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BROILER MEAT QUALITY DEPENDING ON THE WAY OF FATTENING

KAKVOĆA MESA BROJLERA U OVISNOSTI O NAČINU TOVA

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SUMMARY

Meat of fattened chickens plays an important role in nutrition of the population. The purpose of this paper is to compare nutrition quality of the meat of intensively (1st group) and semi-intensively (2nd group) fattened broilers. Broilers of the 1st group were fattened up to 6 weeks in closed accommodation on diets with a higher level of nutrients, while broilers of the 2nd group were fattened from 22 to 56 days in buildings with enclosure and diets with a lower level of nutritients.

Analysis of basic chemical composition (water, fat, proteins and ash) and aminoacid hydroxyproline, as well as of the connective tissue proteins was performed on the samples taken from breast muscles (white meat) and thighs with drumsticks (red meat).

The results of the researches showed that white meat of the chickens from the 2nd group contained significantly more ($P<0.05$) proteins than white meat of the chickens from the 1st group (23.51% : 23.15%, respectively). Fat content in both white and red meat of the chickens from 2nd group was lower ($P<0.01$) than of those from the 1st group (0.94% : 1.35% and 3.44% : 3.95% respectively). The meat of the chickens from the 1st group had less ($P<0.05$) hydroxyproline and connective tissue proteins than meat of the chickens from the 2nd group (white meat 0.072% : 0.075% and 0.576% : 0.600%, respectively, and red meat 0.126% : 0.141% and 1.008% : 1.128%, respectively). The results of the research confirm that feeding technology combined with the way of keeping broilers influence the nutrition quality of the meat.

Key words: broiler, feeding, keeping conditions, meat quality, hydroxyproline, connective tissue proteins

INTRODUCTION

The meat of fattening chickens has an important role in feeding the population. It is characterised by high digestibility and moderate prices. The poultry meat consumption in Croatia is 15 kg per capita on average, but it is higher in villages than in urban milieux. In many western European countries poultry meat consumption is about 25 kg, while in U.S.A it reaches 35 kg per

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capita yearly. It is assumed that poultry meat consumption in Croatia will also increase (year 2000 19.4 kg per capita yearly) and because of this research on improvement of the production and meat quality is becoming more important.

Poultry meat is mainly produced in industrial by (intensively, throughout the year with fast gains). Some consumers (France, Germany, Italy) show special interest in the production of poultry meat in so called natural manner. In this type of production chicken are kept in buildings with enclosure under special feeding regimes. Poultry of high biological quality can be bought in France under market name "Label Rouge".

The nutritional quality of poultry meat depends on several factors. BOGOJEVIĆ (1979) reported on the high quality of turkey and chicken breast meat. High digestibility and low fat content in breast muscle make them very convenient in the diet of ill and elderly persons.

Nutrition quality depends on the amount of nutrients. The chemical composition of the chicken meat is influenced by genetype and gender (KRALIK et al., 1993; PETRIČEVIĆ et al., 1993), feeding (KOCIOVA, 1974; KRALIK et al., 1988; KIRCHGESSNER et al., 1990; MENDES et al., 1992), age of the poultry (SHUMKOV et al., 1981; GREY et al., 1983; MAURUS et al., 1988; RISTIĆ et al., 1990, 1994) as well as by health condition of the chicken (DOBES et al., 1975).

Besides chemical analysis of water, proteins, fat and ash; the contents of hydroxyproline and connective tissue proteins are also used as indicator of biological value (PFEIFFER et al., 1969; KRALIK et al., 1979; PETRIČEVIĆ et al., 1993). The research of KRALIK et al., (1979) and PETRIČEVIĆ et al., (1993) showed that breast meat contains less hydroxyproline and connective tissue proteins than the meat of drumsticks. According to PELCZYNSKA (1974) and SHUNKOV et al (1981) the hydroxyproline content in meat increases with the age of the poultry, while FISININ et al. (1981) reported that keeping conditions (floor, cage) had no influence on shares of hydroxyproline and tryptophane in turkey meat.

The aim of this study was to determine the nutritive meat quality of broilers, intensively fed during six weeks and broilers fed less intensive by during last three weeks of fattening (in the enclosure). Besides basic chemical composition of the meat (water, proteins, fat and ash), share of hydroxyproline and connective tissue proteins in the meat were researched.

MATERIAL AND METHODS

The research was performed on two groups of Ross 208 male chickens. The first group of chickens (n=50) was intensively fed from 1st to 42nd day (complete diet) in a closed building with controlled microclimate factors. The second group of chickens (n=50) was kept in buildings with enclosure from 22nd to 56th day on less intensive feeding regime. The program of the experiment is shown in the table 1.

