In the name of Allah, the

Compassionate, the Merciful

IN THE NAME OF ALLAH
THE COMPASSIONATE,
THE MERCIFUL.

INFLUENCE OF VARYING LEVELS OF PROTEIN, ENERGY AND CALCIUM ON THE PERFORMANCE OF BROILER CHICKS

By

Nisar Ahmad

1970

INFLUENCE OF VARYING LEVELS OF PROTEIN, ENERGY AND CALCIUM ON THE PERFORMANCE OF BROILER CHICKS

By

Nisar Ahmad

B.Sc., A.H.,(Pb).M.Sc.(WPAU)

A thesis submitted in partial fulfilment of

requirements for the degree of

DOCTOR OF PHILOSOPHY

In

NUTRITION

WEST PAKISTAN AGRICULTURAL UNIVERSITY

LYALLPUR

1970

To

The Controller of Examinations

This thesis, submitted by Mr. Nisar Ahmad, has been found to be satisfactory by the undersigned members of the Supervisory Committee. It is recommended, therefore, that it be processed for evaluation by the External Examiner/s for the award of degree.

Chairman: _____
(DR. M.B. SIAL)

Member : _____
(DR.MUHAMMAD AKRAM)

Member : _____
(DR. A.O. SHAW)

Member : _____
(DR.M.JAMIL QURESHI)

DEDICATED TO MY PARENTS

ACKNOWLEDGEMENTS

The author wishes to express his deep sense of gratitude to Dr. M.B. Sial, Dean, Faculty of Animal Husbandry, under whose guidance and supervision this research was conducted. He is thankful to Dr. Muhammad Akram, Nutrition Research Officer, College of Animal Husbandry, Lahore, Dr.A.O. Shaw, Visiting Professor and Chief of Washington State University Party and Dr. M. Jamil Qureshi, Reader, Department of Livestock Management for their constant guidance, Constructive criticism and help in preparing this manuscript.

The author is also highly grateful to Dr.Israr-ul-Haq, T.Q.A., Vice Chancellor, West Pakistan Agricultural University, Lyallpur for his ardent inspiration, sincere guidance and support for the present study.

Gratitude is extended to Dr. A.Z. Memon and Mr. M. Ashfaq for their help in statistical analysis of the data. Thanks are due to Mr. Abraf Hussain Gilani and Altaf-ur-Rehman for their co-operation and help during the course of this study.

The writer is also thankful to Dr. S.M. Ali, Senior Research Officer and Sh. Iftakhar Ali, Research Officer, Department of Nutrition PCSIR Laboratories, Lahore for providing facilities in their laboratory for analysing the

samples for energy content.

The author wishes to extend his sincere gratitude to his parents, brothers and sister whose words of encouragement and patience helped him to undertake and complete higher studies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

The scientific consideration of the nutrition of farm animals and poultry must take account both of the objectives of production and of the function that food constituents serve. In practice the objectives of production vary e.g., in case of broiler chicks it is maximum growth rate and in laying hens it involves efficient reproduction ability at low cost. The most important means to achieve that objectives is to feed efficient rations. In formulating efficient rations every effort must be made to supply each nutrient at a level favouring optimum growth or production at minimum feed cost. It means that every constituent is allocated its own appropriate proportion and that all of the components fit in so as to balance one another.

Studies on economical and efficient rations for broilers have increased the interest of poultry farmers and research workers to see the effect of lowering the protein level of rations. Any factor influencing feed intake would affect the requirements for protein and calcium when the requirements are expressed as a per cent of the diet. Energy is probably one of the most important factors to be considered when investigating the nutritive value of proteins because of

its influence on feed intake. Greater fat deposition resulting from feeding high energy ration could prove to be of economic importance to poultry processors and manufacturers of poultry meat products.

The increased requirements of birds for protein to supply adequate methionine when fed high energy rations were shown by Baldini and Rosenberg (1955). This may explain the need for high protein contents of ration containing high energy. The work presented by Summers et al. (1964) substantiates the desirability of considering the protein and energy levels when evaluating protein supplements. Thus the influence of varying levels of protein and energy in the rations has been frequently and thoroughly investigated and certain definite calorie/protein ratios have been developed for broiler chicken during their starting, growing or finishing period.

Calcium is an essential factor for the growing chicks for their maximum growth and bone formation, therefore, a large amount of calcium is expected to be utilized by these chicks. Studies on the effect of calorie and protein content of the diet on the calcium requirement revealed that the requirement expressed as a per cent of the ration for dietary calcium increases in relation to the increase in feed efficiency (Edwards et al. 1960). After about forty or more

years of investigation into the levels of calcium and phosphorus in the rations of growing chicks, there is still considerable disagreement in the reports cited in the literature. However, the range of disputed calcium levels is getting narrower to an extent that it may become policy very soon to have calcium levels in the ration much lower than recommended by National Research Council of the United States.

