ISSN (Print) : 0974-6846
Indian Journal of Science and Technology, Vol 8(28), DOI: 10.17485/ijst/2015/v8i28/82778, October 2015 ISSN (Online) : 0974-5645

The Effects of Different Sources of Organic and Inorganic Chromium on Blood Parameters of Broiler Chickens

M. Molavi Kani*

Department Animal Science, Islamic Azad University, Sanandaj Branch, Sanandaj, Iran; Majedbahar90@gmail.com

Abstract

This work has been carried out in order to study the effects of using different resources of organic and inorganic Chrome on production performance of broilers. 200 broilers, in a completely random plan, were allocated with five treatments and four repetitions with ten chickens per repetition within a period of six weeks. The respective supplements were used in treatments for Zero levels (control) (T1, 200 micrograms of Chloride Chrome per kg of feed (T2) and 200 micrograms of (Chrome Yeast) per kg as feed (T5). The blood parameters were measured on the 21st and 42nd days respectively. Use of Chrome supplement has caused a significant increase of level of blood VLDL ($p<0.01$). Chrome supplement in the 21st and 42nd days has had a significant increase of level of triglyceride ($p<0.05$). Organic Chrome supplement in the 21st and 42nd days has caused a significant increase of level of total cholesterol and Chrome resources has caused a significant decrease of level of total cholesterol ($p<0.01$). Chrome supplement has caused a significant increase in level of HDL ($p<0.01$). Using organic Chrome supplement in the 21st and 42nd days has caused a significant increase of level of serum LDL and organic Chrome has caused a significant decrease in serum LDL ($p<0.01$).

Keywords: Blood Metabolites, Broilers, Mineral Chrome, Organic Chrome

1. Introduction

Mineral in the nutrition of plant and animal are important and enough amounts for maintenance, growth, production and reproduction of animals is necessary. Minerals have different tasks and essential in the body, which in general include catalytic and physiological functions, and in particular affecting their reproduction. One of the most important factors in relation to minerals nutrition and needs is balance of different minerals. Because many elements interact with each other increase or decrease to attract and influence on other elements. Thus, on the metabolism and absorption of each have bilateral and complex effects. For example, the interaction of the elements copper, molybdenum, iron and sulfur on metabolism, reproduction and production in feeding ruminant is amazing (100).

Awareness of the role of micronutrients in poultry breeding is one of the issues for farmers, veterinarians and other investigators. Intake and absorption of micronutrients necessary for proper metabolic actions, including immune responses to pathogens, reproduction and growth, is essential. Because the symptoms are acute shortages of subclinical or simply are not evident, the diagnosis is difficult, in the event of such circumstances (lack of subclinical); animal suffered a subtle and gradual loss. Reduce the consumption of micronutrients in the trap decreases the safety and activity of enzymes and decline the growth and in fertility and in case of shortage of clinical symptoms in cattle and sheep occurred (100).

In the last decade indicated that Trivalent chromium for normal metabolism of carbohydrates, proteins and lipids in humans and animals is essential (Pchva and Pavlt, 2004) and also involved in the formation and expression of genetic information in the animal. Trivalent chromium in organic and inorganic forms in feeding different animal and such as broiler chickens is used. Mineral form of the element (chloride chrome, chromium oxide), very little is absorbed and the absorption rate is 0.4–2 per cent, while

*Author for correspondence

the bioavailability of organic chromium 10 times longer than mineral chromium (Lokasky, 1999).

Organic compounds such as nicotine chromium, chromium picolinate, chromium methionine chromium yeast chromium noted. However, the chromium chloride is most important of mineral form of the element used as a dietary supplement (Habibiaan Shalamzari 2011). Hexavalent chromium (Cr^{+6}) the second form of chromium in terms of stability, this form of chromium passes easily through biological membranes and the combination of proteins and nucleic acids inside the cell reacts to when the Cr^{+3} deoxygenated. The reaction with the genetic material is carcinogenic properties Cr^{+6} (70).

