

Effects of Chromium on meat and egg production in poultry-A review

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Abstract

In poultry, Chromium (Cr) is a vital micro-element and helps in the overall performance of the birds. The Cr plays an important role in egg formation and meat production. It helps in lipid, carbohydrate and protein metabolism. The Cr supplementation helps in better egg quality and albumin layers. The Cr also enhances the male reproductive system activity in terms of sperm motility and reduction of its deformities. The Cr plays key role in the fertility and hatchability of the eggs. The Cr has positive effect with ascorbic acid and carnitine and improved the consumption of different minerals but Cr has negative effect with the iron and copper. The Cr has the toxic effect on the fertility and hatchability, embryogenesis, irritation to the skin, toxic agent for the liver and also acts as a carcinogenic factor when added in the feed. So Cr in velogenic form III has the potential beneficial effects but in velogenic form VI has the harmful effects on the production performance and the life of the poultry.

Key words: Chromium, poultry, egg production, growth rate.

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Introduction

Chromium (Cr) is an essential micro element that plays an important role in nutrition of animal and human being [1]. The Cr in two different ways enhances the poultry production for example meat and egg production [2]. The Cr helps in the fat, carbohydrates and protein metabolism in animals. The Cr is also called as “Glucose Tolerance Factor” because helps in potentiation of insulin metabolism. Supplementation of Cr and ascorbic acid can improve the nitrogen, calcium, iron, zinc and phosphorus consumption [1]. The Cr stable form is the trivalent state (III) and Cr also help to decrease the cholesterol level of blood, blood plasma, muscle and egg yolk with addition of Cr in diet [3]. The Cr is essential trace element help in physiological and nutritional role [4]. The Cr also helps in excretion, less mortality rate and growth rate [5]. Environment stresses affect the performance of the poultry species but supplementation of the micro minerals such as Cr and manganese act as anti-stress factor [6]. The Cr affects the function of digestive enzyme [7]. The Cr toxicity depends on the oxidation state and in blood large portion of Cr III bind with protein molecule and less quantity bind with oligopeptide. Sources of Cr are the drinking water, air and through ingestion [8]. The Cr supplementation can reduce the negative effect of environmental stress and also reduced the heat stress during yolk formation. The Cr supplementation can reduce the negative effect of environmental stress and also reduced the heat stress during yolk formation [10]. The Cr did not affect carcass traits but it help in decline of average fat and increment in the muscling [11]. The Cr is very important organic trace mineral that enhances the nutritious impacts of poultry meat [11]. The Cr supplementation has not any effect on the body weight

gain and feed conversion ratio but have effect on the average daily feed intake [11]. The Cr in feed helps to improve the sperm number, activity and density of sperm and decline the defects of sperm [13]. The Cr deposition in the form of Cr VI (Cr VI) not only depressed hatchability but also have toxic effect on the liver [14]. The Cr helps to enhance the immune level and growth and it might be enhance, decline or have no effect on serum cholesterol level [16, 17]. The Cr supplementation in the diet along with copper not only enhances the growth process of different organs but also diminishes the side effects of each other [26]. The Cr deficiency impairs the glucose tolerance and cause the immuno-suppression in the body that may lead to the disease and even death [27]. The addition of the Cr in the feed of the poultry both in organic or inorganic form not only enhance the level of Cr and zinc in the serum but also decline the level of the copper in the serum [29].

The aim for this review is to analyze the effect of the Cr on the overall health in poultry especially its effect on the metabolism and growth of the broiler, sperm and egg production, fertility and hatchability determination, mineral retention, nutrient utilization. Its harmful form has also been reviewed in the form of Cr deposition on the tissues.

