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THE EFFECT OF DIFFERENT SOURCE AND CHROMIUM LEVEL IN RATION ON BROILER BREAST MUSCULATURE[1]

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Contents: Objective of this paper was to determine if addition of different forms of chromium (organic and inorganic) and levels (quantity) into mixtures for nutrition of broilers will have any effect on quantitative and qualitative traits of breast musculature

Investigation was carried out on 840 chickens divided into 4 groups-treatments. Difference between groups (treatments) was in the amount of chromium preparation (200 and 400 ppb) and its source (organic and inorganic) in basic mixtures for nutrition of chickens. At the end of fattening (42 days) 24 broilers per each treatment were sacrificed, on processed carcasses the breast angle and breast yield were determined and by dissection the yield of certain tissues in breast and chemical composition of the muscle were determined. .

Analysis of results demonstrated that group of chickens fed diets with supplemented with organic chromium in amount of 200 ppb realized significantly better results in regard to breast angle, yield, share of breast, share of muscle tissue and share of fat in breast.

Based on obtained results it can be concluded that addition of organic chromium into mixtures for nutrition of broilers had resulted in positive effects in regard to monitored slaughter characteristics, which can be of significance to production of poultry meat.

Key words: Chromium, broiler, breast angle, share of breast, share of tissues

Introduction

In the last decade, increasing attention is directed to certain number of insufficiently studied micro elements, their functions and requirements. Chromium belongs to this group of so called trace mineral elements, and some researches have demonstrated its positive effects in poultry nutrition.

Role of chromium can be considered from two aspects. First is improvement of poultry productivity, second is improvement of dietary profile of poultry products – meat and eggs, which is specially important and up-to-date considering consumer concern related to cholesterol and fats, as well as in general increased demand of consumers relating to quality of poultry products (*Pavlovski et al.,* 1997). Quality of poultry products can be modified or improved/enriched by addition of bio-available forms of chromium. So, recently, there is considerable scientific interest for use of chromium as additive in livestock feed (*Hossain,* 1998). Positive effect of chromium on quantitative and qualitative traits of meat is confirmed in numerous researches where by adding chromium better carcass yield (*Paul et al.*, 1991., *Kim et al.,* 1995., *Bee et al.,* 1999), breast yield (*Hossain,* 1998.) were achieved, abdominal fat reduced (*Lien et al.,*1999., *Kwon et al.,* 1999), as well as content of fat in carcass (*Wane et al.*,1999.) and in breast meat (*Motozono et al.,* 1998.).

In regard to form of micro elements, studies indicate better exploitation/utilization of organic forms compared to inorganic (*Sinovec and Lazaravić,* 2002.)

*Lindeman (*1996.) stated that one of the most interesting areas of research in poultry nutrition is addition of chromium, also that chromium wasn't awarded the role it deserves because of the difficulties in analysis and due to definition of the form (organic-inorganic form), which created confusion in initial evaluation of requirements and effects. According to same author, during the last decade, there are increasing number of researches dealing with addition of chromium in organic form, and achieved results are often positive and of great importance.

Objective of this paper was to investigate the effect of nutrition without and with chromium, in organic and inorganic form, as well as effect of different amounts of added organic chromium on broiler breast musculature – breast angle, yield and share of breasts, yield and share of breast tissue and chemical composition of white meat, in order to contribute to better knowing of the efficiency of different forms and level of chromium in production of chicken meat.

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Material and methods

Trial – treatments and repetitions were carried out according to principle of random block system. Four groups – treatments were formed, three repetitions for each treatment. Chicken coop for housing of 840 chickens was divided into 12 boxes. In each box there were 70 chickens, 210 in each treatment. Difference between groups (treatments) was in amount of added chromium preparation and its source (organic or inorganic) in main diets for chicken nutrition. Nutrition treatments were following:

K: control – no chromium added

O-I: 200 ppb organic chromium (chromium yeast)

O-II: 400 ppb organic chromium (chromium yeast)

O-III: 200 ppb inorganic chromium

Standard technology was applied – fattening of chickens in duration of 42 days. Chickens were fed ad libitum and two mixtures were used, initial/starter for fattening period from 1 to 28 days and final/finisher from 29 to 42 days. Basic mixture, which was used for control group, was supplemented with chromium preparations (as described in definition of treatments). First experimental group received diet supplemented with 200 ppb of organic chromium preparation, second experimental group received diets containing 400 ppb of organic chromium, and third group was fed diet containing inorganic chromium in amount of 200 ppb.