Chromium in the metabolism of carbohydrates, lipids, proteins, nucleic acids and minerals play a role. In stress of glucose metabolism and insulin by secretion an increase hormone cortisol and other regulated hormones increases glucose in the blood. Cortisol acts as an antagonist with insulin because prevent entered the glucose into peripheral tissues (such as muscle and fat tissue) tissue needs with high needs (such as the brain and liver) provided. This increase in blood glucose and insulin, which is a result of the displacement of chromium from physical stores (68) as a result, chrome is not reusable and is rapidly excreted in the urine.

Anderson (7) clinical symptoms of chromium deficiency are expressed as follows: it cause starvation hyperglycaemia, decreased glucose tolerance, increased insulin circulating in the blood, glycosoaminoglycans, increased cholesterol and triglycerides in the blood, reducing insulin bound and reducing the number of insulin receptors. The researchers reported that chromium deficiency causes, slow growth, reduced productive life, infertility and local neurological disorders. Metabolic profile of chromium deficiency is similar to Type 1 diabetes mellitus.

Sahin et al.[9,10] reported the use of chromium supplementation in broilers chickens under heat stress increases the concentration of vitamins C and E in serum and malondialdehyde (MDA) is reduced. Several studies have suggested that at least the amount of chromium for normal metabolism of lipids and thermogenesis is necessary, for example, has been reported in rats and rabbits that their diet contains low levels of chromium, the higher the concentration of serum cholesterol and increase platelet formation (51).

Using 200 kg/μg supplement the form $CrCl_3$, in humans and increase HDL and chromium concentration in serum (51). Also Uyanik et al. (104), observed that the 400 kg/μg, mineral chromium in the diet of animals reduces total cholesterol, LDL and total protein but increase HDL levels.

2. Materials and Methods

To study the effect of different sources of food chromium supplements in both form of organic (chromium methionine, chromium picolinate, chromium yeast) and minerals (chromium chloride) on the blood parameters of broiler chickens Ross 308, in a 42–day growing period, 200 male one-day chicks in groups of 10 chicks were weighing and randomly assign into testing units. The chickens were randomly divided into 5 experiment groups with 4 replicates and 10 chickens in each repetition were divided.

Light sources were provided by 5 rows of light bulb 60 watt. During the first 5 days, lighting 24 hours were exposed. After 4 days on the exposure, every day for 15 minutes, there was darkness. During the experiment, two types of diets grow and the final in order to 21–0 and 42–21 days in broilers chicken diet were used. Diets based on standards recommended in the catalog top 308 were set.

In this experiment, the statistical model is as follows:

$$Y_{ij} = \mu + T_i + e_{ij}$$

In which Y_{ij} represent value of each observation in the test, μ mean observations, T_i represents supplement effect of chromium and e_{ij} is the impact of experiment error. The numerical value of each observation of totals the effects of treatment and experiment error and means total community will be achieved. Data were analyzed with SAS software and means were compared by Duncan's multiple range test.

Table 1. Experiment group related to growing period

Sample Group Ration	**Chrome Level in each Period Grow (0–21 Day)**	**Final (21–42 Day)**
T1	0	0
T2	200 micro grams (Chloride chrome)	200 micro grams (chloride chrome)
T3	200 micro grams (Methionine chrome)	200 micro grams (Methionine chrome)
T4	200 micro grams (Picolinate chrome)	200 micro grams (Picolinate chrome)
T5	200 micro grams (Yeast chrome)	200 micro grams (Yeast chrome)

