

Quality Properties of Meat Derived from Broilers of Different Age

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The work presents the examination results of quality properties of Hybro broilers slaughtered at the age of 6,7 and 8 weeks. The authors examined the participation relations of breasts, drumsticks with thighs, wings and backs, as parts of ready-to-grill carcasses. As for amino acids, there were examined tryptophan and hydroxiprolin as well as their mutual relation in order to evaluate the participation of more or less valuable proteins in meat of the examined carcass parts.

The examination results show that there are differences in the content of nutrients in meat derived from broilers of different age, and for some of the examined properties these differences are also statistically justified. Comparative observation of the participation of individual parts in the carcass and of the analysis results of food quality of meat indicates the age of broilers being the optimum one for slaughter, what was the aim of this examination.

Qualitate Eigenschaften des Broilerfleisches verschiedenen Alters

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Das Referat zeigt die Untersuchungsergebnisse der qualitativen Eigenschaften der, im Alter von 6,7 und 8 Wochen geschlachteten Hybrobroiler. Es wurden die Beteiligungsverhältnisse der Brust, des Schenkels mit Oberschenkel, der Flügel und des Rückens als Teile des grill-fertig bearbeiteten Rumpf untersucht. An den Brust- und Schenkelmuskeln wurde der Anteil an Wasser, Fett, Eiweißstoff und Asche festgestellt.

Von den Aminosäuren wurden triptophan und hidroksiprolin, sowie auch ihr Verhältnis untersucht, um den Anteil mehr oder weniger wertiger Eiweißstoffe im Fleisch des untersuchten Rumpfs beurteilen zu können.

Die Untersuchungsergebnisse zeigen, dass Unterschiede im Nährstoffgehalt im Fleisch der Broiler verschiedenen Alters bestehen und für einige der untersuchten Eigenschaften sind diese Unterschiede sogar statistisch gerechtfertigt. Eine komparative Beobachtung des Anteils der einzelnen Rumpfteile und der Ergebnisse der Analyse der Nahrungsqualität des Fleisches weist auf das optimale Alter der Schlachtbroiler, was auch das Ziel dieser Untersuchung war.

3.9

Les qualités de la viande des poulets engraisés de l'âge différent

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L'objet de cet exposé fond les résultats des recherches sur les qualités des poulets égorgés à 6, 7 ou 8 semaines. On a étudié les rapports de la part de la poitrine, des cuisses, des ailes, du dos et d'autres parties de la carcasse préparées pour la cuisson sur le gril. Les muscles de la poitrine et des cuisses ont servi à constater la quantité d'eau et de graisse et celle d'albumines et de cendre. Quant aux acides aminés on a recherché le tryptophane et l'hydroxyline ainsi que leur rapport réciproque afin d'évaluer la part des albumines plus ou moins importante dans la chair des parties examinées de la carcasse.

Les résultats de ces recherches révèlent que le contenu de matières nutritives diffère avec l'âge du poulet, ce qui est, pour certaines qualités examinées, statistiquement justifié. Les observations comparatives de la part des pièces isolées dans la carcasse et des résultats de l'analyse de la qualité nutritive de la viande indiquent l'âge optimal du poulet à égorgé, ce qui d'ailleurs était le but de ces recherches.

Качественные особенности мяса бройлеров разного возраста

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Доклад показывает результаты исследования качественных особенностей мяса бройлеров, которые были забиты в возрасте 6, 7 и 8-ми недель. Исследованы соотношения участия груди, бёдер и надбедренной части, крыльев и спины как частей grill-fertig обработанной тушки. Грудные мышцы и мышцы бёдер с надбедренной частью являются подтверждением для участия: воды, жира, белков, пепла. Из аминокислот исследованы triptophan и hidroksiprolin и их соотношение для оценки участия более или менее качественных белков в мясе исследованных частей тушки.

Результаты исследования показывают, что существуют отличия в содержании питательных веществ в мясе бройлеров разного возраста, а для некоторых из исследованных особенностей эти отличия и статистически оправданы.

Компаративное наблюдение участия отдельных частей в тушке показывают и результаты анализа пищевых качеств мяса указывает на оптимальный возраст бройлеров для убоя, что и было целью этого исследования.

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Introduction

Broiler meat has certain advantages over meat derived from slaughter animals. The advantages are first of all expressed in high content of easily digestible proteins as well as in more favourable price.

Large expansion of broiler industry, connected with continuous advancement of genetics, nutrition, technology and health protection, enabled good supply of market with this meat. The fight for as much as possible quantity in this industry has been overcome, whereas from the standpoint of meat quality there exist and there will be many more investigations, specially because the quality is conditioned by a series of factors.

