EFFECTS OF CALCIUM AND PHOSPHORUS LEVELS ON THE PERFORMANCE, CARCASS CHARACTERISTICS AND BONE MINERALIZATION OF BROILER CHICKENS

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This is to certify that this research work titled "Effects of calcium and phosphorus levels on the performance, carcass characteristics and bone mineralization of broiler chickens" was carried out by Adua, Mohammed Tosin under my supervision in accordance with the partial fulfillment of the requirements for the award of the degree of Master of Science (M.Sc.) in Animal Science, Obafemi Awolowo University, Ile –Ife, Nigeria.

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DEDICATION

I dedicate this project to Almighty Allah, the Creator of all beings and my Parents (Alhaji. and Alhaja. A. B. Adua), for their immeasurable support during the course of my study and research.

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LIST OF ABBREVIATIONS

ADP	Adenosine diphosphate
aP	Available Phosphorus
ATP	Adenosine triphosphate
BM	Bone Meal
Ca	Calcium
CP	Crude protein
CF	Crude fibre
DM	Dry matter
EE	Ether extract
ME	Metabolisable Energy
NFE	Nitrogen free extract
nPP	Non Phytate Phosphorus
P	Phosphorus
PTH	Parathyroid hormone
TD	Tibia Dyschondroplasia
tP	Total Phosphorus

ABSTRACT

The study determined the effect of Calcium (Ca) and Phosphorus (P) levels on growth performance, carcass characteristics, tibia ash and serum Ca and P concentration of broiler chickens with a view to determining the optimum levels of these elements for growth and bone mineralisation.

A total of three hundred and sixty day-old unsexed Arbor Acre broiler chicks were assigned to twelve dietary treatments in a 4×3 factorial design comprising of four Calcium (Ca) levels (0.6, 0.75, 0.9 and 1.2%) and threeAvailable Phosphorus (aP) levels (0.25, 0.35 and 0.45%). Each treatment group consisted of 30 birds and each treatment had three replicates of ten birds and the study lasted for eight weeks. Data were collected on the growth performance and carcass characteristics of the broiler chickens. Digestibility trials were also carried out from 4-6 weeks of age. Feed and feacal samples were analysed for proximate analysis. The right tibia of three birds per treatment were removed to determine the tibia parameters and blood samples were collected to determine serum Ca and P concentration.

The birds fed 1.2% Ca: 0.45% aP had the highest ($P<0.05$) final body weight (1979 g/bird) and daily weight gain (46 g/bird), which were similar to those of birds fed 0.6% Ca and 0.35%aP and 1.2% Ca: 0.35% aP levels comparedto the other treatment groups. This same trend was observed for feed conversion ratio. The highest ($P<0.05$) daily feed intake was observed for birds on 1.2% Ca: 0.35% aP treatment group. The dressing weight increased as the Ca levels increased but Ca and aP levels had no significant effect on othercarcass portions.Birds fed 0.9% Ca and 0.35% aP

had the highest *(P<0.05)* dressing percentage compared to other treatment groups.Ca and aP had no significant *(P<0.05)* effect on Tibia weight. Percentage tibia ash increased linearly with increasing Ca values. Birds fed 1.2% Ca and 0.45% aP had the highest *(P<0.05)*percentage ash value of 44.61%. However, birds fed 0.9% Ca and 0.35% aP had a comparable high percentage tibia ash. Tibia Ca content increased with Ca and aP levels and birds fed 1.2% Ca and 0.45% aP had the highest Ca content. Tibia P content increased linearly with increase in aP levels and birds fed 0.3% Ca and 0.45% aP had the highest tibia P content. Serum Ca increased with decrease in aP values and birds fed 0.75% Ca and 0.25% aP had the highest *(P<0.05)* serum Ca content of 20.00 mg/dL. There was a linear increase in serum P content with increase in aP values. Birds fed 0.6% Ca and 0.45% aP had the highest *(P<0.05)* serum P content of 12.62 mg/dL. Ca and aP had a significant *(P<0.05)* effect on the apparent digestibility coefficient of crude protein. Birds fed 0.75% ca and 0.35% aP (T5) had the highest value of 83.85%. The apparent digestibility coefficient of Ash increased linearly with increase in Ca values. Birds fed 1.2% Ca and 0.35% aP had the *(P<0.05)* highest Ash value of 65.62%. Ca and aP had no significant *(P<0.05)* effect on dry matter, ether extract, crude fibre and nitrogen free extract.