Table 2. Diets used in different periods

0–21 Day					
T5	**T4**	**T3**	**T2**	**T1**	**Ration**
54.93	54.93	54.93	54.93	54.93	Corn
37.90	37.90	37.90	37.90	37.90	Soya
3.39	3.39	3.39	3.39	3.39	Fat
2.18	2.18	2.18	2.18	2.18	Bone meal
0.29	0.29	0.29	0.29	0.29	Bone shell
0.47	0.47	0.47	0.47	0.47	Salt
0.25	0.25	0.25	0.25	0.25	Mineral supplements
0.25	0.25	0.25	0.25	0.25	Vitamin supplements
0.13	0.13	0.13	0.13	0.34	DL-Methionine
0	0	0	2000mg	0	Chromium chloride supplements
0	0	2000mg	0	0	Chromium methionine supplements
0	2000mg	0	0	0	Chromium picolinate supplements
2000mg	0	0	0	0	Chromium yeast supplements
					Dietary compounds
3000	3000	3000	3000	3000	Metabolic energy (kcal/kg)
20.95	20.95	20.95	20.95	20.95	Crude protein (%)
0.88	0.88	0.88	0.88	0.88	Calcium (%)
0.43	0.43	0.43	0.43	0.43	Available phosphorus (%)
0.21	0.21	0.21	0.21	0.21	Sodium (%)
1.26	1.26	1.26	1.26	1.26	Lysine (%)
0.86	0.86	0.86	0.86	0.86	Threonine (%)
0.99	0.99	0.99	0.99	0.99	Methionine + cysteine (%)
0.28	0.28	0.28	0.28	0.28	Tryptophan (%)

21–42 Day					
T5	**T4**	**T3**	**T2**	**T1**	**Ration**
56.75	56.75	56.75	56.75	56.75	Corn
36.71	36.71	36.71	36.71	36.71	Soya
3.05	3.05	3.05	3.05	3.05	Fat
1.87	1.87	1.87	1.87	1.87	Bone meal
0.33	0.33	0.33	0.33	0.33	Bone shell
0.42	0.42	0.42	0.42	0.42	Salt
0.25	0.25	0.25	0.25	0.25	Mineral supplements
0.25	0.25	0.25	0.25	0.25	Vitamin supplements
0.38	0.38	0.38	0.38	0.38	DL-Methionine
0	0	0	2000mg	0	Chromium chloride supplements
0	0	2000mg	0	0	Chromium methionine supplements
0	2000mg	0	0	0	Chromium picolinate supplements
2000mg	0	0	0	0	Chromium yeast supplements
					Dietary compounds
3000	3000	3000	3000	3000	Metabolic energy (kcal/kg)
20.64	20.64	20.64	20.64	20.64	Crude protein (%)
0.80	0.80	0.80	0.80	0.80	Calcium (%)
0.39	0.39	0.39	0.39	0.39	Available phosphorus (%)
0.19	0.19	0.19	0.19	0.19	Sodium (%)
1.23	1.23	1.23	1.23	1.23	Lysine (%)
0.85	0.85	0.85	0.85	0.85	Threonine (%)
0.85	0.85	0.85	0.85	0.85	Methionine + cysteine (%)
0.28	0.28	0.28	0.28	0.28	Tryptophan (%)

3. Conclusion

Effects of chromium supplementation on hematocrit, hemoglobin and VLDL

The effects of different sources of chromium on hematocrit, hemoglobin and VLDL are shown separately in Table 3.

Chromium supplements in the organic form had no significant effect on daily weight gain chickens (P>0.05). But the effects of mineral chromium supplementation on average daily weight gain in the final period and total growing period, causing a significant reduction in daily weight gain, while the weight of the chickens in the total experimental period using chromium supplementation increased. Lowest daily weight gain related to chromium chloride (62.03 g/d) gram and the greatest increase is for chromium yeast (75.65 g/d) gram. Average daily weight gain in the first three weeks of breeding between experimental groups, did not show significant differences (P>0.05).

Experiment treatments have no significant effect on hematocrit, but treatments tend to have a number reduction, the highest percentage related to chromium yeast (36.l67 mg/d) and the lowest percentage was related to the treatment of chromium methionine. Chromium supplements have no significant effect on hemoglobin, but decrease in chrome methionine and in other treatments has a slight increase. The highest effect related to chromium picolinate (12.29) and the least effect related to chromium methionine (4.11). However, methionine chromium and chromium picolinate, treatments have been significant over ach other. The impact of experiment treatments on VLDL was significant and all treatments compared to control group decrease significantly. The highest effect of the control group was (15.14 mg/dl) and the least effect of chromium methionine (9.25 mg/dl).

Table 3. The impact of the experimental groups on the level of hematocrit, hemoglobin and VLDL in 42 days old.

