

Nutritional and microbiological quality of by-products

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Slaughter by-products, especially internal organs of slaughter animals, have been so far only slightly used for consumption purposes. There is a considerable amount of valuable nutritive components in them, especially proteins, thus further concern with possibilities of using them in consumption is purposeful. There is still a lack of detailed information about the composition, and first of all the biological quality, as well as about the microflora present in slaughter by-products.

The aim of the examinations was to determine: a/ the basic composition and biological value of internal organs of pigs in relation to the animals' age, b/ pH and the degree of bacterial contamination in relation to the time of keeping the organs in cold storage.

Material and methods:

The examinations were carried out on the livers, hearts, lungs and kidneys of the pigs. The animals were all of the same sex /females/ and came from the normal production at the slaughter house. Two age groups were made: young pigs of 80 kg and adult animals of 140 kg body weight. Directly after slaughter the mentioned internal organs were taken and the following were determined in them: content of total protein by Kjeldahl's method, total collagen - colorimetric method according to Hurych-Chvapil, fat - Soxhlet's method, moisture - drying the sample at 105°C to the solid weight and pH level which was determined 1, 4, 12 and 24 hours after slaughter. The contents of protein, fat and moisture were given in relation to the weight of a fresh sample and the collagen contents in relation to total protein contents. The biological value was expressed by PER coefficients. Microbiological determinations included the total number of bacteria in the surface and deep layers of the organs, 0, 12, 24, 48 and 72 hours after slaughter stored at 0-2°C. Results of determinations of total amount of bacteria were given as common logarithms. The results obtained were analysed statistically. T-Tukey's test was used at $\alpha \leq 0.05$ and $\alpha \leq 0.01$ to determine the significant effect of variability factors examined.

Results:

The composition and PER coefficients of the examined organs is presented in table 1. A significant effect of age on the chemical composition of the examined organs was found only in relation to the heart and lungs and concerned the level of the total collagen, fat and moisture. In both organs of the young pigs the contents of collagen and fat were lower and that of moisture higher as compared with the older animals. No significant differences were found in the protein contents. Significant differences in the biological value were found only in the heart and in the kidneys. PER coefficients in young pigs were higher as compared with the older animals.

Tab.1. Basic composition and PER of by-products in relation to age of swines $\bar{x} \pm s$; in %; n = 10/

Age	Liver					Heart				
	Protein	Collagen*	Fat	Moisture	PER	Protein	Collagen*	Fat	Moisture	PER
Young	19,30a	3,03a	3,96a	71,08a	2,80a	16,81a	3,15a	3,22a	78,02a	2,82a
	1,11	0,72	0,87	1,20	0,2	0,19	0,57	0,71	0,54	0,2
Old	19,51a	2,92a	2,87a	71,55a	2,76a	16,90a	4,01b	4,29b	77,68b	2,61b
	0,85	0,45	0,75	1,39	0,2	0,48	0,45	1,00	0,93	0,2
	Lung					Kidney				
	Protein	Collagen*	Fat	Moisture	PER	Protein	Collagen*	Fat	Moisture	PER
Young	17,63a	12,75a	2,51a	79,00a	2,51a	16,33a	12,95a	4,54a	76,95a	2,71a
	0,64	2,92	0,30	0,57	0,2	0,19	1,29	0,72	0,88	0,2
Old	17,13a	19,58b	3,30b	77,98b	2,52a	16,64a	13,81a	4,53a	77,00a	2,57b
	0,98	2,12	0,52	0,65	0,1	0,84	2,31	1,00	1,34	0,2

a, b - means with different superscript letters differ significantly at $p \leq 0.01$,
* - expressed as percent in total protein.

Tab.2. pH level of by-products in relation to storage time $\bar{x} \pm s$; n = 10/

Time /hrs/	Liver		Heart		Lung		Kidney	
1	6,19 a	0,12	5,99 a	0,12	6,96 a	0,25	6,58 a	0,15
4	6,43 b	0,14	6,25 b	0,09	7,32 b	0,26	6,82 b	0,20
12	6,50 b	0,14	6,49 c	0,19	7,46 b	0,26	6,96 c	0,26
24	6,60 c	0,12	6,49 c	0,18	7,46 b	0,24	6,97 c	0,14

a, b, c - means with different superscript letters differ significantly at $p \leq 0.01$.

