

QUALITY OF MEAT FROM BROILERS FED CONCENTRATE MIXTURES WITH DIFFERENT CHROMIUM SOURCE AND LEVEL **

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Abstract: Objective of the paper was to investigate if adding of chromium in different forms (organic and inorganic) and levels (quantities) to mixtures for broilers has any effect on broiler meat traits.

Investigation was carried out on 840 chickens divided into four groups – treatments. Differences between groups (treatments) were in the form (organic and inorganic) and quantity of added chromium preparation (200 and 400 ppb) in basic mixtures for chicken nutrition. At the end of fattening (42 days) 48 broilers were dissected and shares of certain tissues in breasts, thighs and drumsticks were determined as well as chemical composition and tenderness of meat.

Based on obtained results it can be concluded that adding of chromium in the amount of 200ppb resulted in statistically very significant increase of share muscle tissue and decrease of share of fat tissue in breasts, also tendency of improvement of the muscle tenderness of breasts and drumsticks was registered. When chromium was added in the amount of 400ppb, tendency of decrease of fat content of white meat was registered. No statistically significant differences were established in case of addition of 200ppb of chromium in regard to share of muscle and fat tissue in breasts, chemical composition and tenderness of broiler meat.

Key words: chromium, broiler, share of tissue, chemical composition, meat tenderness

Introduction

Consumers are aware of well known positive aspects of the poultry meat (high nutritive value, complete food stuff for old and young persons, etc.), but they are becoming increasingly choosy and with higher demands in regard to the quality. Many consumers (especially in developed countries) find that conventional (classical) quality standards of chicken meat are inadequate and need to be supplemented with new quality traits *Pavlovski et al.* (1997).

Beside genotype, age of poultry, housing conditions and health aspects, great influence on quality of poultry products has the nutrition (composition of food and nutrition method). After the knowledge that quality of poultry products can be modified or enriched by adding to the diet of bio available forms of chromium, in scientific circles the interest for use of chromium in livestock feed increased *Hossain* (1998). Chromium, *Lindenman* (1996) didn't get the attention it deserves, because of the difficulties in the analysis and form (organic and inorganic), which created confusion in initial estimates relating to requirements and effect. However, organic form of chromium now is preferred to inorganic forms which are less available for utilization, which is in accordance with research confirming that conventional (inorganic) forms of microelements are less available compared to organic forms, *Sinovec et al.* (2002).

In broiler production role of chromium can be perceived from two aspects: improvement of production productivity and improvement of the nutritive profile of the product, i.e. meat. It is known fact that poultry meat is less fatty compared to beef or young beef, but because of constantly increasing demands by the consumers, production cannot be satisfied with present, existing advantages, and research carried out by many authors indicate that for better production and improvement of the quality of broiler carcass it is necessary to add to the feed bio available chromium forms *Paul* (1991), *Lien* (1999). The effect of chromium on quality traits of meat is confirmed in sense of increase of the percentage of muscle tissue in breasts *Hossain et al.* (1998), *Guo et al.* (1999), tendency of increase of the mass of leg muscles *Holoubek et al.* (2000), decrease of fat in the carcass *Kim et al.* (1995), decrease of abdominal fat *Lien et al.* (1999), *Kwon et al.* (1999), decrease of fat content in liver *Wanne et al.* (1999), decrease of fat in breast meat *Motozono et al.* (1998) and increase of chromium content in meat, liver and bones *Kalous* (1986).

Objective of this paper is to determine the effect of nutrition using

mixtures with or without addition of chromium (in organic or inorganic form), as well as different levels of organic (200 and 400 ppb) chromium on quality of broiler meat, in order to contribute to better knowledge of the efficiency of chromium application on production of chicken meat.

Material and methods

In the trial four groups – treatments were formed. To the basic mixture used in broiler nutrition, which was used for the control group, organic and inorganic chromium were added in the form Bio-chrome (Alltech) and inorganic in chloride form according to the following scheme:

I treatment: Control group without addition of chromium (K)

II treatment: Group where 200 ppb of organic chromium was added (O-I)

III treatment: Group where 400 ppb of organic chromium was added (O-II)

IV treatment: Group where 200 ppb of inorganic chromium was added (O-III).