VLDL (mg/dl)	Hemoglobin (g/dl)	Hematocrit (%)	
15.14^{a}	11.44^{ab}	35.67	T1
10.07^{b}	11.58^{bb}	35.17	T2
9.25^{b}	11.04^{b}	33.84	T3
10.50^{b}	12.29^{a}	36.17	T4
9.88^{b}	11.84^{ab}	36.67	T5
0.0100	0.0768	0.7088	P-Value
0.971	0.276	1.476	SEM

Different letters in each column indicate significant differences at the level of 5%

3.1 Effects of Chromium Supplementation on Serum Cholesterol and Triglyceride

In this experiment, oxygen released from cholesterol with the enzyme cholesterol oxidase with by 4-amino and phenolic anti Perin and phenol in the presence of peroxidase enzymes formed quinonimine as photometry at a wavelength of 546 nm is measurable. The quinonimine released as a direct relationship with serum cholesterol and to measure triglycerides first glycerol using the enzyme lipoprotein lipase separated from fatty acids, then hydrogen peroxide released from glycerol with 4-amino anti Perin and phenol in the presence of peroxidase enzyme formed quinonimine. Quinonimine formed which can be measured by photometric directly related to the amount of triglycerides.

In this study, using of chromium supplementation in chicken 21 day old significantly increased level of serum triglyceride (0.05>P), at 21 days old, the lowest value in the control treatment (43.83 mg/dl) the maximum amount of chromium yeast treatment (50.62 mg/dl), while has no significant effect in 42 days.

At 42 days, the highest level related to chromium picolinate group 52.90 mg/dl and the lowest level 41.28 mg/dl related to control group. Chromium supplementation on

Table 4. Impact of experimental groups on triglyceride and total cholesterol levels in 21 and 42 days

Triglyceride(mg/dl)		Total cholesterol(mg/dl)		
42 Days old	21 Days old	42 Days old	21 Days old	
121.14	135.01^{d}	41.28	43.83^{d}	T1
104.22	123.70^{e}	52.6	49.18^{c}	T2
180.00	185.64^{a}	46.52	48.9^{c}	T3
140.17	154.83^{C}	52.90	49.77^{b}	T4
171.58	177.82^{b}	49.80	50.26^{a}	T5
0.1479	<0.0001	0.7832	<0.0001	P-Value
0.032	0.254	7.212	0.093	SEM

Different letters in each column indicate significant differences at the level of 5%

serum total cholesterol chickens at the age of 42 days had no significant effects (0.05<P). At 42 days, the highest level related to control group on the amount of 00.163 Mg/dl and the lowest level 138.5 mg/dl related to group ppb1200 chromium methionine. The results are not consistent with Krolik Zoiska et al (51), in the broiler chickens. However, the results are consistent with Chen and Koliagoys (22) in the turkeys. Chromium supplementation on serum total cholesterol in chickens 21 days old had a significant impact (0.05>P) (Table 6–4), as the inorganic form of chromium chloride (123.70 mg/dl), and organic forms significantly increased total cholesterol, the maximum amount related to chromium methionine (185.64 mg/dl), respectively. Although it was expected due to the effect of chromium fat burning, cholesterol and triglyceride levels reduced. This result in the current study is likely due to incomplete intestinal tract of poultry and proper use of chromium supplements during growth.

Reducing the amount of fat by chromium chloride, can interpreted through influence chromium supplementation on changing the way energy from fat tissue into muscle or fat shift.

3.2 Effects of Chromium Supplementation on HDL and LDL

In this way, antibodies against lipoproteins VLDL, LDL and blocked chylomicron and just HDL concentrations - cholesterol were determined exclusively by measuring enzymatic cholesterol. First of all lipoprotein other than LDL includes HDL, VLDL and chylomicron are removed just LDL concentration - cholesterol levels are specific using enzymatic color-generating reaction calculated.

As seen in Table 5 of chromium supplementation on serum HDL levels at 21 days old had a significant impact (0.05>P) and has been significantly increased. The highest level (72.26 mg/dl) related to the treatment of chromium methionine and the lowest level (45.05 mg/dl) for the control group. At the age of 42 days had no significant effect on HDL cholesterol levels (0.05<P), however, the mean HDL in 42 days between the experimental groups was not statistically different in the supplements showed a tendency to increase and the highest level 74.35 mg/dl and the lowest was observed in the treatment of chromium chloride 29.97 mg/dl relating to the control group of chromium.

