissection by Walstray and Markus method to determine meatiness of animals, measured as the lean meat percentage (LMP). Chemical analyses were performed on the following carcass cuts: meat of loin (ML), meat of ham (MH), meat of shoulder (MS), collar butt (CB), shoulder hock (HS), leg hock (HL), back fat (BF), belly (B) and jowl (J). The following determinations were carried out: the content of fat (F), humidity (H), protein (P) and collagen (C), applying Polish Standards (PN) in accordance to ISO standards. The humidity: protein content ratio (H/P), that is, Feder Number (FN) and the percent content of collagen in protein (C/P) were calculated.

Results and Discussion

In tab.1, the obtained results of analyses in a form of arithmetical means and standard deviation S_x, are given. Any significant differences in chemical composition of the cuts, coming from animals of different gender were not found which allowed analyzing the whole experimental material in total. Statistical analysis, as conducted by the test of marking the means, characterizing chemical composition of the studied cuts, showed a significance of differences in spite of a high individual variability because we have always to deal with the in-pair correlated factors.

Table 1. Chemical composition of pork meat

Carcass Cuts	Fat F %		Humidity H%		Protein P %		Collagen C %		H/P FN [-]		[C/P]·100% CP	
	$\bar{X}$	S_x	$\bar{X}$	S_x	$\bar{X}$	S_x	$\bar{X}$	S_x	$\bar{X}$	S_x	$\bar{X}$	S_x
Loin ML	4,92	1,26	72,15	1,54	21,46	1,26	0,95	0,16	3,37	0,24	4,43	0,78
Ham MH	3,98	0,96	74,13	1,18	20,30	1,24	0,75	0,11	3,67	0,26	3,68	0,62
Schould. MS	4,34	1,36	74,40	1,10	19,60	0,98	1,09	0,19	3,81	0,20	5,59	0,99
Collar b. CB	17,16	3,26	65,05	2,41	16,94	1,11	1,28	0,17	3,85	0,20	7,54	1,06
Hock. S. HS	15,15	7,00	65,05	5,30	19,29	0,65	6,08	0,91	3,43	0,16	32,38	4,86
Hock L. HL	19,84	3,29	61,62	2,70	17,62	0,82	4,22	0,66	3,50	0,12	23,80	3,26
Back fat BF	75,00	5,70	16,64	3,60	6,64	1,51	4,59	1,03	2,50	0,39	67,85	8,95
Belly B	35,80	6,18	48,64	5,12	14,73	1,47	3,05	0,50	3,31	0,21	20,88	4,17
Jowl J.	34,41	7,63	50,47	6,44	13,65	1,57	2,26	0,52	3,65	0,28	16,61	5,81

The studies of relationships were based on correlation and regression analysis. The results are in tab.2.

Table2. Correlation analysis. Legend: A – R-squared % [$R^{2\cdot}$100%], B and C P-value [PV] for independent variables x_1 [LMP] and x_2 [PSW] , 1. PV 0,30 – 0,10, 2. PV 0,10 – 0,05, 3. PV 0.05 -0,01, 4. PV 0,01 – 0,001, 5. PV 0,000 and less, + positive correlation - negative correlation.

Carsass Cuts	Fat F %			Humidity H%			Protein P %			Collagen%			H/P FN [-]			[C/P]· 100% C/P		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Loin ML	10,2	0	-2	4,7	0	0	28,8	+2	+2	16,8	0	-3	26,4	-2	-2	26,0	0	-4
Ham MH	2,8	0	0	9,5	0	-2	19,4	+3	+1	4,2	0	0	20,8	-3	-1	1,1	0	0
Schould. MS	4,1	0	0	7,4	0	-1	20,9	+3	+1	1,4	0	0	23,2	-3	-2	0,4	0	0
Collar CB	17,0	-3	0	27,2	+4	0	34,5	+4	+2	5,3	0	0	17,5	-2	-2	6,2	0	0
Hock S. HS	24,5	-4	-2	26,3	+3	+3	18,4	+3	0	8,2	-2	0	9,8	0	-2	4,8	0	0
Hock L. HL	17,1	-3	+1	17,1	+	-3	19,8	+4	0	3,7	0	0	10,0	0	-2	9,9	0	0
Back Fat BF	27,1	-3	+4	20,3	+2	-3	9,5	0	-1	1,9	0	0	2,3	0	0	7,1	0	-1
Belly B	44,5	-5	0	41,4	+5	0	34,3	+5	0	7,7	0	0	1,9	0	0	10,8	-2	0
Jowl J	53,8	-5	0	50,1	+5	0	40,1	+5	0	7,2	0	0	0,7	0	0	25,0	-4	0

In case of lean meat of hams and shoulders, the effect of LPM and PSW factors on fat content was not found whereas their effect, and especially of LPM meatiness on protein content and, to a smaller extent, of PSW on humidity, was observed. The both discussed factors are mutually supplementary and cause decrease of Feder Number value (A 20,8 % and 23,2%, respectively). The analyzed factors do not affect the content of collagen or participation of collagen in protein. A strong influence of the both analyzed factors is well visible in case of chemical composition of loin meat. In this case we may observe a significant effect of post slaughter weight (PSW) of animals on the content of intramuscular fat tissue that is manifested by decrease of fat content as well as of collagen content in the meat, being compensated totally by the increase of total protein content, with the unchanged level of humidity. A final effect brings lowering of collagen content in protein (A 26,0%). In case of the loin meat, the increase of protein content caused by the increase of carcass meatiness (LMP) results in the highest observed decrease of Feder Number (A 26,4%).

