THE EFFECT OF PHASE FEEDING ON BROILER PERFORMANCE

BY

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B.Sc. (Honours) Animal Production
University Of Khartoum
July 2003

Dissertation submitted in partial fulfillment for the degree of master of science in poultry production

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December 2006

DEDICATION

To:

My parents, brothers,

sisters and my friends

for all the efforts devoted

for my education

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ACKNOWLEDGEMENTS

At the beginning and the end, my special praise and thanks are to **ALLA** who gave me the health and spiritual to support to bring this work to the end and for his gracious, merciful and innumerable bounties.

I express my sincere thanks to my supervisor Professor **Omer El-Amain Mohammed Hassan** for his guidance, encouragement, valuable advice and assistance throughout the course of this work.

I greatly appreciate the assistance and help offered by staff members of the Department of Poultry Production during the course of the experiment.

My heartfelt thank go to my dear loving family's member for their encouragement, understanding and unfailing moral support during my study.

I would like to express my special thanks to my father **Ali Eltayeb Algam** and my mother **Basheera El- Amin Algam** for all the efforts they devoted for my education, let them consider this work as the result of your efforts. I also thank my brothers, sisters and friends

ABSTRACT

This study was conducted to assess the effects of phase feeding on growth performance of broiler chicks. The experimental work consisted of a 7-week feeding trial, in which three different feeding programmes were fed to day-old broiler chicks (Hubbard). The chicks were reared on deep litter in an open experimental poultry house. The experiment was arranged in a completely randomized block design consisting of three rows (blocks) with three pens (experimental units) each, with 10 chicks per pen.

Three experimental diets were formulated to contain different levels of ME and Crude protein; namely a broiler starter diet containing approximately 3072 Kcal ME/kg and 23.9% crude protein, a grower diet containing 3118 Kcal ME/Kg and 21.8% crude protein, and a finisher diet containing 3200 Kcal ME/kg and 18% crude protein.

The three feeding programmes were randomized within each block giving three replicates per treatment. The first programme (treatment I) consisted of feeding the starter diet throughout the whole experimental period (7 week), While the second feeding programme (treatment II) consisted of feeding the starter diet for the first two weeks followed by feeding the grower diet for the following two weeks, followed by the finisher diet for the remaining two weeks of the experiment. In the third feeding

programme (treatment III), the starter diet was fed for three weeks followed by the finisher diet for four weeks.

Records were kept for weekly feed consumption, weekly live weight and live weight gain, feed conversion ratio, daily mortality and dressing percentage at the end of the experiment. The collected data was subjected to analysis of variance to assess statistical differences among the experimental treatments.

The results diets not reveal any significant differences in productive parameters, but indicated marked trends in differences among the experimental treatment. These differences showed that the highest feed consumption and live weight gain were attained by the group of birds fed the starter diet throughout the experimental period. Feeding the starter diet followed by the finisher diet for four weeks resulted in the lowest total feed consumption, reasonably high body weight gain, lowest feed conversion ratio and highest dressing percentage.

It can, however, be considered under the conditions of the present experiment that the three experimental feeding programmes supported similar productive performance of broiler, indicating a slight economic advantage of feeding the starter diet followed by the finisher diet.

CHAPTER ONE

1. INTRODUCTION

The broiler industry has been developed into the most efficient animal production sector. This development has been brought about through development and advancement of research in the fields of poultry science and related subjects. The most significant of these developments were in the fields of genetics and nutrition, which lead to the breeding of commercial broiler chicks capable of rapid growth and efficient utilization of feed.

Since feed cost constitutes the major cost item of producing broiler meat, considerable research effort was concentrated in improving nutrition and efficiency of feed utilization of the broiler chicks. The broiler chicks are known to be exacting in their nutrient requirements for rapid growth and development, and that they need to be supplied with adequate diets capable of satisfying these requirements in a utilizable form. The nutrient requirements of boiler chicks have been almost precisely established and the capacity of various feed ingredients to supply these nutrients has been identified, and consequently the formulations of adequate diets became possible.

The broiler chick has an extremely high nutrient requirements, particularly during the early stages of its growth. The capacity of the digestive system of the chick is very limited during this period, and it became important to feed them diets highly concentrated in metabolizable energy and protein of high quality, beside high levels of vitamins and essential minerals during the

early stages of the growing period. Such diets have been commercially established and used world- wide.