The results are not consistent with Uyanik et al (104) in lambs and Krolik Zoiska et al. (51) in broiler chickens.

Table 5. Effects of experimental groups on HDL and LDL on 21 and 42 days

HDL (mg/dl)		LDL (mg/dl)		
42 Days old	21 Days old	42 Days old	21 Days old	
29.97c^{d}	30.39^{d}	29.97	45.05^{e}	T1
24.91^{d}	29.96^{d}	74.35	64.22^{c}	T2
62.18^{a}	52.66^{c}	48.05	72.26^{a}	T3
32.33^{c}	75.50^{a}	66.36	52.32^{d}	T4
42.40^{b}	65.47^{b}	49.28	67.54^{b}	T5
0.1505	<0.0001		<0.0001	P-Value
1.207	0.007	12.01	0.293	SEM

Different letters in each column indicate significant differences at the level of 5%

Chromium supplements in organic form at the age of 21 days was significantly increased serum LDL levels in chickens (0.01>P), but had no significant impact on the mineral form. At 21 days old the highest level (75.50 mg/dl) related to chromium picolinate group and the lowest level (29.96 mg/dl) related to chromium chloride treatment.

Different sources of organic chromium supplementation at chicks 42 days old had a significant impact on serum LDL (0.05>P), but there was no significant effect on inorganic chromium (0.05<P), but with organic and inorganic treatment has a significant impact. The highest level (62.18 mg/dl) related to the chromium-methionine and the lowest level (mg/dl 29.97) related to control group. The results are not consistent with Uyanik et al. (104) in lambs and Krolik Zoiska et al. (51) in broiler chickens, Kim et al (49) in laying hens, Chen and Koliagoys (22), in Turkey and Krolik Zoiska et al., (50) in broilers chicken. In contrast the results is not consistent with Uyanik et al. (103) and Kopo and Dnaldson (23), they reported that chromium supplementation has no effect on serum cholesterol levels in the broiler chickens.

A very simple explanation for the effects of chromium Hypo lipidemic associated with an increase in glucose tolerance and reduces in lipolysis. Many studies show positive effects of chromium on lipid metabolism and reduce the risk of atherosclerosis have been cleared. Chromium increases the efficiency of insulin, insulin reduced concentration of ketone bodies in the blood are associated with in three ways: (1) reduction of lipolysis that reduce the supply of NEFA to the liver 2. Decrease in liver Chetozhenziz 3 facilitating the use of ketone bodies (17).

3.3 Effects of Chromium Supplementation on Blood Glucose Levels

Oxygen is released from the glucose with oxidase glucose enzyme with 4-amino anti Perin and phenol in the presence of peroxidase enzyme formed quinonimine by photometry method at 546 nm wavelength is measurable. The quinonimine released has direct relation with serum glucose levels. The accuracy of glucose measurement is less than an hour after the blood to prevent glycolysis, is separated from the blood serum. As can be seen in Table 6 chromium supplementation in 21 days (0.05>P) and 42 days (0.05>P) (0.01>P) significantly reduced serum glucose levels in chickens.

Chromium in the diet may be necessary to maintain the sensitivity of normal pancreatic beta cells to glucose, or insulin production. These in rats have shown that chromium to maintain normal sensitivity of insulin-secreting beta cells to prevent high secretion of the pancreas is needed (93). In this study, insulin concentration levels rise, while cortisol decreased. This is a common metabolic relationship between insulin as an anabolic hormone; cortisol is a catabolic hormone, which has opposite effects on metabolism. In our study, insulin levels increased with increasing levels of chromium in the diet, which demonstrates the physiological role of chromium in improving insulin. In this study, chromium supplementation resulted in increased serum insulin levels in laying hens, which were stored at low temperature and reduced concentration of corticosterone. Chromium is a cofactor for insulin and for normal use of glucose and animal growth is necessary (83).