Investigation included 840 chickens housed in 12 boxes with 80 chickens in each box (for each of four treatments there were three repetitions), with application of standard fattening technology, in duration of 42 days. Investigation of the quality of meat was done on 48 samples (12 per each treatment).

Dissection of breasts, thighs and drumsticks was carried out in order to determine the shares of muscle and fat tissue. Measuring of tissue was done using electronic scale of precision of $\pm 0,01$ g.

On samples of white meat (breasts) main chemical composition was investigated (water, protein, fat and ashes), and tenderness of white (breast) and red meat (drumstick) was determined on consistence meter according to Wolotkiewitsh.

Results and Discussion

Shares of meat and fat in mass of breast, thighs and drumsticks, for both sexes in trial groups are presented in table 1.

In regard to the data on shares of muscle tissue in breasts (table 2), the lowest average value was determined in K group (81,50%), and the highest in group O-I (83.01%), in which the highest yield of muscle tissue was

established (324,55g). Share of fat tissue in breasts was the lowest in group O-I (1,92%), whereas the group K (2,44%), compared to other trial groups realized the highest share of fat tissue. Values obtained in this research for average mass of muscle tissue are in accordance with results of *Hopić* (1996), but values determined for fat tissue are lower.

Table 1. Share of certain tissues in breasts, thighs and drumsticks

Group	Os	Breast		Thighs		Drumsticks	
		Muscle (%)	Fat (%)	Muscle (%)	Fat (%)	Muscle (%)	Fat (%)
K	X	81,50	2,44	64,33	0,63	72,48	4,31
	Sd	2,54	1,38	4,30	0,64	2,79	1,46
	Cv	3,11	56,42	6,67	61,92	3,84	33,97
O-I	X	83,01	1,92	62,33	1,07	70,57	4,69
	Sd	1,71	0,73	7,10	0,49	4,32	1,58
	Cv	2,07	37,74	11,38	45,72	6,12	33,77
O-II	X	81,83	2,22	62,37	1,19	70,25	5,51
	Sd	1,41	0,71	6,18	0,76	1,88	1,50
	Cv	1,71	32,03	9,87	64,01	2,39	27,23
O-III	X	81,73	2,14	65,23	0,91	72,54	4,06
	Sd	1,93	0,86	2,30	0,67	2,16	1,18
	Cv	2,36	35,30	3,53	73,87	3,28	29,08

Shares of muscle tissue in thighs and drumsticks (table 2) were lower in groups consuming food with added chromium in amounts of 200ppb and 400ppb, compared to group where 200ppb of inorganic chromium was added to the mixture and control group.

Statistical analysis of data relating to share of muscle and fat tissue in carcass parts is presented in table 2.

By statistical analysis of data on share of muscle tissue in breasts, statistically very significant differences between group K and O-I group and between O-I and O-II and O-III groups were determined (table 2), so it can be concluded that group of chickens fed mixture with 200ppb of organic chromium added to it realized the highest average values for yield and share of muscle tissue, compared to control group, group with 400ppb of organic chromium added and compared to group where inorganic chromium was added (200ppb). Also, it can be concluded that addition of organic chromium in the amount of 200ppb influenced decrease of share of fat in breasts which was confirmed by statistically significant difference between groups O-I and K (table 2).

Table 2. Evaluation of significance of differences in shares of certain tissues in breasts, thighs and drumsticks

Tissues	Group	X	Differences, d			
			K	O-III	O-II	O-I
Breasts						
Muscle	O-I	83,01	1,51**	1,28**	1,18**	-
	O-II	81,83	0,33	0,10	-	
	O-III	81,73	0,23	-	Lsd _{0,05} =0,809	
	K	81,50	-		Lsd _{0,01} =1,083	
Fat	O-I	1,92	0,52*	0,22	0,30	-
	O-II	2,22	0,22	0,08	-	
	O-III	2,14	0,30	-	Lsd _{0,05} =0,470	
	K	2,44	-		Lsd _{0,01} =0,629	
Thigh						
Muscle	O-I	62,33	2,00	2,90*	0,04	-
	O-II	62,37	1,96	2,86*	-	
	O-III	65,23	0,90	-	Lsd _{0,05} =2,206	
	K	64,33	-		Lsd _{0,01} =2,952	
Fat	O-I	1,07	0,44	0,16	0,12	-
	O-II	1,19	0,56	0,28	-	
	O-III	0,93	0,28	-	Lsd _{0,05} =1,236	
	K	0,63	-		Lsd _{0,01} =1,654	
Drumstick						
Muscle	O-I	70,57	1,91**	1,97**	0,32	-
	O-II	70,25	2,23**	2,29**	-	
	O-III	72,54	0,06	-	Lsd _{0,05} =1,230	
	K	72,48	-		Lsd _{0,01} =1,646	
Fat	O-I	4,69	0,38	0,63	0,82*	-
	O-II	5,51	1,20**	1,45**	-	
	O-III	4,06	0,25	-	Lsd _{0,05} =0,644	
	K	4,31	-		Lsd _{0,01} =0,889	