These high density broiler diets were recommended to be fed as a sole diet for the whole 6-7 weeks growing period. Further research development indicated that the nutrient requirements of the broiler chicks vary with its advancement of growth according to the increase in body weight and nature of growth. The growth curve established that young broiler chicks during the first 3-4 weeks of life are at their most active phase of growth, and the nature of growth during this period is mostly in the form of tissue protein and very little fat. Accordingly, it has been indicated to vary the composition of broiler diets during the growing period according to the actual nutrient requirements for the changing nature of growth. In this context, different feeding programmes with varying dietary nutrient composition have been developed for the growing broilers as a means for economy of feed and efficient nutrient utilization, and ultimate reduction of the cost of feeding. In this respect, different diets of variable nutrients composition have been advocated for phase feeding of broilers, based on increasing the energy content of the diet and reducing its crude protein content with the advancement of age.

It is intended in this study to assess the effect of phase feeding using different feeding programmes ,on the production performance and carcass yield of broilers.

CHAPTER TWO

2. REVIEW OF LITERATURE

Broiler chicks are bred for rapid growth, high feed efficiency and good carcass yield and meat quality. To a achieve these characters, the broiler chicks need to be adequately fed by offering adequate and balanced diets which would satisfy all the nutrients requirements in a utilizable form. Practically, broiler diets are based on high energy density and high protein content of high quality and amino acid balance. In addition broiler diets are to be highly digestible and fortified with adequate minerals and vitamins.

2.1. Nutrient requirement of broiler chicks

The nutrient requirement of broilers has been established and almost precisely estimated (NRC, ARC). These estimates are internationally recognized and used as standards and guides for adequate nutrition and ration formulation. Of these nutrients requirement, energy constitutes the major entity, as it is required in large quantities than the other nutrients and it also influences voluntary feed intake, and is much related to amino acids and other dietary nutrient consumption and utilization.

The nutrient requirement of the broiler chick is affected by numerous factors of which genetic, dietary, and environmental factors are most effective (Baker, 1997). It is also affected by the rate and nature of growth of the chick, and it varies with the phase of growth as indicated by the growth curve of

broiler chicks (Goliomytis *et a*l, 2003). It has been indicated that the requirement for protein and amino acids decreases while that for metabolizable energy (M E) increases with advanced growth of broiler chick (Skinner *et al*, 2000).

2. 1.1 Energy requirements

One of the factors affecting the performance of broiler chicks is the level of nutrients in the diet, mainly the energy and protein levels. Diets of high energy content tend to promote more rapid growth and better feed conversion in chicks, than diets of lower energy content (Scott *et al,* 1947). In addition, there was a reduction in feed consumption and an improvement in feed conversion efficiency as dietary energy was increased (Sadagopan *et al*, 1971). Farrel (1974) found that as the metabolizable energy (M E) content of the diet is increased, the birds would grow faster, and the metabolizable energy (M E) required per unit body weight gain decreases significantly as dietary M E content is increased. Khoo,(1974) found that, live weight gain of chick was increased with increased dietary energy content, but it was not significantly improved with the highest level of M E used. On the other hand, the efficiency of feed conversion improved with energy intake of finishing diets.

2.1.2 Protein and amino acid requirements

Protein is an important component of poultry diets it is used as building material for the development of bones flesh and feathers. The general performance, carcass characteristics and composition of broiler meat are markedly affected by dietary protein level and quality. Hey wang *et al*, (1953) reported that average weight of chicks at the end of ten weeks growth period

was increased by increasing the protein level of the diet from 20.1% to 22.3%. When the crude protein level of the diet was increased to 24.3%, the average live weight of birds was significantly ($P<0.01$) increased. Hassan *et al*, (1973) studied the effect of two dietary protein 18.8% and 22.5% on the performance of broiler chicks through different seasons in the Sudan. They found that the diet that contained 22.5% crude protein supported significantly ($P<0.001$) better live weight gain than the other diets during all seasons. The feed consumption was significantly reduced on the diet that contained 18.8% crude protein than on the diet of 22.5% protein during the warm and hot seasons. Pesti (1982), investigated the effect of decreasing dietary protein level (25.9% to 17.2%) in diets of constant metabolizable energy (1339 mj/kg) on broiler performance. Differences in weight gain as produced by the highest and lowest dietary protein levels were found to be 136g in the first three weeks. Salmon et al, (1983) conducted an experiment to evaluate the effect of increasing dietary protein level on broiler performance. They used three dietary protein levels (20.5, 22.2, and 24%), and they concluded that there was a positive effect on growth rate and feed conversion ratio during the first four weeks of age due to the increase in protein level. Jalora and Sharma, (1975) reported that 22% crude protein gave significantly higher body weight gain and better feed conversion efficiency ($P< 0.05$) in winter and spring when they used three levels of crude protein (18, 20, and 22%). Yeong, et al (1979) found that increasing dietary protein content in broiler diets from 20 to 22% significantly increased body weight gain and efficiency of feed utilization during the finishing period. Ahmed, *et al* (1985) fed three level of protein (18, 20 and 22%) and three levels of Ca (1, 1.5 and 2%) to broiler chicks for 8 weeks. They showed that birds fed diets with 18% protein and 1% Ca gained more and ate less than the others birds. Bougon and Menc,(1986) fed chicks