The study concluded that the calcium and available phosphorus levels for the optimum growth and feed intake were 0.6% Ca and 0.35% aP and 0.9% Ca and 0.35% aP for the optimum bone mineralization in broiler chickens.

CHAPTER ONE

INTRODUCTION

1.1 Background information

Calcium (Ca) is, together with Phosphorus (P), the main mineral retained in the body of broilers (Brown, 2002). It is a structural component of bones, but also plays a role in many metabolic and functional aspects of the animal physiology. Calcium and P are important and required because they are main constituents ofskeleton(Coon *et al.,* 2002). The nutritional role of calcium is closely linked to that of phosphorus and cholecalciferol (vitamin D). More than 70% of animal body ashes consist of Ca and P, with about 98 and 80%, respectively, present in the bones. Even though Ca is considered an inexpensive ingredient, the deficiency or excess of this mineral may negatively affect broiler chicken's performance, bone development, P and Vitamin D utilization and of other nutrients. (Alves *et al*., 2002).The metabolic and structural function of these minerals in bone and eggshell formation is essential in poultry production (Araujo, 2005).

Having excess phosphorus and calcium in feed poses a host of problems including nutrient loading of the environment and increasing feed costs (Tahir *et al,* 2012). Low calcium leads to development of rickets, increased broiler chick's mortality and reduced body weight in older birds and inadequacy of P also results in similar anomalies such as loss of skeletal integrity, loss of appetite, subnormal growth in young birds and weight loss in older birds (Narcy*et al*., 2009). However, when in excess, Ca impedes the availability of other minerals like Phosphorus(P), Magnesium(Mg), Manganese(Mn), Zinc(Zn) and may reduce the energy value of the diet through the chelation of lipids (Driver *et al*,. 2005a).

Calcium and Phosphorus requirement for broilers chickens is a major area of debate in the poultry industry, and contradictions persist regarding the optimum level required for growth and bone mineralization (Hamdi *et al.,* 2015).Since Ca and P interact in many biological functions, their dietary requirements are interdependent (Yan *et al*., 2005) which highlights the importance of establishing recommendations of Ca and P concomitantly.

In the animal industry, Ca and P requirements in the diet of broiler chickens have been measured following criteria to maximize performance and bone mineralization (FEDNA, 2008). As Ca is mainly stored in bones, calcium requirements for bone mineralization are usually higher than those established to optimize body weight gain (Driver *et al.*, 2005b).

High prevalence of broiler lameness in broiler chickens has been reported in studies around the world. In 1992, the Farm Animal Welfare Council (FAWC) stated that their Working Group found leg problems of varying degrees of severity on nearly every broiler farm visited (FAWC, 1992). A 1999 Danish study assessed the prevalence of lameness in a large and representative sample of commercial broiler flocks and the study found that 30.1% of the broiler chickens had gait scores of 3, 4 or 5, scores which indicate that they are suffering from chronic pain (Sanotra, 1999). Also a Swedish pilot study surveyed eight flocks from four different broiler farms and found that 14.8% of the birds had gait scores of 3 or above (Berg and Sanotra, 2001). Another detailed Swedish study examined 15 flocks of Ross 208 broilers and 16 flocks of Cobb broilers and also found that 14.1% of the Ross 208 broilers and 26.1% of the Cobb broilers had gait scores of 3 or above (Sanotra *et al,* 2002).According to FAO, (2010), assuming the worldwide prevalence of leg disorder of broiler chickens is similar to that in the United Kingdom, 12.5billion broilers are experiencing leg problems worldwide per year. Knowles *et al*. (2008)

reported that at a mean age of 40 days, over 27.6% of 51,000 sampled broiler birds showed poor locomotion and 3.3% were almost unable to walk.

1.2 Statement of the Research Problem

Mineral imbalance, particularly of Caand phosphorus P in diets of broiler chickens is one of the major problems associated with skeletal disorder and eutrophication. High prevalence of these disorders especially lameness, prolapse and osteoporosis causing welfare problems have a profound economic impact in poultry industry. Information availableon the Ca and P levels of broiler chickens for tropical environment appears inconclusive. Hence this study.

1.3 Objectives of the Study

The objectives of this work were to:

i. determine the effect of calcium and phosphorus levels on growth performance and carcass characteristics of broiler chickens; and
ii. investigate the effect of calcium and phosphorus levels on tibia ash and serum calcium and phosphorus concentrations of broiler chickens.