Table 1. Feeding regime and keeping conditions of broilers
Tablica 1. Način hranidbe i uvjeti držanja brojlera

Group / Skupina	Days / Dana	Fattening technology - Tehnologija tova		
		Držanje - Keeping	Feeding – diets - Obroci	
1 st	1-21	Closed - Zatvoreno	D1	23.0% crude proteins - sirove bjelančevine, 13.0 ME MJ/kg
	22-35	Closed - Zatvoreno	D2	21.0% crude proteins - sirove bjelančevine, 13.4 ME MJ/kg
	36-42	Closed - Zatvoreno	D3	19.1% crude proteins - sirove bjelančevine, 13.6 ME MJ/kg
2 nd	1-21	Closed – Zatvoreno	D1	23.0% crude proteins - sirove bjelančevine, 13.0 ME MJ/kg
	22-35	With enclosure - S ispustom	D4	19.5% crude proteins - sirove bjelančevine, 13.3 ME MJ/kg
	36-56	With enclosure - S ispustom	D5	17.6% crude proteins - sirove bjelančevine, 13.4 ME MJ/kg

In the ration 0.5% of premix was added which contained:2400000 i.u. of vitamin A; 400000 i.u. of vitamin D3; 6000 mg of vitamin E, 300 mg of vitamin K3; 270 mg of vitamin B1; 1200 mg of vitamin B2; 720 mg of vitamin B6; 200 mg of folic acid; 15 mg of Ca pantothenate; 5000 mg of niacine; 2.25 mg of vitamin B12; 500 mg of choline chloride; 10 mg of biotine; 24000 mg of antioxidant; 16080 mg of Mn; 4000 mg of Fe; 400 mg of Cu; 200 mg of I; 40 mg of Co; 8000 mg of Zn; 20000 mg of Mg, 30 mg of Se; 6000 mg of salinomycine-Na and 1000 mg of virginiamycine.

The chickens in each group were fed for 42 and 56 days respectively in order to achieve approximately the same live weights. After the fattening the chickens were slaughtered and processed "ready to grill". After 24 hours of cooling, 10 samples of the meat from each group were taken. Samples were taken separately from breast muscle (white meat) and from the muscles from thighs with drumsticks (red meat). The muscles were removed from the bone and skin ned. Muscles prepared in this manner were fragmented and homogenised so they could be used for analysis.

By chemical analysis of every sample shares (%) of water (drying at 105°C to a firm mass), proteins (micromethod according to Kjeldahl), fat (Soxhlet method) and ash (burning at 550°C to afirm mass) were determined. The shares of (%) hydroxyproline and connective tissue proteins were determined by methods of Neuman and Logan, i.e. Stegman (quoted by PETRIČEVIĆ et al.1993). Statistical analysis of data was carried out by Excel 5.0 for Windows program.

RESULTS AND DISCUSSION

The fattening of the 1st group of chickens lasted 42 days, and the 2nd group 56 days in order to reach approximately the same live weights of the chickens. Means of live weights and slaugtering values of the chicken carcasses are shown on table 2.

Table 2. Live weights, carcass weights, rendement and abdominal fat
Tablica 2. Živa težina, težina polovica, randman i abdominalna mast

Group - Skupina		Live weight, g Živa težina	Carcass weight, g Težina čista	Rendement, % Randman	Abdominal fat, % Abdominalna mast
1st	$\bar{x}$	2207.48	1645.02	74.52	3.91*
	s	244.58	115.15	2.49	0.74
2nd	$\bar{x}$	2215.19	1662.06	75.03	2.53
	s	265.82	132.40	3.31	0.26

*P<0.05

The chickens from the 2nd group had better rendement and significantly less abdominal fat (P<0.05) in carcasses than the chickens from the 1st group. The results of the chemical analysis of water, proteins, fat and ash in, percentage, in the meat of the broilers are presented in table 3. The shares of hydroxyproline and connective tissue proteins are shown in table 4.

The results obtained of the chemical composition of meat show that broilers of the 2nd group have greater share of proteins in white and red meat than the broilers of the 1st group. The only significant difference (P<0,05) is the one between the groups of chickens in white meat. The analysis of the results of the fat share shows that 2nd group of chickens, fattened in buidings with enclosure, had a highly significant (P<0,001) lower percentage of fat in white and red meat (0,94% and 3.44%) than 1st group of chickens (1,35% and 3,95%). Fast fattening characterised by greater gains also resulted in greater deposition of the fatty tissue in chicken carcasses. The meat with lower fat content

could be interesting from the dietary aspect. Differences in the shares of water and ash, regarding the fattening technology and kind of meat, were not statisticaly significant.