diets containing 20.5, 21.7, 22.4 and 22.9% protein level from day old to 45days of age, and showed that at 35days of age, body weight was 6.4% less in the group fed the 20.5% crude protein diet than the others, and there was a little difference in weight at 45 days of age.

2.2 Calorie protein ratio

There is a close association between the number of calories of metabolizable energy in the diet of broiler chicks and the percentage of protein necessary to balance dietary energy in accordance with the increasing dietary energy requirement and the decreasing protein requirement with the advancement of growth. The ratio is expressed as a figure calculated by dividing the number of calories of metabolizable energy / kg of the diet by the protein percentage. This ratio varies with age and for this purpose it is accordingly adjusted. Broilers chicks should have Cal/ P ratio of 61 from 0-4 weeks of age and 70 from 5 to 10 weeks of age (Mack, 1984) Batrov *et al* (1974) compared three values of Cal/P ratios with the amount of carcass fat at 8 or 9 weeks of age**.** They found that growth rate of chicks was not affected by changing protein level, but a better feed to weight gain ratio was observed with higher protein diets. Increasing or decreasing the protein level of finisher diet resulted in a decrease or increase in the degree of fatness respectively. Donnaldson, *et al* (1956) reported that as energy to protein ratio was increased, energy intake and carcass fat deposition were also increased, but the carcass water content decreased. Impaired growth and feed conversion ratio occurred when Cal/P ratio exceeded 43.9, 48.6 and 53.7 on low, medium and high fat diet, respectively. Leong *et al*, (19550 investigated the effect of calorie- protein ratio on broiler growth. They used different levels of protein, varying from 12 to 42% and energy levels of 700, 950 and 1450 Cal/P, for

respective protein levels. They found that the best growth among these levels of energy was obtained at 22, 27 and 32% protein at 5 weeks of age. The respective feed conversion ratio was 3.1, 2.3 and 1.5. Lewis and Morgan, (1963) fed broiler a diet with 2950 Kcal/kg energy level, and obtained the best performance with a starter diet containing 24% crude protein and a finisher diet containing 20% crude protein. Best performance was also achieved by Cal/P ratio of 170, but fluctuation of protein level in starter ration did not affect live weight at 10 weeks of age, at 3100 to 3250 Kcal/kg dietary energy level.

Halga *et al*, (1977) studied the effect of calorie- protein ratio on the growth of meat chickens in batteries. The ratios investigated were 124 and 143 from hatching to 35 days, and 36 to 56 days for the first group, and 122, 144 and 167 from hatching to 14 days, and 15 to 35 days and 36 to 56 days for the second group, 124 and 143 from hatching to 128 and 29 to 59 days for the third group. The results showed that the second group of chicks has the largest weight gain, although differences among the groups were not statistically significant. The average feed conversion ratio was 2.89, 2.59 and 2.61 respectively.

2.3. Growth pattern of broiler chicks

Jull, Morley Allum (1951) indicated that when a baby chick is fed a normal' diet growth proceeds at a more or less continuous rate until maturity is attained. Although the chick increases steadily in body weight, the percentage increase in weight from week to week, throughout the growing period, is not the same. In most cases body weight is approximately doubled each 2- weeks period up to the end of 6 weeks; but after that the percentage

gain in weight is lower. The growth curve of chicks, like that of other animals, is divided in two principle segments, one of increasing and the other of decreasing slope. The point of inflection of the curve depends upon the kind of diet and the amount of feed consumed. The chick usually grows rapidly during the first two weeks of life. The growth curve of broiler chicks indicates that young chicks during the first week of life are at their most active phase of growth, and the nature of growth during this period is mostly in the form of tissue protein synthesis and very little fat synthesis. (Jull, morley Allum,1951). Growth pattern of broiler chicks involves the increase in body weight and that of body parts important for the consumer, such as breast and legs. Goliomytis *et al*, (2003) studied the pattern of development for high value component parts, and reported that the percentage increase in breast and breast meat increases with age, where as the percentage increase of leg, thigh and drum stick remains nearly constant.