In our conditions, fattening of chickens lasts from 52 to 56 days, since the Yugoslav consumer prefers heavier broilers. From zootechnical and economical standpoints, it is very interesting to shorten the fattening period, because in the earlier stage of fattening broilers spend more food energy for production purposes and less for breeding purposes.

The aim of our examinations was to establish the parameters of participation of breasts and drumsticks with thighs, as high-quality parts, and then of backs and wings, in carcasses of differently aged broilers. Slaughter of broilers was carried out after fattening for 6, 7 and 8 weeks, because all the three age limits dovetail into modern technology. However, in addition to quantitative participation of individual parts of carcasses, their nutritive value is also important. Beside the analysis of amino acid composition, determination of the total content of nutrients is also helpful for the evaluation of food quality of meat. The evaluation can also be decided on the basis of tryptophan-hydroxyproline ratio, because tryptophan is present only in high-value proteins and hydroxyproline in connective tissue proteins /Oluški, 1973 and Milosavljević, 1973/. Biological value of meat is in so much higher as the tryptophan-hydroxyproline ratio is higher. Having in mind that this relation, in addition to other factors, depends also on meat kind and animal age, we decided to examine the food quality of meat as well.

Material and Methods

Hybro broilers were used for the examinations and the fattening was performed according to the usual technological process - the floor system. From the first to the fourth week of fattening the chickens were fed with the starter mixture and afterwards till the end of fattening with the finisher mixture. Chemical composition of mixtures is presented in Table 1.

Table 1. Chemical composition of mixtures

Components	Starter	Finisher
Raw protein, %	20.80	16.65
Raw fat, %	4.37	4.85
Raw fibers, %	3.41	3.41
Raw ash, %	6.36	5.83
Ca, %	1.28	1.22
P, %	0.80	0.74
Kcal of metabolic energy	2957	2974

After the fattening period which lasted 6 weeks for the first group, 7 weeks for the second group and 8 weeks for the third group, broilers were delivered to the slaughterery where grill-fertig procedure /clean carcasses without legs, head, neck and edible inlets/ was applied on occasion of slaughter. Hundred broilers from each group were used for the examination of relative participation of individual parts in the carcass and 20 broilers from each group for the examination of chemical composition of meat. Breast muscles without skin were used for the examination of chemical composition of light meat, whereas muscles of drumsticks with thighs without skin were used for dark meat.

Broiler carcasses were cooled at +2°C for 24 hours. After determination of their slaughter weight, the carcasses were cut into basic parts: breast, drumsticks with thighs, wings and back with pelvis. Absolute values of basic parts were determined and presented as percentages of slaughter weight.

The following chemical indices were determined:

- moisture, by drying at 105°C up to the constant weight
- fat, according to the Woxhlet method
- protein, according to the Kjeldahl method
- ash, after incineration, ignition at 525°C up to the constant weight
- tryptophan and hydroxyproline, by means of paraaminobenzaldehyde.

Examination results

Average weight of grill-fertig processed and cooled carcasses was 0.88 kg for the first group, 1.09 kg for the second group and 1.21 kg for the third group.

Participation of breast, drumsticks with thighs, wings and back in relation to the carcass weight as well as the examination of the justifiableness of differences among the groups is presented in Table 2.

As seen from the presented mean values, the increase of the participation of individual parts in the carcass was not always in agreement with the age group of broilers in relation to longer fattening period. Such agreement was observed only in the participation of wings, amounting to 13.40% in the first broiler group fattened for 6 weeks, 13.69% in the second group fattened for 7 weeks and 14.04% in the third group fattened for 8 weeks. At the same time, breasts with 23.18% and backs with 33.13% showed the highest participation in the second group, whereas drumsticks with thighs were represented to the highest extent in the first group.

