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Full Length Research Paper

Effects of adding aluminum sulfate to different litters on selected trace elements and vitamins concentrations in broiler

Mehmet Fatih Çelen[1]*, Suleyman Kozat[2], Suat Ekin[3], İbrahim Hakki Yörük[3] and Emine Alkiş[1]

[1]Animal Science Department, Agriculture Faculty, Yuzuncu Yil University, 65300 Van, Turkey.
[2]Ozalp Vocational High School, Yuzuncu Yil University, 65800 Ozalp/Van, Turkey.
[3]Biochemical Department, Faculty of Arts and Sciences, Yuzuncu Yil University, 65300 Van, Turkey.

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The objective of this study was to determine the effects of adding aluminum sulfate to different litters on blood plasma concentrations of some principal microelements and some vitamins in broilers. In this experiment, 645 day old Ross 308 broiler chicks were randomly divided into 4 litter group (straw, sawdust, alum treated-straw and alum treated-sawdust). At the end of the experiment 10 birds (5 male + 5 female) from each of the groups were slaughtered by severing the jugular vein and sampled by taking the blood. Blood plasma concentrations of vitamin A (retinol), vitamin E (α-tocoferol), Co, Zn and Cu were determined. Body weight measured at 6 week of age. Blood plasma Zn, Cu concentrations did not differ significantly ($P < 0.05$) among treatments, but the broilers reared in the control straw group showed lower Co concentration. The vitamin A and E levels in the serum of the broilers in the straw and saw dust groups were slightly lower than the other groups. The body weight of female in the alum treated groups at the end of the experiment was significantly higher than control groups. The body weight of male in the alum treated-sawdust group at the end of the experiment was significantly higher than the other groups. It could be concluded that amending aluminum sulfate to different litters adversely affected blood plasma concentrations and body weight of broiler.

Key words: Litter, aluminum sulfate, broiler, trace element, vitamin.

INTRODUCTION

Ammonia (NH_3) concentration in a commercial poultry house is a major airborne contaminant. Researches suggested that 25 ppm of ammonia should not be exceeded in a poultry house (Chesters and Arthur, 1988; Kristensen and Wathes, 2000; Reynolds and Judd, 1984; Underwood and Suttle, 2001). Also, high concentrations of ammonia in poultry house can affect chicken by reducing growth rate, feed efficiency, decrease egg production, damage the respiratory tract such as, clearance of *E. coli* from lungs and airsacs, and increasing airsacculitis, deciliation and increase susceptibility to Newcastle disease, levels of *Mycoplasma galliseptícu*, and incidence of keratoconjunctivitis (Tasistro et al., 2007b; Underwood and Suttle, 2001). All the same, there are several studies concerned with stress factors that are related to ambient temperature, mycotoxins and stocking densities in poultry production (Beker et al., 2004). The control of ammonia volatilization in poultry house has been studied (Blake and Hess, 2001; Elwinger and Svensson, 1996; Tasistro et al., 2007a). There are several litter amendments for ammonia volatilization control which have been used extensively by the poultry. They are applied prior to chick arrival and are critical in maintaining proper air quality during the brooding period when ventilation rates are the lowest in winter seasons (Blake and Hess, 2001; Shah et

*Corresponding author. E-mail: celen@yyu.edu.tr. Tel: +90432-2251120. Fax: +904322251123.

al., 2007; Tasistro et al., 2007b).

Litter quality is very important in broiler performance. Litter quality both directly and indirectly impacts bird respiratory health, microbe numbers and viability, ventilation needs, power usage and worker health (Hess et al., 2007). The quality of the in-house environment is highly dependent upon litter quality. The litter environment is ideal for bacterial proliferation and ammonia production (Ritz et al., 2005). Many products have been used as bedding materials. Sawdust is currently the most popular bedding materials. Regionally, straw can be favoured by poultry producers for litter when sawdust and pine shavings are becoming scarce and expensive.

Trace element deficiencies have been reported to occur in all the geographic regions and climatic zones of the world (Underwood and Suttle, 2001). It is known that particularly mineral and trace element deficiencies, caused by insufficient feeding led to growth-retardation (Radostits et al., 1995). Clinical disorders seen in trace element deficiencies include diarrhoea, anaemia, loss of hair, depigmentation, bone deformities, parakeratosis, lack of appetite, reduced fertility, retardation in the development of the foetus, loss of sperm quality, abortion unrelated to infections, and interruptions in protein synthesis (Chesters and Arthur, 1988; Kozat et al., 2007; Underwood and Suttle, 2001).

