EFFECT OF SOME MINERALS ON PERFORMANCE OF BROILER CHICKS

By

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B.Sc. Agric. Sc. (Poultry Production), Ain Shams University, 2003

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ABSTRACT

Islam Mohamed El-Sayed Hashish: Effect of Some Minerals on Performance of Broiler Chicks. Unpublished M.Sc. Dissertation, Department of Poultry Production, Faculty of Agriculture, Ain Shams University, 2010.

Two experiments were used in this study to investigate the effect of different levels of copper or zinc on growth performance, carcass characteristics, tibia measurements and blood constituents of broiler chicks.

Five hundred and four Ross chicks, one day old were used in these experiments. The chicks were allocated randomly into 24 pens (21 chicks / pen). Each pen was considered as experimental replicate which were assigned to 8 treatments with three replicates each.

Basal starter, grower and finisher diets were formulated to meet the nutrient requirements according to the nutritional recommendation of **NRC (1994)** and considered as a common control diets for both experiments. The diets were supplemented with one level of either copper as copper sulfate (100, 200 or 300 mg/Kg diets) or zinc as zinc oxide (250, 500, 750, 1000 mg/ kg diets). The experimental period was 35 days.

The results of the first experimental indicated that, copper supplementation from 100 to 300 mg/kg of broiler diet had a significant positive effect for body weight gain and feed conversion ratio for overall period compared with control group. But there were no significant differences between those two levels on the same two measurements; hence it could be used 100 mg/kg broiler diet for obtaining the best productive performance under concerned experimental conditions.

There were no significant negative effects for control, 100 and 300 mg Cu / kg broiler diet on carcass characteristics, liver function or kidney function of broiler chicks. It was noted that there were a significant reduction in tibial Ca and P at 300 mg Cu /kg broiler diet compared with control, 100 and 200 mg Cu / kg broiler diet groups, this level exhibited a significant lower plasma cholesterol level of treated chicks compared with control group.

The results of the second experiment showed that, there were no significant differences between all experimental groups for body weight gain and feed conversion ratio of broiler chicks, but the 500 mg Zn / kg diet showed the higher body weight gain compared with control group (1906 gm vs. 1775 gm for control group) and feed conversion ratio (1.57 vs. 1.78 for control group).

There was insignificant negative effect between all experimental groups for carcass characteristics except for spleen weight which showed the higher value under high Zn levels (750 and 1000 mg/kg diet levels) compared with control group. Also, neither liver function nor kidney function did significantly affected by experimental treatments.

It showed that a gradual significant increase in tibial Zn content with increasing of dietary Zn of broiler chicks. High dietary Zn levels (750 and 1000 mg/kg diet) showed a significant lower cholesterol plasma concentration of broiler chicks. Hence, the productive performance of chicks didn’t significantly affect till 500 mg Zn / kg diet level.

All experimental Zn treatments (from 250 till 1000 mg Zn /kg diet) showed significant lower plasma triglyceride compared with control group.

It could be concluded from the obtained results that copper sulfate and zinc oxide can be added to broiler diets effectively under the condition of this study without any adverse effects on growth performance, carcass traits, tibia mineralization and blood constituents.

Keywords: broiler, copper, zinc, performance, carcass traits, tibia measurements and mineralization.

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LIST OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

BWG	Body Weight Gain
CF	Crude Fiber
CP	Crude Protein
Cu	Copper
dl	deciliter
DM	Dry Matter
EE	Ether Extract
FCR	Feed Conversion Ratio
FI	Feed Intake
GOT	Glutamate-Oxaloacetic Transaminase
GPT	Glutamate-Pyruvic Transaminase
IU	International Unit
Kcal	Kilocalorie
Kg	Kilogram
LBW	Live Body Weight
mg	Milligram
MR	Mortality Rate
NFE	Nitrogen Free Extract
OM	Organic Matter
r.p.m.	Revolution Per Minute
SBM	Soybean Meal
Zn	Zinc

1. INTRODUCTION

The National Research Council (**NRC, 1994**) suggested requirements of most known nutrients for broilers. However, many of the requirements are based upon research conducted more than 40 years ago with animals of markedly different productive potential than those exist today. This is particularly true for requirements of most vitamins and trace minerals (**Waldroup, 2004**). The current NRC copper and zinc requirements for broilers are 8 and 40 mg/kg, respectively, but these requirements are based on only a few research reports, most of which were carried out using purified or semi purified diets on growth as the only requirement criterion (**Morrison and sarett, 1958**; **Roberson and Schaible, 1958**; **Zeigler et al., 1961**). However, the estimates determined in purified or semipurified diets may not be applicable to conventional diets because of the absence of phytate and fiber (**wedekind et al., 1992**).

The requirement of nutrients including Cu and Zn for animals is usually defined as the minimum dietary concentration required for maximum performance (**Sterling et al., 2005**). An animal's maximum performance is difficult to assess because there are often several response criteria for each nutrient. There may be different maximum responses for the various criteria such as growth, feed efficiency, carcass composition, and bone ash, etc.