Table 2. Percentage participation of individual parts in broiler carcasses and examination of the justifiableness of differences among the groups

Broiler group	Duration of fattening -indicator	Breasts %	Drumsticks with thighs %	Wings %	Backs %
1.	6 weeks				
	\bar{x}	22.70	30.40	13.40	33.10
	$m\bar{x}$	0.16	0.16	0.07	0.22
	s	1.60	1.65	0.74	2.22
	s%	7.06	5.42	5.36	6.72
2.	7 weeks				
	\bar{x}	23.18	30.00	13.69	33.13
	$m\bar{x}$	0.11	0.14	0.06	0.18
	s	1.11	1.48	0.68	1.80
	s%	4.79	4.94	5.01	5.45
3.	8 weeks				
	\bar{x}	22.91	30.07	14.04	32.98
	$m\bar{x}$	0.16	0.15	0.08	0.16
	s	1.18	1.54	0.82	1.67
	s%	5.16	5.12	5.86	5.08
	7 value				
	$\bar{x}_1 - \bar{x}_2$	2.74 ⁺⁺	1.90	1.22	0.10
	$\bar{x}_2 - \bar{x}_3$	1.80	0.35	3.50 ⁺⁺	0.62
	$\bar{x}_1 - \bar{x}_3$	1.10	1.57	2.40 ⁺	0.44

$x\text{-}P < 0.01$

$x\text{-}P < 0.05$

Table 3. Chemical composition of broiler meat

Broiler group	Kind of meat	Moisture	Fat %	Protein	Ash
1.	light \bar{x}	74.40	1.53	22.54	1.15
	s	0.45	0.17	0.56	0.11
	s%	0.61	11.18	2.47	9.32
	dark \bar{x}	74.76	4.51	19.64	1.04
	s	0.53	0.42	0.54	0.04
	s%	0.70	9.41	2.75	3.93
2.	light \bar{x}	73.56	1.71	23.35	1.06
	s	0.79	0.23	0.63	0.06
	s%	1.08	13.66	2.71	6.02
	dark \bar{x}	74.00	5.61	19.55	1.03
	s	0.78	0.43	0.62	0.04
	s%	1.06	7.65	3.19	3.79
3.	light \bar{x}	73.68	1.71	23.36	1.03
	s	0.48	0.33	0.49	0.03
	s%	3.53	18.89	2.10	2.80
	dark \bar{x}	74.07	5.54	19.49	1.03
	s	0.38	0.42	0.45	0.03
	s%	0.51	7.65	2.32	3.19

Table 4. Quantities of tryptophan, hydroxyproline and connective tissue in broiler meat

Broiler group	Kind of meat	Tryptophan %	Hydroxyproline %	In total proteins Connective tissue, %	Tryptophan %
1.	light \bar{x}	0.315	0.042	1.497	1.397
	s	0.011	0.002	0.049	0.061
	s%	3.33	3.57	3.27	4.36
2.	dark \bar{x}	0.301	0.100	4.123	1.522
	s	0.010	0.009	0.417	0.055
	s%	3.62	9.00	10.11	3.61
3.	light \bar{x}	0.343	0.053	1.840	1.471
	s	0.015	0.012	0.458	0.077
	s%	4.37	22.64	24.89	5.23
3.	dark \bar{x}	0.331	0.115	4.740	1.680
	s	0.023	0.010	0.487	0.126
	s%	6.94	8.69	10.27	7.49
3.	light \bar{x}	0.385	0.071	2.419	1.653
	s	0.009	0.003	0.079	0.046
	s%	2.33	4.22	3.26	2.78
3.	dark \bar{x}	0.358	0.120	5.25	1.840
	s	0.019	0.030	0.77	0.087
	s%	5.30	25.00	14.67	4.72

By the evaluation of statistical significance of differences in the participation of four basic parts of the carcass among the age groups of broilers, it has been established that only differences in the participation of breasts between the first and the second group as well as of wings between the second and the third group were highly significant / $P < 0.01$ /, whereas differences in the participation of wings between the first and the third group were significant / $P < 0.05$ /.

Examination results on the participation of water, fat, protein and ash in light /breast/ and dark meat /drumstick with thigh/ are presented in Table 3.

The obtained data indicate that light meat in relation to dark meat regularly shows considerably higher participation of proteins, considerably lower participation of fat and slightly lower participation of water. These results are in agreement with the findings of many authors /Roseg, 1966; Dakić, 1968; Pfeifer and Ljubić, 1978 and others/ and they give advantages to light meat regarding the food quality. However, for our investigation it was interesting to establish these differences among the age groups of broilers.

Differences in the content of moisture, fat, protein and ash in light meat, between the first and the second group as well as between the first and the third group of broilers were significant, namely highly significant / $P < 0.05$ and $P < 0.01$ /. This was not established for the protein content in dark meat only (Table 5). Similar results were presented by Trumić et al. /1972/, Lončar et al. /1978/, Pfeifer and Ljubić /1978/, Rahelić /1978/ and others. From this it comes out that extension of the fattening period from 6 to 7 weeks increases the contents of protein and fat and decreases the contents of water and ash in light meat of broilers, whereas in dark meat the contents of fat and ash are increased and the changes of protein content are slight.