Table 1. Composition of complete mixtures used in trial, %

Feeds	Starter				Finisher			
	K	0-I	0-II	0-III	K	0-I	0-II	0-III
Maize, grain	58,15	58,15	58,15	58,15	64,20	64,20	64,20	64,20
Soy bean meal, 44%	24,50	24,50	24,50	24,50	22,00	22,00	22,00	22,00
Sunflower meal, 33%	2,00	2,00	2,00	2,00	3,00	3,00	3,00	3,00
Deh. alfalfa., 17%	3,00	3,00	3,00	3,00	2,00	2,00	2,00	2,00
Fish meal, 64%	7,00	7,00	7,00	7,00	3,00	3,00	3,00	3,00
Methionine 99%	0,15	0,15	0,15	0,15	0,10	0,10	0,10	0,10
Soybean oil	2,00	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Limestone	0,80	0,80	0,80	0,80	0,90	0,90	0,90	0,90
Dicalcium phosphate	1,20	1,20	1,20	1,20	1,50	1,50	1,50	1,50
Salt	0,20	0,20	0,20	0,20	0,30	0,30	0,30	0,30
Premix	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Chromium-organic (ppb)	-	200	400	-	-	200	400	-
Chromium-inorg. (ppb)	-	-	-	200	-	-	-	200

At the end of trial from each of the 12 boxes by random choice sample consisting of 4 male and 4 female chickens was taken, 24 chickens per each treatment slaughtered and examined, in total 96 chickens. Breast angle and mass of breast were determined on processed carcasses, by dissection of breasts (48 samples, 12 per each treatment) yield of breast tissues was determined. Samples of white breast meat were used for analysis of basic chemical composition.

Results were processed using statistical method of variance analysis and significance of differences was tested on the level of difference of 0,05 and 0,01 using LSD test.

Results and discussion

Based on presented average values for breast angle in trial groups (table 2) it can be observed that O-I and O-II group (101,00 and 100,92) realized higher values for monitored trait compared to groups K and O-III (99,00 and 99,67). Statistical analysis demonstrated statistically significant differences in comparison of O-I and O-II group with group K (table 3).

Table 2. Breast angle (^{o})

Group	Breast angle (degrees)			
	n	X	Sd	Cv
K	24	99,00	4,30	4,35
O-I	24	101,00	4,93	3,60
O-II	24	100,92	4,95	4,97
O-III	24	99,67	4,30	4,35

Table 3. Evaluation of significance of differences for breast angle in both sexes

Trait	Group	X	Difference , d			
			K	O-III	O-II	O-I
Breast angle	O-I	101,00	2,00*	1,33	0,08	-
	O-II	100,92	1,92*	1,25	-	
	O-III	99,67	0,67	-	$LSD_{0,05} = 1,298$	
	K	99,00	-		$LSD_{0,01} = 1,719$	

Presented results demonstrate the positive effect of organic chromium in amounts of 200 and 400 ppb compared to control group and contrary to inorganic chromium where no effect could be established. Literature data (*Hopić et al.,* 1996, *Cmiljanić et al.,* 1994) are similar to data obtained in this research.

Data on yield and share of breasts as one of the major carcass parts are presented in table 4. Comparison of data shows the greatest yield of breast in chickens from group O-I (358,06g), whereas the lowest breast yield recorded was in chickens from group O-III (339,42g). Observed in relative indicators share of breasts in cold carcass varied from 28,22% (O-III group) to 29,29% (O-I group).

Statistical analysis of data determined significance between observed groups in absolute and relative indicators. Group O-I achieved statistically the highest yield of breast in relation to O-III group, whereas between other trail groups and control group no statistically significant differences were established. Statistically significant difference was established in relative share of breasts between groups K and O-III and very significant between groups O-I, O-II and O-III.