In research of *Holoubek et al.* (2000) tendency of increase of muscle mass in breasts and decrease of fat was established, when organic chromium in the amount of 300 $\mu\text{g/kg}$ was added. When organic chromium was added (chrome yeast), *Hossain* (1998) stated that yield of breasts improved by 6,4%. Results of stated research can be linked to results obtained in this research where yield of breasts was higher by 2,47% in group fed mixture where 200 ppb of organic chromium was added.

Analyzing obtained results on share of muscle tissue in thighs, based on realized statistical significances (table 2) it can be concluded that addition of

organic chromium (200 ppb and 400 ppb) had no effect on share of muscle and fat tissue in legs, which is contrary to results obtained by *Holoubek et al.* (2000) according to which chromium pikolinat has tendency to increase the muscle mass of legs.

Results on share of muscle tissue in drumsticks indicate that groups of chickens fed diets with added organic chromium (200 and 400 ppb) had the lower share of muscle tissue compared to control group and group of chickens fed diets with inorganic chromium (200 ppb). Addition of organic chromium in the amount of 400 ppb resulted in statistically significant increase of share of fat tissue in drumstick, compared to control group and group fed mixtures with inorganic chromium (table 2).

Obtained data on content of water, protein, fat and mineral matters are presented in table 3. By individual comparison of average values for observed traits no statistically significant differences between trial groups of females, males and on the level of both sexes were established, so it can be concluded that addition of organic and inorganic chromium had no effect on chemical composition of meat. Analysis of data on fat content shows the tendency of decrease of fat with addition of organic chromium in the amount of 400ppb, which was also concluded in research of *Motozon et al.*(1998), *Kim et al.* (1995), *Wanne et al.* (1999).

Table 3. Chemical composition of the breast muscle tissue

Sex	Group	Chemical composition of breast muscle tissue (%)			
		Water	Protein	Fat	Ashes
Males	K	73,48	24,43	0,87	1,18
	O-I	73,46	24,84	0,79	1,12
	O-II	73,69	24,46	0,68	1,16
	O-III	73,69	24,34	0,77	1,19
Females	K	73,42	24,51	0,92	1,14
	O-I	73,82	24,05	0,98	1,14
	O-II	73,70	24,46	0,70	1,28
	O-III	74,15	23,88	0,77	1,19
Average	K	73,45	24,54	0,90	1,16
	O-I	73,64	24,45	0,89	1,13
	O-II	73,69	24,46	0,69	1,14
	O-III	73,92	23,98	0,77	1,29

Increase of percentage of protein in meat, with addition of organic chromium, *Lindeman* (1996) wasn't established in this research, although

values obtained for protein content, in all trial groups were slightly higher than those obtained in research by *Bogosavljević-Bošković* (1999). Obtained values for content of water in white meat are in accordance with research of *Tomašević* (1990), and for content of mineral matters with research of *Pavlovski et al.*(1985).

Data on tenderness of muscle tissue of breasts and drumsticks are determined on consistence meter, according to Wolotkiewitch, expressed in kilograms (table 4).