Vitamins are important for the normal physiological function of all organisms. Vitamin deficiency decreases resistance to various diseases and some conditions. There are many studies on the relationship between growth and vitamins (Mert et al., 2007).

The aim of the study was to investigate the alterations in plasma concentrations of Co, Zn, Cu, vitamin A, and vitamin E levels in broilers, reared on different litters treated with the aluminum sulfate.

MATERIALS AND METHODS

The study was carried out at the Animal Science Department Poultry Research Unit of the Yuzuncu Yil University. The poultry house was divided into 2 parts as control and treatment groups. Each part was separated by floor to ceiling partitions and had separate air exhaust/heating systems. In this study, 645 day old Ross 308 broiler chicks obtained from a commercial hatchery were randomly divided into 4 litter group (straw, sawdust, alum treated-straw, and alum treated-sawdust). Litter material was placed on the floor and spread to depth of 10 cm. Alum was added to the straw and sawdust litter at 0.091 kg/bird (Miles et al., 2003). Broilers in each group were weighed at the end of the experiment and 10 birds (5 male + 5 female) from each of the group were slaughtered by severing the jugular vein and sampled by taking the blood. Blood samples were centrifuged at 3000 x g 10 min and plasma stored frozen until assayed for vitamin A (Retinol), vitamin E (α-Tocoferol), Co, Zn and Cu. The plasma Co, Zn, and Cu concentrations were measured using a Solaar atomic absorpsion spectrophotometer (Thermo Electron Corporation, Solaar House, Cambridge UK). Vitamins A and E levels in the samples were determined by High performance liquid chromatography (HPLC) method (Reynolds and Judd, 1984; Miller and Yang, 1985).

Birds had *ad libitum* consumption of water and feed under continuous lighting. Starter, grower 1, grower 2, and finisher diets were fed from 1 - 11, 11 - 21, 21 - 35 and 35 - 42 days, respectively. All diet changes were conducted at the same time for all groups. The starter diet contained 23% protein and had an metabolizable energy (ME) value of 3023 kcal/kg; the grower 1 diet contained 22.25% protein with ME level of 3200 kcal/kg; the grower 2 diet contained 21.20% protein and had ME value of 3325 kcal/kg; the finisher diet contained 21% protein and with ME level of 3375 kcal/kg.

The results were analyzed by using one way ANOVA and Dunnet multiple comparisons was used to compare treatment means.

RESULTS AND DISCUSSION

The effects of the different litters with the aluminum sulfate compound, on the alterations in blood plasma concentrations of some trace elements (Co, Zn, and Cu), vitamins (Vitamin A, Vitamin E) and body weight (BW) at the end of experiment in broilers are summarized in Table 1. In this study, clinical findings such as keratoconjuctivitis and ascites (7% observed) developed on control groups.

Plasma levels of Zn and Cu were similar in all treatments. Co concentration in the control straw group was significantly lower than the other groups ($P < 0.01$). The vitamin A and E levels in the serum of the broilers in the control groups were slightly lower than the other groups. The body weights of female in the alum treated groups at the end of the experiment were significantly higher than control groups. The body weight of male in the Alum treated- sawdust group at the end of the experiment was significantly higher than the other groups.

Ammonia volatizitation is produced in poultry houses when uric acid in the urine and organic N in the feces and shed feed are converted to NH_4^+, a plant-available N form, by the microbes in the litter and feces. A portion of NH_4^+ depending on temperature, moisture content, and pH of the litter, may be converted into NH_3 (Elliot and Collins, 1982; Shah et al., 2007). Alum amendment resulted in a more acidic and slightly drier litter (Moore et al., 1999; Sims and Luka-McCafferty, 2002). Researchers have shown that increases in litter total N were probably due to the acidification of the litter by the alum, which in turn converted NH_3 to NH_4^+, probably forming $(NH_4)_2SO_4$ (ammonium sulfate) in the litters, and thus reduced gaseous losses of N (Moore et al., 1995; Moore et al., 1996). Alum dramatically reduces ammonia volatilization from the litter (Moore et al., 1995; Moore et al., 1996; Moore et al., 1999; Do et al., 2005; Moore and Edwards, 2007). In the above studies, alum reduced in-house NH_3 concentrations, and this likely improved bird performance. Atmospheric NH_3 in poultry facilities has been linked to damage respiratory tract lining, reduced resistance to respiratory diseases, and increased ascites. In this study, clinical findings in control groups are support

Table 1. Plasma concentrations of some trace elements and vitamins in broilers.