In case of middle fatty carcass cuts, we may observe the decline of fat content, connected with the increase of meatiness (LMP) with the lack of the effect, weak effect or tendency to contrary effect of post-slaughter weight (PSW). The discussed effect is compensated by increase of humidity as well as protein, with a certain excess of protein, resulting in less than noticeable decline of Feder Number (A from 9.8% for shoulder hock to 17,5% for collar butt). In case of collar butt, the both analyzed factors have an influence on the rise of humidity that causes the effect of lowering of Feder Number should be related to the increase of carcass weight. In case of hocks, we may observe decline of humidity, caused by the increase of the post-slaughter weight (PSW); it causes that only the mentioned factor is responsible for the decrease of Feder Number. In this group, any significant effect of the examined factors on collagen content and collagen participation in total protein was not found.

In case of the cuts, being characterized by a high content of fat tissue, a significant effect of the examined factors on their fat content was observed; simultaneously, the increase of meatiness (LMP) of the carcasses resulted in lowering of fat content and the increase of post-slaughter weight (PSW) of carcass caused the increase of fat content, or does not have a noticeable effect. In case of backfat, the effect of the rise of post-slaughter weight is dominating, and that results in the increase of fat content, with the simultaneous decline of humidity as well as protein content. The proportions of the mentioned components remain unchanged and Feder Number does not reveal variability, owed to the examined factors. In case of belly and jowl, the decline of fat content is compensated by the increase of water and protein content but without changes in properties between these components that is manifested by a lack of changes in Feder Number. A small decline of collagen content, with the increase of protein content results in lowering of collagen content in total protein, especially noticeable in case of jowl.

In tab.3, the coefficients of linear equations, describing linear relationships of chemical composition and carcass meatiness (LMP) and post-slaughter weight (PSW) are given.

Table3. Regresion analysis. Coefficient of linear model: $y = a + bx_1 + cx_2$ (x_1 LMP [%], x_2 PSW [Kg])

Carsass Cuts	FAT F %			Protein P %			H/P FN [-]			[C/P]· 100 % C/P		
	a	b·10	c·100	a	b·10	c 100	a	b·100	c 1000	a	b·10	c·100
Loin ML	8,32	0	-4,4	11,86	+1,18	+4,5	5,13	-2,1	-9,2	8,11	0	- 4,6
Ham MH	3,98	0	0	12,76	+1,04	+2,8	4,80	-2,2	0	3,68	0	0
Schould. MS	4,36	0	0	14,97	+0,90	0	4,99	-1,4	-6,0	5,59	0	0
Collar CB	31,74	-2,80	0	7,97	+1,27	+3,1	5,04	-1,3	-7,0	7,54	0	0
Hock S. HS	19,28	-2,43	+9,1	16,11	+0,62	0	3,78	0	-4,6	32,48	0	0
Hock L.HL	32,82	-2,52	0	13,52	+0,80	0	3,85	0	-4,5	23,80	0	0
Back Fat BF	76,24	-2,52	0	10,09	0	+0,4	2,06	0	0	67,85	0	0
Belly B	75,68	-7,83	0	5,01	+1,89	0	3,21	0	0	20,80	0	0
Jowl J	77,66	-8,52	0	4,27	+1,85	0	3,94	0	0	32,15	-3.04	0

Conclusions

1. Gender of pigs does have no effect on chemical composition of their meat.
2. In carcass cuts, being naturally poor in fat tissue (loin, ham and shoulder), the increase of meatiness and post-slaughter weight does not have any effect on intermuscular fat content; it has a synergetic action and causes a significant increase of protein content and lowering of Feder Number. It is a favourable phenomenon from the meat processor's and consumer's point of view.
3. In carcass cuts, being naturally abundant in fat tissue, the rise of meatiness causes a decline of fat content without increase of protein content in the meat
4. Numerical data, characterizing chemical composition of the most important cuts of pig carcasses, deriving from mass production in Poland have been presented (tab.1). The linear equations, allowing the consideration of the effect of meatiness and post-slaughter weight of animals on chemical composition of the meat were also given (tab.3).

References: Tyszkiewicz et al. 2005. Effect of carcass leanness in pig on protein content and chemical composition of prime cuts. 51st ICOMST Baltimore.