Copper is an essential constituent of several proteins, metalo-enzymes and some naturally occurring pigment. It is also essential for hemoglobin synthesis and bone formation (**Harper et al., 1977**). Copper may be added to rations of broilers as a growth promoter. It has been reported that the addition of 125–250mg Cu/kg of feed results in gain in live body weight and increased feed efficiency (**Fisher et al., 1972; Hoda and Maha, 1995**). Copper is often added to poultry diets at prophylactic concentrations for its growth promoting effects (**Pesti and Bakali, 1996**). Copper is usually fed commercially at much higher pharmacological levels (100–300 mg/kg diet) because of its growth promoting properties

(**Bakalli et al., 1995**). The administration of copper sulphate has also shown adverse effects on feed intake and body weight when higher levels were used in the feed. It has been reported that the use of copper above 300 mg/kg of feed causes growth depression (**Creek and Helbacka, 1967; Smith et al, 1969; Fisher et al., 1972**). The toxic doses of copper sulphate cause severe depression and weakness in birds along with convulsions, paralysis and coma precede death. It causes coagulation necrosis of the lower oesophagus and the crop with severe degenerative changes in liver and kidney.

Zinc is a component of many important metalloenzymes and it is also important for the maintenance of membrane structure and function. Consequently, zinc is involved in many different metabolic processes (**Bettger et al, 1981; Mills 1989**). It has been determined that Zn is necessary for normal mobilisation of vitamin A from the liver and therefore to maintain the normal concentration of vitamin A in the plasma (**Smith et al 1973**). Chief among the systemic functions of vitamin A is its clear role in the differentiation of epithelial cells and it has also been proposed to have a coenzyme-like role (**Combs 1998**). On the other hand, it has been reported that vitamin A increased the accumulation and transport of Zn in the chick ileal mucosa and the level of the plasma Zn could be increased by vitamin A (**Berzin et al 1989**).

Attention has been focused on the potential consequences of excessive dietary Zn intake in humans (**Fosmire 1990**) and the various metabolic and growth depressing effects of excess Zn in many animals have been reviewed (**Hambridge et al 1986)**, though Zn is regarded as relatively non-toxic to man and animals, particularly when administered orally (**Dean et al 1991**). Several studies indicated that moderately excessive Zn intakes in humans (**Black et al 1988, Nishiyama et al 1994**) and animals (**Tobia et al 1998**) typically used with self-supplementation can have adverse metabolic consequences.

The aim of this study is to investigate the effect of adding graded levels of Cu and Zn in broiler diets on performance, carcass traits, tibia mineralization and blood parameters.

2. Review of Literature

2.1. Copper

Copper is an essential trace mineral for poultry. The Cu requirement for broilers is 8 ppm **(NRC, 1994).** In the poultry industry, 125 to 250 ppm Cu from Cu sulfate pentahydrate is normally added in the United States as a growth promoter **(Pesti and Bakalli, 1996). Pang *et. al.*, (2009)** claimed that copper is normally supplemented in broiler diets as a growth promotion and antimicrobial.

However, there are conflicting reports about the growth benefits and little information about how Cu affects the microbiota in the intestinal tract of poultry and its growth stimulation mechanisms. One of the possible mechanisms could be attributed to the bactericidal, bacteriostatic, or both, effects of Cu on the gastrointestinal tract microbiota **(Hawbaker et al., 1961; Bunch et al., 1965).** The bactericidal action of Cu is dependent on the concentration of free ionic Cu in solution **(Zevenhuizen et al., 1979; Menkissoglu and Lindow, 1991)**, whereas the free ionic Cu concentration is affected by pH and solubility.

For many years, subtherapeutic antibiotics (**AGP**) have been incorporated into poultry and swine diets because of their favorable effects on growth, feed intake, and feed efficiency **(Eyssen and deSomer, 1963).** It is thought that AGP promote or allow optimal growth by regulating the microflora in the small intestine, allowing commensal bacteria to maintain an environment for maximum nutrient absorption and reducing pathogenic bacteria that can produce toxins and damage the intestine **(Coates et al., 1955; Lev et al., 1957).** As a result, animals fed AGP have fewer incidences of subclinical immune challenges from pathogenic bacteria, which would negatively affect performance **(Barber et al., 1955; Coates et al., 1955; Stanley et al., 2004).**

However, there are growing concerns that the continual feeding of AGP is leading to the development of antibiotic resistance in many pathogenic bacteria isolated from production animals as well as from humans **(Mamber and Katz, 1985; Aarestrup, 1999; Aarestrup et al., 2001).**

Therefore, there is considerable interest in alternatives to AGP that can produce similar results in terms of intestinal microflora regulation, as well as optimal growth and performance. The intestinal environment is a specialized system that is highly regulated, allowing for the absorption of nutrients and the proliferation of commensal microorganisms and also maintaining defenses against pathogenic bacteria and other antigens. These defenses include the mucosal barrier and components of the innate and adaptive immune system **(Sanderson, 2003).** The mucosal barrier provides protection through mucus production and secretion, peristalsis, and secretion of lysozymes **(Sanderson and Walker, 1999)** vs. the innate immune system, which uses pattern recognition receptors (i.e., toll-like receptors) to recognize pathogenic and commensal bacteria **(Tlaskalova-Hogenova et al., 1995).**

Additionally, cells of the innate and acquired immune system, such as T and B cells, macrophages, mast cells, and Mcells, are located throughout the lamina propia, intraepithelial area, and lymphoid tissue and maintain a regulated environment that develops tolerance or induces an immune response when necessary **(Shao et al., 2001; Tlaskalova-Hogenova et al., 2004).** The intestinal microflora can influence the mucosal immune system as well as the development of the systemic immune system **(Tlaskalova-Hogenova et al., 1983);** germ-free animals have reduced macrophage chemotaxis and phagocytosis activity **(Tlaskalova-Hogenova et al., 2004).**

Therefore, some microflora populations are critical for normal immune system development, but excessive levels of pathogenic bacteria can reduce performance and increase disease risks. With the increasing public concern of bacterial resistance to antibiotics, animal production