Trace elements and vitamins		Straw $\bar{X} \pm S_{\bar{X}}$	Sawdust $\bar{X} \pm S_{\bar{X}}$	Alum treated- straw $\bar{X} \pm S_{\bar{X}}$	Alum treated-sawdust $\bar{X} \pm S_{\bar{X}}$
Vit.A (µg/ml)		0.339 ± 0.016	0.352 ± 0.019	0.357 ± 0.016	0.357 ± 0.017
Vit.E (µg/ml)		3.285 ± 0.139	3.106 ± 0.184	3.398 ± 0.242	3.406 ± 0.223
Co (µg/ml)		0.012 ± 0.004[b]	0.016 ± 0.007[ab]	0.024 ± 0.004[ab]	0.032 ± 0.005[a]
Zn (µg/ml)		0.218 ± 0.011	0.234 ± 0.009	0.213 ± 0.021	0.218 ± 0.014
Cu (µg/ml)		0.027 ± 0.005	0.027 ± 0.005	0.026 ± 0.005	0.030 ± 0.006
Body weight after 42 day (g)	Female	2173.46 ± 40.45[b]	2183.43 ± 31.96[b]	2365.74 ± 28.56[a]	2383.27 ± 35.40[a]
	Male	2566.69 ± 36.03[b]	2503.43 ± 36.68[b]	2578.68 ± 40.14[b]	2675.46 ± 52.11[a]

[a,b] $P < 0.01$

previous findings (Chesters and Arthur, 1988; Kozat et al., 2007; Tasistro et al., 2007b; Underwood and Suttle, 2001).

It has also been reported that broiler weight gain when wheat straw was used was significantly lower than with wood shavings (Tasistro et al., 2007b). But in our study, blood plasma concentrations and body weight were not affected by choice of litter material.

Stoyanchev et al. (2005) observed that the levels of trace elements (Cu, Zn and Se) decreased in turkey-broilers with muscular dystrophy, more distinctly in stressed birds. Cobalt is a transition metal that is essential in the diet for ruminants as well as for monogastric animals (Kozat et al., 2007). Cobalt must be supplied in the diet of man and other monogastric species in its physiologically-active form, Cobalamin or vitamin B_{12} (Underwood, 1975). Vitamin B12 act as coenzyme in many enzymatic reactions, including some involved in hematopoiesis, and is essential for growth and normal neural function. Non-ruminant animals require dietary intake of cobalt in the physiologically active form of vitamin B_{12} (Underwood and Suttle, 2001). The addition of zinc, cobalt and manganese to the diet in the form of the triple basic salt (in pharmacological doses) increases the body weight gain in the treated chicks and compensates, to a certain degree, the loss of body weight caused by *A. galli* infection (Tsocheva-Gaytandzhieva et al., 2003). On the other hand, High dietary cobalt (500 parts/10^6) was able to induce ascites by causing polycythaemia and/or cardiomyopathy in broilers. The major effect of high dietary cobalt was a marked reduction in body weight and feed intake compared to birds fed the control diet (Diaz et al., 1994). In the study, Co concentration in the control straw group was significantly lower than the other groups ($P < 0.01$). High Co concentrations in the alum-treated sawdust and alum-treated straw group may be associated with reducing ammonia volatilization in the poultry house.

Characteristic clinical signs associated with vitamin A deficiency in chicks include ataxia, poor growth, and poor feather formation (National Research Council, 1984). In our study, Vitamin A and vitamin E concentrations in the control straw and control sawdust groups were significantly lower than the other groups. This level of vitamin A and vitamin E in the alum-treated sawdust and alum-treated straw group may be associated with reducing ammonia volatilization in the poultry house.

So far, in literature, there is no report related to effects of adding aluminium sulfate to different litters on blood plasma trace elements and vitamins of broiler despite several studies related to the effect of the other parameters on blood parameters of broiler.

Conclusion

Ammonia volatilization can be influenced by the application of alum. Increased body weight in alum treated groups resulted from low concentartion of ammonia in the poultry house, preventing respiratory disease. It could be speculated that it led to a reduced vitamin A, vitamin E and Co concentration in broilers exposed to the highest ammonia volatilisation.

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