Table 4. Yield and share of breast in mass of chilled carcass (grill)

Group	Total (n =24)		
	X	Sd	Cv
Mass of breast, g			
K	342,07	67,19	19,64
O-I	358,06	10,54	19,70
O-II	346,65	42,66	12,31
O-III	339,42	58,14	17,13
Share of breast, %			
K	28,63	2,27	7,91
O-I	29,29	2,12	7,25
O-II	28,53	1,52	5,37
O-III	28,22	1,61	5,93

Table 5. Evaluation of the significance of differences in yield and share of breast in mass of chilled carcass of broiler

Trait	Group	X	Differences, d			
			K	O – III	O - II	O - I
Absolute share, g	O–I	358,00	15,99	18,64*	11,41	-
	O-II	346,65	4,58	7,23	-	
	O.III	339,42	2,65	-	$LSD_{0,05} = 17,499$	
	K	342,07	-		$LSD_{0,01} = 23,170$	
Relative, %	O–I	29,29	0,66*	1,07**	0,76**	-
	O-II	28,53	0,10	0,31	-	
	O.III	28,22	0,41	-	$LSD_{0,05} = 0,555$	
	K	28,63	-		$LSD_{0,01} = 0,734$	

Based on obtained results it can be observed that in comparison to control group addition of chromium in amount of 200ppb to mixtures for broilers had positive effect on increase of yield and share of breast, whereas no effect was established in trial group fed inorganic chromium and group fed mixtures containing organic chromium in amount of 400 ppb. *Hosain,* 1998 stated that chromium yeast in amount of

300 ppb increased breast yield by 6,4%, which can be correlated to this research where yield of breast by 2,47% higher was established in chickens fed diets containing 200 ppb of chromium yeast.

Obtained results for share of breast are in accordance with values obtained in research by *Pupavac*, (*1994.*), but are better than results obtained by Tomašević, 1990. Reasons for different values for share of breast can be consequence of genotype, but also the fact that results are rather old should be considered.

Data on yield and share of meat, bones, skin and fat of breast are presented in table 6. It can be observed that values for yield of muscle tissue varied from 268,95g (O-III group) to 324,55g (O-I group). In regard to share of muscle tissue in breast the lowest average value was determined in chickens of group K (81,50%), and the highest in group O-I (83,01%).

Statistical analysis of data showed significance of differences. For share of muscle tissue statistically significant differences were determined between K and O-I groups and O-I: O-II and O-III groups.

Table 6. Yield and share of individual tissues in breast mass

Group	Os	Muscle		Bone		Skin		Fat	
		g	%	g	%	g	%	g	%
K	X	294,00	81,50	33,07	9,33	23,71	6,74	8,94	2,44
	Sd	30,14	2,54	4,92	1,23	4,56	1,45	5,65	1,38
	Cv	20,46	3,11	14,88	13,14	19,25	21,54	63,19	56,42
O-I	X	324,55	83,01	33,09	8,62	24,94	6,45	7,69	1,92
	Sd	39,80	1,71	4,92	1,14	5,71	1,19	3,86	0,73
	Cv	21,51	2,07	14,86	13,23	22,89	18,41	50,16	37,74
O-II	X	280,53	81,83	33,73	9,93	20,53	6,01	7,62	2,22
	Sd	43,51	1,41	4,27	1,11	4,99	1,18	2,75	0,71
	Cv	15,51	1,71	12,66	11,15	24,28	19,71	36,09	32,03
O-III	X	268,95	81,73	32,71	9,99	20,08	6,14	7,27	2,14
	Sd	48,25	1,93	5,94	1,02	3,69	0,79	3,60	0,86
	Cv	17,96	2,36	18,16	10,23	18,37	12,80	49,54	35,30

Table 7. Evaluation of significance of differences in share of individual tissues in breast, %

Tissues	Group	X	Differences, d			
			K	O-III	O-II	O-I
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	-		$LSD_{0,01} = 1,083$	
Bone	O-I	8,62	0,71**	1,37**	1,31**	-
	O-II	9,93	0,60**	0,06	-	
	O-III	9,99	0,66**	-	$LSD_{0,05} = 0,490$	
	K	9,33	-		$LSD_{0,01} = 0,655$	
Skin	O-I	6,45	0,29	0,31	0,44**	-
	O-II	6,01	0,73**	0,13	-	
	O-III	6,14	0,60**		$LSD_{0,05} = 0,389$	
	K	6,74	-		$LSD_{0,01} = 0,520$	
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	-		$LSD_{0,01} = 0,629$	

Analysis of obtained results shows that group of chickens fed diet containing 200 ppb of organic chromium realized the greatest average values in regard to yield and share of muscle tissue compared to control and other trial groups where organic chromium in amount of 400 ppb and inorganic chromium in amount of 200ppb was added. Also it can be concluded that addition of organic chromium in amount of 200 ppb affected decrease of share of bones and fat in breasts. Addition of organic chromium in amount of 400 ppb, as well

as inorganic chromium had no effect on share of muscle and fat tissue in breasts but it was also concluded that these two trial groups of chickens realized higher share of bones and skin in breast compared to control.