Similar results in chemical composition of white and red meat of Ross 208 chickens reported KRALIK et al. (1979), KRALIK and PETRIČEVIĆ (1992), PETRIČEVIĆ et al. (1993), as well as KIRCHGESSNER et al.(1993). According to research of RISTIĆ (1990), breast meat of broilers of different provenance contains significntly less fat (only 0,34%-0,47%) than that found in this study. Regarding the extended fattening SKUKOV et al. (1981), found more proteins in the meat of the chickens. FISININ et al. (1981) and RISTIĆ et al. (1990) pointed out better organoleptic traits of the meat as well. MAURUS et al. (1987) and GREY et al (1983) reported that extension of the fattening period increases the deposition of the fat in the body. However, this was not the case in this research because extension of the fattening was connected to less intense feeding and greater possibility of the poultry moving when kept in buildings with enclosure.

Table 3. Chemical composition of broiler meat
Tablica 3. Kemijski sastav mesa brojlera

Kind of meat - Vrsta mesa		Water, % Voda	Proteins, % Bjelančevine	Fat, % Mast	Ash, % Pepeo
1st group (fattened in standard way) 1. skupina (standardno tovljena)					
White	$\bar{X}_1$	74.20	23.15	1.35***	1.30
	s	0.65	0.35	0.15	0.05
Red	$\bar{X}_2$	74.68	20.08	3.95***	1.29
	s	0.45	0.18	0.18	0.03
2nd group (fattened in buildings with enclosure) 2. skupina (tovljena u nastambama s ispustom)					
White	$\bar{X}_3$	74.24	23.51*	0.94	1.31
	s	0.58	0.29	0.11	0.08
Red	$\bar{X}_4$	75.07	20.21	3.44	1.28
	s	0.50	0.21	0.21	0.02

*** P<0.001; **P<0.01; *P<0.05; n.s.P>0.05

The data in table 4 show the statistically significant differences (P<0.05) in the mean values of shares of hydroxyproline and connective tissue proteins in total proteins between the 1st and 2nd group of chickens. The fattening of the broilers in buildings with enclosures resulted, as already mentioned, in greater gains, better protein production in the meat, but also in simultaneous increase of the hydroxyproline and connective tissue protein percentages. The established shares of hydroxyproline, in respect to the kind of meat, are in accordance with the results of PFEIFER et al. (1969) and PETRIČEVIĆ et al. (1993). Our results confirm the opinion of FISININ et al. (1981) that keeping conditions influence hydroxyproline content, as well as the report of SKUMKOV et al. (1981) that hydroxyproline content in the meat of the chicken increases with age. Increased hydroxyproline affected the occurrence of greater shares of the connective tissue proteins in the meat, which is in agreement with the statements of PFEIFER et al. (1969). PELCZYNSKA (1974), KRALIK et al. (1979), and PETRIČEVIĆ et al.(1993).

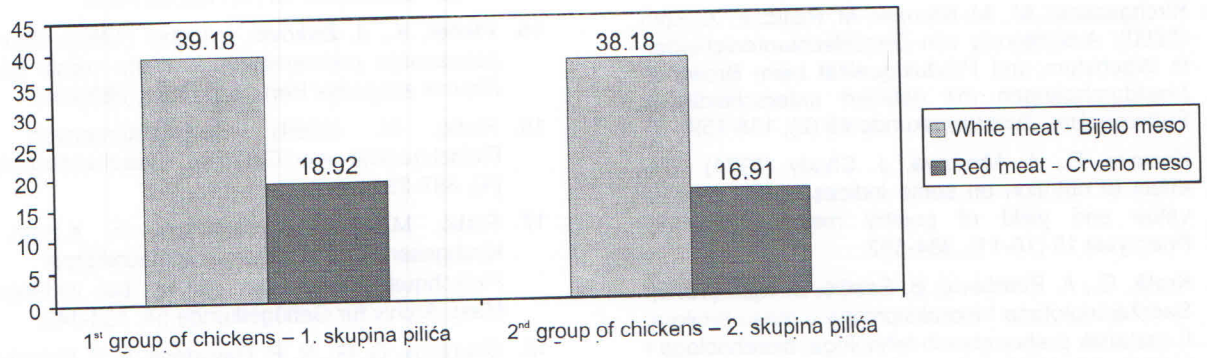
The ratio of biologically more valuable muscle proteins and connective tissue proteins in white and red meat is more favourable in the chickens from the 1st than in those from the 2nd group, which means that meat of the intensively fattened chickens has better quality, in the sense of biological value of proteins. From the nutritional aspect, having in mind digestibility and feasibility of nutrients, the meat containing less connective and more muscle tissue is more favourable because it is more digestible.