Considering the facts presented above a project was planned to investigate the influence of varying levels of calcium on the performance of broiler chicks fed rations containing different levels of protein and energy. Performance was to be tested in terms of growth rate, feed consumption, feed efficiency and metabolization of dietary energy, nitrogen and calcium.

CHAPTER II

REVIEW OF LITERATURE

With the modifications made in the energy contents of chick starter and broilers rations the requirements for some of the nutrients may be different than those determined on the basis of diets commonly formulated some years ago. The relation of dietary fat and energy levels to requirements of other nutrients is not so clear. Although from present knowledge of calcium, phosphorus and vitamin D interrelationship it is possible to define calcium requirements within fairly close limits. A number of factors, such as difference in the genetic, environment and the composition of basal diet used may be responsible for varied calcium utilization. A lot of work appears in the literature on this aspect of poultry nutrition but no investigation seems to have been carried out in Pakistan. So all of the literature cited here were obtained from the research work of various laboratories from outside the country.

Givens (1917) observed that poor utilization of fats or fatty acids increased the excretion of lime in the faeces and prevented the storage of calcium although the calcium intake was comparatively high.

Boyd et al. (1932) reported that presence of fat in the

diet had a beneficial influence on the absorption of calcium and phosphorus by maintaining a favourable condition of acidity in the intestinal tract. The calcium soaps of palmitic and oleic acids formed in the intestine under such conditions were well utilized.

Cheng et al. (1949) stated that calcium intake level was of considerable importance in relation to calcium retention as a function of the fat content of the diet. It was observed that when the dietary fats had a low melting point a minimum calcium loss would occur. However, a marked loss of calcium proportional to the amount of dietary fat might be expected when the melting point of ingested fat exceeded 50°C. But with simple triglycerides an inverse relationship was obtained between the melting point and the coefficient of digestibility of fat. They also observed that the presence of calcium and magnesium in the diet did not influence the digestibility of low melting fats but markedly decreased that of simple triglycerides and hydrogenated fats.

Hill and Dansky (1950) observed no improvement in growth of cross bred chicks at seven weeks of age by increasing protein level above 20 per cent in a diet containing relatively high productive energy. But growth rate was decreased by reducing the protein level below 20 per cent in a similar diet high in productive energy. They reported

that productive energy value of the ration was a major factor in controlling feed intake.

Biely and March (1954) observed that the addition of fat to a 19 per cent protein diet depressed growth and feed efficiency of chicks. But that growth was stimulated and feed efficiency was improved when fat was added to a 24 per cent or 28 per cent protein diet. Fastest growth was obtained to 7 weeks of age with a 28 per cent protein diet containing 5.0 or 7.5 per cent of tallow supplemented with aureomycin. They reported that in chick and poult rations the addition of fat may be advantageous when relatively high levels of protein are fed.

Mellen et al. (1954) stated that fasting oxygen consumption of growing male chickens was significantly higher when fed ration containing 975 calories of productive energy per pound than those fed a ration containing 505 calories per pound. They hypothesized that the observed differences in basal metabolism were related to the differences in body composition resulting from feeding rations differing in energy content.

Hill and Dansky (1954) used in chicken diets energy levels ranging from 975 to 505 calories per pound of ration. They noted maximum growth rate with a ration containing an energy level of 623 calories per pound. Chicks fed the ration high in energy had the highest fat contents.

The fat content was noted to be progressively lower as the dietary energy level and total energy intake declined. The rate of feed consumption was determined by the energy level of the ration. Protein level had little or no effect on rate of feed consumption.

Lewis et al. (1955) compared basal ration for chicks from 1-8 weeks old and the same diet with 2 per cent added lard or maize oil. Feed consumption was greater on the fat supplemented diets than the basal diet. The kind of fat made no difference. The birds fed on the diet supplemented with fat were heavier than those getting the basal ration only. But the efficiency of feed utilization was not altered.

Rosenberg et al. (1955) observed that the growth and feed efficiency of chicks 8 or 10 weeks old were improved by the addition of fat and D.L. methionine alone or together over a non-supplemented basal ration. Fat was added at a level of 3 to 6 per cent and methionine at 0.05 per cent. The response to methionine supplementation alone was slight. But when both the fat and methionine were added substantial improvement in performance resulted.

Baldini and Rosenberg (1955) stated that when the percentage of energy is increased in the diet of chicks, the percentage of methionine must be increased. Sunde (1956) conducted an experiment with chickens from day-old to 4 weeks