Values for average mass of muscle tissue, bones and skin obtained in this research are in accordance with results obtained by *Hopić*, 1996, except for average mass of breast fat since lower values were established in our research. In research by *Holubek et al.,* 2000 tendency of increase of mass of muscle tissue and decrease of fat tissue was determined when organic chromium in dose of 300 ppb had been added to diet which is in accordance with results obtained in this research.

Chemical composition of white meat is presented in table 8. It can be observed that contents of water, protein, fat and mineral matters are equal, and analysis of data shoed no statistically significant differences between trial groups. Values for water content varied from 73,45% (K-group) to 73,92% (O-III group), for protein content from 23,98%(O-III group) to 24,54(K- group), for content of fat 0,69% (O-III group), to 0,90%(K- group), and for content of mineral matters from1,13 (O-I group) to 1,19 (O-III group).

Table 8. Chemical composition of breast musculature

Group	Chemical composition			
	Water	Protein	Fat	Ashes
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

Studying data obtained by chemical analysis of breast musculature it can be concluded that addition of organic and inorganic chromium to broiler mixtures had no effect on contents of water, protein and mineral matters in white meat. Content of fat was the lowest in chickens of group fed diets containing 400 ppb of organic chromium which is in accordance with results obtained by *Motozonu et al.(1998)*. Tendency of decrease of fat in breast musculature when organic chromium is added into mixtures for broiler nutrition was also established in research by *Kim et al.,* 1996 and *Wane et al.,* 1999.

Conclusion

Based on trial results obtained in regard to effect of different sources (organic and inorganic) and levels (quantity) of chromium added to mixtures for nutrition of broilers on breast angle, yield and share of breasts, yield and share of individual tissues in breast and chemical composition of meat, the following can be concluded:

Trial group of chickens fed concentrate mixtures containing organic chromium in quantity of 200ppb achieved best results in regard to breast angle, yield and share of breast, share of muscle and fat tissue in breast

In trial group of chickens fed concentrate mixtures containing organic chromium in quantity of 400ppb positive effect on breast angle can be registered, but addition of inorganic chromium had no effect on quantitative and qualitative traits of broiler breast musculature.

Positive effects established in this research when organic chromium in quantity of 200 ppb was added can be of importance to production of poultry meat.

UTICAJ RAZLIČITIH IZVORA I NIVOA HROMA U OBROKU NA GRUDNU MUSKULATURU BROJLERA

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Rezime

Cilj rada je da utvrdi da li dodavanje hroma različitih oblika (organski ili neorganski) i nivoa (količina) u smeše za ishranu brojlera ima uticaja na kvantitativne i kvalitativne osobine grudne muskulature brojlera.

Ispitivanje je izvedeno na 840 pilića podeljenih u četiri grupe-tretmana. Razlika između grupa (tretmana) je u količinskom učešću hromnog preparata (200 i 400 ppb) i njihovom izvoru (organski ili

neorganski) u osnovnim smešama za ishranu pilića. Na kraju tova (42 dana) žrtvovano je 24 brojlera po tretmanu, a na obrađenim trupovima utvrđen je grudni ugao I prinos grudi, dok je disekcijom utvrđen prinos tkiva u grudima, a na uzorcima mišićnog tkiva grudi ispitan je hemijski sastav.

Analizom rezultata konstatovano je da je grupa pilića sa dodatkom organskog hroma u količini od 200 ppb u smeše za ishranu ostvarila signifikantno bolji rezultat za grudni ugao, prinos, udeo grudi, udeo mišićnog tkiva i udeo masti u grudima.

Na osnovu dobijenih rezultata može se zaključiti da je dodavanje organskog hroma u smeše za tov brojlera rezultiralo pozitivnim efektima kod praćenih klaničnih osobina, što svakako može imati značaja za proizvodnju živinskog mesa.

Ključne reči: Hrom, brojler, grudni ugao, udeo grudi, udeo tkiva

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