Chromium is essential for normal metabolism of glucose and is one of the components Glucose Tolerance Factor (GTF), that through insulin enter glucose into cells and produce energy. Insulin regulates the metabolism of carbohydrates, proteins, and use of glucose (83). By comparing the results with previous studies and the availability of lower mineral chromium is suggested that higher levels of it is used. Also, due to the better effects of organic and inorganic chromium supplementation resources in lowering blood glucose and the prevention of diabetes mellitus in the study, in the growth phase, the researchers suggested that, in humans, and high levels of chromium are examined.

Table 6. The effect of the experimental groups on the level of blood glucose at the age of 21 and 42 days.

glucose (mg/dl)		
42 Days old	21 Days old	
170.73[a]	167.55[a]	T1
110.83[b]	107.34[e]	T2
119.12[b]	117.30[c]	T3
127.25[b]	124.62[b]	T4
112.36[b]	110.39[d]	T5
8.956	<0.0001	P-Value
0.0044	0.435	SEM

Different letters in each column indicate significant differences at the level of 5%

4. References

1. Anderson RA. Stress effects on chromium nutrition of humans and farm animals. In: Lyons P, Jacques KA, editors. Proceedings of Alltech's 10th Annual Symposium, Biotechnology in the Feed Industry. UK: Nottingham University Press; 1994. p. 267–74.
2. Brockman RP. Pancreatic and adrenal hormonal regulation of metabolism. In: Englewood Cliffs NJ, editor. Control of Digestion and Metabolism in Ruminants. Prentice-Hall. 1986; 450.
3. Chen KL, Lien TF, Lu JJ, Chiou PW. Effects of chromium nicotinate on performance, carcass characteristics and blood chemistry of growing turkeys. British Poultry Science. 2001; 7:399–404.
4. Сиро MA, Donaldson WE. Chromium and Vanadium Effects on Glucose Metabolism and Lipid Synthesis in the Chicken Poultry Science. 1987; 66(1):120–6.
5. Cusin I, Rohner-Jeanrenaud F. Hyperinsulinemia and its impact on obesity and insulin resistance. International Journal of Obesity. 1992; 16:51.
6. Kitchalong L, Fernandez JM, Bunting LD, Southern LL, Binder TD. Influence of chromium tripicolinate on glocose metabolism and nutrient partitioning in growing lambs. Journal of Animal Science. 1995 Sep; 73(9):2694–705.
7. Kroliczewska B, Zawadzki W, Skiba T, Miata D. Effects of Chromium Supplementation on Chicken Broiler Growth and Carcass Characteristics. ACTA Veternaria. BRNO 2005; 74:543–9.
8. Kroliczewska B, Zawadzki W, Dobrzanski Z, Kaczmarek-01iwa A. Changes in selected serum parameters of broiler chicken fed supplemental chromium. Journal of Animal Physiology and Animal Nutrition. 2004; 88:393–400.
9. Sahin K, Sahin N, Kucuk O. Effects of chromium and ascorbic acid supplementation on growth, carcass traits, serum metabolites, and antioxidant status of broiler chickens reared at a high ambient temperature (32oC). Nutrition Research. February 2003; 23(2):225– 38. doi: http://dx.doi.org/10.1016/S0271-5317(02)00513-4.

10. Sahin K, Ozbey O, Onderci M, Cikim G, Aysondu MH. Chromium supplementation can alleviate negative effects of heat stress on egg production, egg quality and some serum metabolitis of laying Japanese Quail. Journal Nutrition. 2002; 132(6):1265–8.
11. Striffler JS, Polansky MM, Anderson RA. Dietary chromium enhances insulin secretion in perfused rat pancreas. Journal of Trace Element Experiment and Medicine. 1993; 6:75.
12. Underwood EJ, Suttle NF. Minerals in animal nutrition. CABI Publishing, 3rd edition, New York. 1999; 598.
13. Uyanik F, Atasever A, Ozdamar S, Aydin F. Effects of dietary chromium chloride supplementation on performance, some serum parameters, and immune response in broilers. Biological Trace Element Research. 2002; 90(1-3):99–115.
14. Uyanik F. The effects of dietary chromium supplementation on some blood parameters in sheep. Biological Trace Element Research. 2001; 84(1):93–101.