Effect of Cr on meat production

The Cr supplementation improved the weight gain and increased the live weight gain [4]. The Cr improve the carcass especially more breast muscle growth that the abdominal region in broiler [20]. The Cr does not affect the structure and function of intestinal tract [26]. The Cr has the good effects to strengthen the muscle mass and increase the growth process of the body [18]. When Cr yeast delivered to the broiler the weight gain

of the body and also this leads to less accumulation of fat on breast region and decline the mortality rate. Broiler having deficiency of Cr those reared in the corn soya bean meal but for the performance improvement and good carcass broiler should be delivering the Cr containing diet. Organic Cr is preferable than inorganic Cr and Cr enhances the growth performance in the broiler [11]. In broiler, the use of the Cr causes the improvement in the activity of blastocyst formation and has the immunity against the Newcastle disease along with positive effect on the overall growth of the broiler [33]. Organic Cr nutrition has positive effect on the breast angle, breast yield and improves the meat production but inorganic Cr has not any effect on the production of the meat [2]. The Cr affects the muscle fat and cholesterol content but there will be no effect on the protein level in the breast muscle when added in the feeding material of the broiler [15]. The Cr supplementation in the diet of the broiler has not any impact on their weight, feed conversion ratio and intake of their feed [29]. The Cr supplementation in the diet not only enhances the muscle mass but also act as an immune stimulating agent in the broiler [26].

Effect of Cr on egg production

The Cr helped to improve the haugh unit, albumin quality and yolk index [1]. Cr supplementation on feed intake has not any effect but improved the performance in term of egg production, broken egg, egg weight and egg mass [5]. The Cr slightly reduced the egg shell thickness, egg weight along with strength of egg [3]. The Cr nano-particles help to antagonize the effect of different mineral utilization and for improvement of animal performance [1]. The Cr supplementation helps to protect the Cadmium antagonistic effect and provide protection against cadmium absorption and with more exposure of radiation can be protected by the Cr supplementation. The Cr supplementation not only enhances the egg production but also enhance the products that are animal origin and important for human nutrition [3]. Trace element present in egg and helps to carry out the embryonic development normally and mostly trace mineral deposition occur in liver [19]. At high environmental temperature in the broiler The Cr helps to decline in death rate [20]. The Cr and manganese supplementation help to improve the lipids considerations [6]. The Cr along vitamin C at low temperature helps in the digestion and both have effect on the brain and bones [21]. The Cr supplementation enhanced the action of anabolic hormones [23]. Some metals are the basic components of an enzyme and these enzymes are the important for crucial activities of the life such as respiration. Enzymes that containing the metals are called as the metalloenzymes or metal enzymes and are important for the synthesizing, repairing, releasing and recognizing the signal of the biological molecules [18]. The microflora in the gastro

intestinal tract having crucial role in the clearing of the toxic effect of heavy metals such as Cr VI and removal of unsafe metal from the body [18]. Toxic effects of Cr VI can be eliminated by efficient working of intestine along with efficient working micro flora and enzymes [18]. Stress improved the mobility of the minerals such as the Cr, that enhances the excretion from the tissue and stop the formation of ascorbic acid [21]. The Cr supplementation along with L-Carnitine in the diet not only improves the growth rate but also improves the feed conversion ratio in the fishes [28].

At low temperature Cr improve the egg production, egg weight, efficiency of feed along with specific gravity of egg [1]. The Cr supplementation improves the weight of egg without affecting the quality of the egg [13]. Heat stress decreased the production of egg performance so for this Cr is added in feed for the improvement of the egg production [6]. The Cr picolinate supplementation in the diet not only enhances the egg production but also improve the feed conversion ratio [1]. The feed that containing Cr delivered to birds having more egg laying ability and utility of the dose of the Cr determined the egg production in the layers [14]. The Cr supplementation in feed not only improves the egg production but also enhances the weight of the egg [23]. The production of poultry was decreased when there is deficiency of the trace minerals in the feed such as Cr and mostly affect in term of egg production [19].

The Cr not only improves the quality of egg yolk but also improve structural protein of egg that is albumin, maintaining the ovomucin and helps in the transferal of cation into the albumin [20]. Egg quality and egg size improved with Cr supplementation in diet [1]. The Cr antagonizes the dangerous effect of the vanadium that affects the internal egg quality [20]. For the optimum production performance minerals are very important and organic and inorganic minerals use having not any good impact on the broiler breeder egg production and the quality of the eggs [26]. Egg quality determination factors improved by the Cr supplementation in the feed of poultry and improvement in term of the albumen index and haugh unit and having no effect on the thickness of egg shell, yolk weight, albumin ratio and egg yolk ratio. The Cr supplementation does not affect the minerals content of the yolk and composition of the egg shell but Cr also deposit in the egg [1]. The Cr supplementation not only enhances the egg weight but also have important impact on the egg quality parameters in term of the egg shell and strength of egg breakage etc [23].