Table 4. Tenderness of white and red broiler meat

Trait	Group	Meat tenderness		
		Males	Females	Average
Breasts (white meat)	K	1,63	1,54	1,58
	O-I	1,53	1,45	1,49
	O-II	1,66	1,52	1,59
	O-III	1,64	1,58	1,61
Drumstick (red meat)	K	1,46	1,41	1,43
	O-I	1,37	1,26	1,32
	O-II	1,61	1,27	1,44
	O-III	1,57	1,43	1,50

Based on obtained data it can be concluded that the best tenderness of white meat was registered in trial group O-II, in males (1,53), in females (1,45) and at the level of both sexes (1,49). Regardless of the observed tendency of improvement of meat tenderness when organic chromium in the amount of 200ppb was added, no statistically significant differences between trial and control groups were established by statistical analysis. Females, compared to males, realized better tenderness in breasts and drumsticks, which is in accordance with research by *Tomašević* (1990).

Tenderness of dark meat (drumstick) also was the most favourable in group O-I, in males (1,37), in females (1,26) at the level of both sexes (1,32). Statistically significant difference was determined between O-I and O-III (at the level of both sexes), but not when trial and control groups were compared. Observed tendency of improvement of meat tenderness with addition of organic chromium in the amount of 200ppb can be related to research of *Bonomi et al.* (1999) who established in young turkeys positive effect of organic chromium on meat tenderness.

Conclusion

Based on analysis of presented results relating to quality of broiler meat, obtained when organic (200ppb and 400ppb) and inorganic (200ppb) chromium were added to mixtures for broiler nutrition, the following can be concluded:

- Addition of 200ppb of organic chromium resulted in positive effects in regard to share of tissues in breasts, considering that in this group statistically considerably higher share of muscle tissue, i.e. lower share of fat tissue were determined. Addition of organic chromium in the amount of 400ppb and inorganic chromium (200ppb) had no significant effect on share of muscle and fat tissue in breasts.
- Addition of organic chromium (200 and 400ppb) and inorganic chromium (200ppb) had no statistically significant effect on share of muscle and fat tissue in thigh.
- Addition of organic chromium (200 and 400ppb) resulted in statistically considerably lower share of muscle tissue in drumstick. Organic chromium in the amount of 400ppb statistically considerably increased the share of fat tissue in drumstick. Addition of inorganic chromium (200) had no significant effect on share of tissues in drumstick.
- In chemical analysis of white meat (breasts), for content of water, fat, protein and mineral matters, at the level of statistical significance, no effect was determined when organic (200ppb and 400ppb) and inorganic chromium (200ppb) were added, but tendency of decrease of fat when organic chromium in the amount of 400ppb was observed.
- Tenderness of white and dark meat was not influenced statistically significantly by addition of organic (200ppb and 400ppb) and inorganic chromium (200ppb), but trend of improvement of tenderness was observed when organic chromium in the amount of 200ppb was added.

KVALITET MESA BROJLERA HRANJENIH SMEŠAMA KONCENTRATA SA RAZLIČITIM IZVOROM I NIVOOM HROMA

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Rezime

Cilj rada je bio da se ispita da li dodavanje hroma različitih oblika (organski i neorganski) i nivoa (količina) u smeše za ishranu brojlera ima uticaja na kvalitativne osobine mesa brojlera.

Ispitivanje je izvedeno na 840 pilića podeljenih u četiri grupe-tretmana. Razlike između grupa (tretmana) su u obliku (organski i neorganski) i količinskom učešću hromnog preparata (200 i 400 ppb) u osnovnim smešama za ishranu pilića. Na kraju tova (42 dana) urađena je disekcija 48 brojlera i utvrđen udeo pojedinih tkiva u grudima, batcima i karabaticima, ispitan je hemijski sastav i mekoća mesa.

Na osnovu dobijenih rezultata može se zaključiti da je dodavanje hroma u količini od 200ppb rezultiralo statistički vrlo značajnim povećanjem udela mišićnog tkiva i smanjenjem udela masnog tkiva u grudima, a zapažena je i tendencija poboljšanja mekoće muskulature grudi i karabataka. Pri dodavanju hroma u količini od 400ppb, uočena je tendencija smanjenja sadržaja masnoće belog mesa. Pri dodavanju neorganskog hroma u količini od 200ppb nisu utvrđene statistički značajne razlike za udeo mišićnog i masnog tkiva u grudima, za hemijski sastav i mekoću mesa brojlera.

Ključne reči: hrom, brojler, udeo tkiva, hemijski sastav, mekoća mesa

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