The level of pH of the all organs examined /Table 2/ increased with the time of their storage and the first significant differences occurred 4 hours after slaughter. The absence of pH decrease after slaughter is characteristic for the organs. After 24 hours the pH values in all organs were comparatively high.

Tab.3. Bacterial contamination of by-products $\bar{x} \pm s$; in log; n = 20/

Layer	Liver	Heart	Lung	Kidney
Surface	5,09 a 0,39	3,71 a 0,85	4,77 a 1,13	4,23 a 0,60
Deep	3,15 b 0,36	2,95 b 0,94	4,42 a 1,20	3,10 b 0,70

The results of the bacterial examinations are presented in tables 3 and 4. The examinations /table 3/ revealed significantly higher bacterial contamination in the surface layer as compared with the deep layer of the liver, heart and kidneys. The total number of bacteria in both layers of the lungs was similar.

Tab.4. Bacterial contamination of by-products in relation to storage time $\bar{x} \pm s$; in log; n = 20/

Time after slaughter /hrs/	Liver		Heart		Lung		Kidney	
	surface	deep	surface	deep	surface	deep	surface	deep
0	4,81 a 0,16	2,92 a 0,35	3,26 a 0,47	2,51 a 0,69	3,85 a 0,31	3,56 a 0,60	3,88 a 0,56	2,79 a 0,55
12	4,77 a 0,16	2,97 a 0,45	3,01 a 0,47	2,19 a 0,87	3,54 a 0,39	3,41 a 0,70	4,08 a 0,61	2,93 a 0,59
24	4,98 ab 0,20	3,10 ab 0,24	3,44 b 0,49	2,78 b 0,85	4,84 b 0,60	4,45 b 0,67	4,27 b 0,45	2,99 a 0,75
48	5,19 b 0,14	3,24 ab 0,14	3,99 b 0,65	3,43 bc 1,07	5,42 b 0,68	5,28 b 0,81	4,35 b 0,47	3,44 b 0,54
72	5,71 c 0,23	3,53 b 0,15	4,82 c 0,66	3,82 c 0,79	6,22 c 0,65	5,41 b 0,84	4,56 b 0,66	3,50 b 0,69

A significant effect of time /table 4/ on the degree of bacterial contamination was found in relation to all the organs kept in cold storage. There was a significant and permanent increase in the number of microorganisms both in the surface and deep layers till 24 hours after storing. The examinations are continued.

Tab.1. Basic composition and PER of by-products in relation to age of swine $\bar{x} \pm s$; n = 10/

Age	Liver		Heart		Lung		Kidney	
	Protein	Collagen	Protein	Collagen	Protein	Collagen	Protein	Collagen
Young	19,10a 1,11	1,02a 0,75	15,91a 0,19	1,10a 0,71	17,00a 0,87	1,02a 0,75	15,91a 0,19	1,10a 0,71
Old	19,51a 0,98	1,02a 0,46	15,91a 0,48	1,10a 0,48	17,00a 0,75	1,02a 0,46	15,91a 0,19	1,10a 0,71
Young	17,51a 0,04	1,02a 0,98	15,91a 0,19	1,10a 0,71	17,00a 0,87	1,02a 0,75	15,91a 0,19	1,10a 0,71
Old	17,51a 0,04	1,02a 0,98	15,91a 0,19	1,10a 0,71	17,00a 0,87	1,02a 0,75	15,91a 0,19	1,10a 0,71

a, b - means with different superscript letters differ significantly at p < 0,01, - expressed as percent in total protein.

Tab.2. pH level of by-products in relation to storage time $\bar{x} \pm s$; n = 10/

Time (hrs)	Liver	Heart	Lung	Kidney
1	6,19 a 0,12	6,09 a 0,12	6,09 a 0,12	6,09 a 0,12
2	6,42 b 0,14	6,32 b 0,09	6,32 b 0,09	6,32 b 0,09
12	6,60 c 0,14	6,49 c 0,19	6,49 c 0,19	6,49 c 0,19
24	6,60 c 0,12	6,49 c 0,19	6,49 c 0,19	6,49 c 0,19

a, b, c - means with different superscript letters differ significantly at p < 0,01. The level of pH of the all organs examined /table 2/ increased with the time of their storage and the first significant difference occurred 2 hours after slaughter. The absence of pH difference after slaughter is characteristic for the organs. After 24 hours the pH values in all organs were comparatively high.