Fertility alters due to poor condition in term of management and poor performance of male in a flock to produce defective sperms [20]. For the production of the viable sperm when the ratio of the male and female is not balance then supplementation of Cr yeast in poultry feed not only improve the concentration of the

sperm, activity of the sperms and also improve the density of the sperm [13]. The Cr addition in diet helpful for normal concentration of sperm, normal motility of sperm and protect from deformities of sperm [20]. When Cr VI is exposed to the man then the level of follicle stimulating hormone will be raised in the serum but it will cause decline in the concentration of the sperm and also its motility [32]. Fertility among the breed variable and Cr methionine enhanced the fertility of the eggs. Egg fertility and hatching chick weight can be improved by supplementation of the Cr yeast in the diet of the Japanese quail [13]. Fertility and hatchability improved by supplementation of organic and inorganic minerals [24]. The rate of fertility of those birds which were delivered Cr containing feed was raised and dose of the Cr also matter a lot. The Cr feed supplementation has effect on both the male and female fertility. If Cr containing feed just delivered to female but not to the male, then female mature earlier than the male and female able to fertilize but male are not able to fertilize at that time [14]. Hatchability is affected by the egg shape index, egg weight and egg shell thickness. There is an inverse relationship between the hatchability and the Cr supplemented feed. When Cr containing feed delivered to the bird the hatchability reduced that may be due to the toxic impacts of the Cr in term of the developmental deformities and it could be due to the hard egg shell [14].

Chromium as a toxic agent

Toxic effects of Cr (VI) are on birds are the early aging process, hatching ability markedly down and toxic effect also on the liver [14]. The Cr is not involved in skin infection but also causes the defect in the nasal septum, and cause irritation of the nose. Cr also having dangerous effects on the fetus that may leads to the malformation or fetal death and also leads to the neural deformities [18]. Cr acts as a carcinogenic metal and having the unsafe effect on the body [14]. Cr (VI) has the damaging effects on the DNA and lead to the mutation. Cr (VI) metal play important role in the toxic effect of gene and on the immunity and function of gastro intestinal micro flora can be change due to the too much quantity of Cr exposed to the animals [18]. Cr has the lethal effects on embryo and causes the defects in the development process play important role in the abnormal growth and early chick mortality. Heavy metals also cause the infection of eyes, visceral organ and skin along with markedly decreased in the body size in the chicken and Cr (VI) has the negative effect on the chick growth and development and more exposure of the Cr (VI) in the feed containing this cause the unsafe and harmful effect on the overall performance of the body [14]. Toxicity can be developed when there will be the excess amount of trace mineral added in the feed of the poultry that may

lead to decrease the production parameters such as egg production and defective embryo development along with toxicities [19].

Conclusions

Poultry in one of the fastest growing industries for human feed and its consumption is increasing day by day. However, its demand is accompanied with number of challenges. Therefore, researchers are paying key attention to increase its production by nutrients and decreasing disease burden through medicine or through vaccination [34-48]. The Cr III is in that type of the element having not or less side effects. The Cr supplementation improves the poultry production. The Cr supplementation in both organic and inorganic form has beneficial effect on the production performance and reproductive performance of the poultry. The Cr also helps in the mineral retention such as copper, zinc and iron etc. Cr helps the farmer to protect the flock from different type of the diseases and even decreased the death rate. Cr VI has the toxic effect on the body of the poultry and other animals and also decreased the production by causing disease and even death. The Cr in the form of the Cr III is good for the poultry diet but should not use Cr VI in the diet of the poultry. Further studies should be carried about the deficiency of the Cr and mechanism of action of the Cr as immune stimulating agent.

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