Table 4. The content of hydroxyproline, muscle tissue proteins and connective tissue proteins in the broiler's meat
Tablica 4. Sadržaj hidroksiprolina, bjelančevina mišićnog tkiva i bjelančevina vezivnog tkiva u mesu brojlera.

Kind of meat Vrst mesa		Hydroxy-proline %	Proteins – Bjelančevine		
			Muscle tissue, % Mišićno tkivo	Connective tissue, % Vezivno tkivo	% of connective tissue in total % ukupnog vezivnog tkiva
1st group (fattened in standard way) 1. skupina (standardno tovljena)					
White Bijelo	$\bar{X}_1$	0.072	22.57	0.576	2.48
	s	0.003	0.38	0.006	0.08
Red Crveno	$\bar{X}_2$	0.126	19.07	1.008	5.02
	s	0.006	0.25	0.003	0.11
2nd group (fattened in buildings with enclosure) 2. skupina (tovljena u nastambama s ispustom)					
White Bijelo	$\bar{X}_3$	0.075*	22.91	0.600**	2.55*
	s	0.002	0.24	0.004	0.12
Red Crveno	$\bar{X}_4$	0.141*	19.08	0.128**	5.58*
	s	0.008	0.27	0.005	0.13

**P<0,01 *P<0,05

Graph 1. Relation between muscle and connective tissue.
Grafikon 1. Odnos između mišićnog i vezivnog tkiva.



CONCLUSION

Nutritional quality of meat regarding the way of keeping the broilers is researched in this paper. Chickens of the 1st group were fattened intensively in the closed building on diets with high level of nutrients, while those from the 2nd group were fattened in buildings with enclosure and on diets with lower level of nutrients during the last three weeks of fattening.

On the basis of the results obtained in the research following can be concluded:

Fattening technology connected with the way of keeping influences the nutritional quality of broiler meat.

White and red meat of the broilers from the 1st group contained significantly more (P<0,05) fat than the meat of the broilers of the 2nd group.

Greater share of proteins in white and red meat of the broilers from the 2nd group was followed by very significantly (P<0,001) greater shares of hydroxyproline and connective tissue proteins.

followed by very significantly ($P<0,001$) greater shares of hydroxyproline and connective tissue proteins.

Ratio of muscle tissue and connective tissue proteins was more favourable in the meat of the chicken from the 1st group compared to those from 2nd group.

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SAŽETAK

Meso tovnih pilića značajna je namirnica u prehrani stanovništva. Svrha rada bila je da se komparira prehrambena kakvoća mesa pilića tovljenih na intenzivan (1. skupina) odnosno poluintenzivan način (2. skupina). Pilići 1. skupine tovljeni su šest tjedana u zatvorenoj nastambi, s višom razinom

hranjivih tvari u obroku, dok su pilići 2. Skupine od 22. do 56. dana tovljeni u nastambi s ispustom, a nižom razinom hranjivih tvari u obroku.

Na uzorcima prsnog mesa (bijelo meso) i mesa batkova s nadbatcima obavljene su analize osnovnih kemijskih sastojaka (vode, masti, bjelančevina i pepela) i aminokiseline hidroksiprolina, kao i vezivnotkivnih bjelančevina.

Rezultati istraživanja pokazuju da bijelo meso pilića 2. skupine sadrži signifikantno više ($P<0,05$) bjelančevina od bijelog mesa 1. skupine pilića (23,51% : 23,15%). Sadržaj masti u bijelom i crvenom mesu bio je kod 2. skupine visoko signifikantno niži (0,94% : 1,35% odnosno 3,44% : 3,95%) nego kod brojlera 1. skupine. Meso pilića 1. skupine sadržavalo je manje ($P<0,05$) hidroksiprolina I vezivnotkivnih bjelančevina od mesa 2. skupine pilića (bijelo meso 0,072% : 0,075% I 2,48% : 2,55%, crveno meso 0,126% : 0,141% i 5,02% : 5,58%).Rezultati istraživanja su potvrdili da tehnologija tova vezano uz način držanja brojlera, utječe na prehrambenu kakvoću mesa.

Ključne riječi: brojler, hranidba, držanje, kakvoća mesa, hidroksiprolin, vezivnotkivne bjelančevine.