All essential amino acids and only a definite number of nonessential acids are present in muscular tissue /Oluški, 1973/. Contrary to that, connective tissue does not contain tryptophan and cystine but it contains a high content of hydroxyproline which was not established in proteins of other tissues of animal origin /Sharner et al., 1966/.

These statements gave us the idea to examine the participation of tryptophan and hydroxyproline in light and dark meat of broilers of different age groups as well as their mutual relation, and the participation of connective tissue proteins and tryptophan in the established total quantity of meat proteins. The results of these examinations are presented in Table 4.

Participation of tryptophan and hydroxyproline, in both light and dark meat, is increased by the extension of the fattening period of broilers (Table 4). Similar to that, the quantity of connective tissue proteins is also increased in both kinds of meat. This shows that although the total participation of proteins is increased with the extension of the fattening period of broilers, the participation of connective tissue is at the same time also increased and, consequently, the total nutritive value of meat is relatively decreased.

Table 5. Examination of the justifiableness of differences in chemical composition of meat

Components %	Kind of meat					
	$\bar{x}_1 - \bar{x}_2$		$\bar{x}_1 - \bar{x}_3$		$\bar{x}_2 - \bar{x}_3$	
	light	dark	light	dark	light	dark
Moisture	4.20 ⁺⁺	3.80 ⁺⁺	5.14 ⁺⁺	4.92 ⁺⁺	0.60	0.35
Fat	3.13 ⁺⁺	8.59 ⁺⁺	2.41 ⁺	8.20 ⁺⁺	0.01	0.51
Protein	4.50 ⁺⁺	0.50	5.12 ⁺⁺	0.93	0.06	0.37
Ash	3.86 ⁺⁺	1.17	5.18 ⁺⁺	6.43 ⁺⁺	2.90 ⁺⁺	0.06
Hydroxyproline	5.00 ⁺⁺	6.81 ⁺⁺	20.71 ⁺⁺	14.28 ⁺⁺	8.18 ⁺⁺	2.27 ⁺
Tryptophan	9.03 ⁺⁺	21.63 ⁺⁺	50.00 ⁺⁺	41.07 ⁺⁺	13.54 ⁺⁺	19.28 ⁺⁺

^x $P < 0.05$

^{xx} $P < 0.01$

Although showing somewhat higher values in certain cases, our results agree with the data stated by Oluški /1973/, Milosavljević /1973/, Lončar et al. /1978/, Pfeifer and Ljubić /1978/, Rahelić /1978/, Bogosavljević /1979/ and others.

Conclusion

In this work, parameters of the participation of carcass parts /breast, drumsticks with thighs, wings and back/ in Hibro broilers slaughtered at the age of 6, 7 and 8 weeks were investigated, together with the analyses of water, fat, proteins, ash and amino acids - tryptophan and hydroxyproline - in light and dark meat. The obtained results are as follows:

1/ Participation of breast in the carcass is higher in broilers slaughtered at the age of 7 weeks than in those slaughtered at the age of 6 weeks. The established difference is highly significant / $P < 0.01$ /.

Participation of wings in the carcass increased with the increase of weight, i.e. by slaughtering broilers at older age. The increase of wing participation was so high that the existing differences were significant

By the analysis of our results it can be concluded that mutual relation of tryptophan and hydroxyproline is far more favourable in light /7.5; 6.5; 5.4/ than in dark meat /3.0; 2.9; 2.9/, whereas in both kinds of meat derived from older broilers this relation is lower.

All these differences /Table 5/ among the age groups were highly significant / $P < 0.01$ / for both kinds of meat, except for dark meat between the second and the third group where they were significant / $P < 0.05$ /.

/ $P < 0.05$ / and highly significant / $P < 0.01$ /. Differences in the participation of drumsticks with thighs and of backs were not significant.

- 2/ Light meat of broilers slaughtered at the age of 7 weeks contained significantly more proteins and fat and less water and ash than that of broilers slaughtered at the age of 6 weeks. Dark meat of broilers slaughtered at the age of 7 weeks contained considerably less water and more ash and fat than the same meat of broilers slaughtered at the age of 6 weeks. The established differences for all indices were significant / $P < 0.05$ / and highly significant / $P < 0.01$ /.
- 3/ The content of amino acids, tryptophan and hydroxyproline, in light and dark meat of broilers, increased with the extension of the fattening period from 6 to 7 weeks, and the evaluation of differences in mean values among the broiler groups showed high significance / $P < 0.01$ /.

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