The pattern and nature of growth of broiler chicks is related to feed utilization efficiency, and used for economical phase feeding of commercial stock by offering diets matching the nutrient requirements of broiler chick during the different phases of their growth and development.

2.4. Phase feeding

The development of feeding systems for meat type birds is based on the concept that the birds should be fed diets with decreasing protein and increasing energy content as they approach market age (Skinner *et al*, 2001).Broiler chicks are commonly fed three diets with increasing energy and decreasing protein content. If meat-type poultry are fed a single diet of average composition, relative to the multiple diets feeding programme, then

theoretically the protein level of the single diet would be lower than recommended when the birds are young, and higher than recommended as the birds get older. Similarly, energy levels would be higher than recommended as the birds are young and lower than recommended as the birds get older. Skinner *et al*, (2001) indicated that a single diet may prove useful in broiler feeding. Feeding the grower diet throughout the growing period reduced body weight as early as 7 days post hatching, and this continued throughout the experiment. This reduction in body weight, however, narrowed between 35 and 42 days of age. Previous reports with broilers chicks used periods of growth restriction lasting less than two weeks and starting at greater than 5 days of age Skinner *et al* (2001)).

Skinner *et al* (2000) reported that body weight of broiler birds fed a single diet was higher at 42 days of age than that of birds fed a three diet feeding programme. The same workers reported that feed intake was similar between a single –diet and three-diets feeding programmes. They also reported that the feed conversion ratio was reduced when the birds were switched to the finisher diet in a three diet feeding programme. Warma and Emmert (2000) indicated that phase- feeding can support growth similar to that of birds fed on NRC diet during the starter period. However minimal amount of feed are consumed during the starter period in relation to the total feed consumption, and so the efficacy of phase feeding in supporting growth performance and carcass yield during the later phases of the growth period are important and more marked. The same workers evaluated phase feeding during a finisher period ranging from 40 to 61days of age, and found that relative to broiler birds fed diet based on NRC (1994) recommendation, broiler fed phase feeding series of diets exhibited similar growth performance

with a reduced intake of digestible lysine and threonine, and no differences in carcass or parts yield were observed. The same workers reported that phase feeding in their current study was efficacious in supporting a rate of growth similar to that of broilers fed on NRC regimen, despite a substantial reduction in the intake of crude protein and digestible amino acids. None of the differences in cost per unit weight gain or cost per unit breast meat at 64 or 71 days of age were significant ($P>0.05$) relative to broilers fed NRC regimen. The decrease in the value of amino acid- containing feed ingredients consumed as a result of phase feeding series of diets is consistent with previous results reported by Warma and Emmert, (2000) and Pope and Emmert, (2001).

Broiler chicks can be switched to a less nutrient-dense grower diet earlier than the recommended 3-weeks of age without sacrificing 6-weeks growth performance (Watkins *et al*, 1993; Saleh *et al*., 1995, 1996 a, b). Previous research work indicated that the time of providing diets in phase feeding programmes has a significant effect on economy of growth and uniformity of broiler crop (Gehle *et al*, 1974; Brown and McCartney, 1982; Skinner et al, 1992; Saleh *et al*, 1996, 1997 a, b; Warren and Emmert, 2000; Bope and Emmert, 2001; Vandegrift, 2002 and Vandegrift *et al*., 2003). Roush (2004) indicated that Broiler chicks fed starter and finisher diets for 30 and 18 days respectively, would meet the production and processing requirements. The same worker reported that there is no single answer to defining optimum conditions of feeding phase feeding diets. However, the numerical analysis indicated that the optimum time combination would be 37 days on starter and 11 days on grower diets since this resulted in a final body weight of 2.759kg. Roush, (2004) indicated that body weight and feed conversion were not very

sensitive to the grower diet feeding, and that increasing starter diet feeding period has the strongest effects in increasing body weight and decreasing feed conversion ratio ; decreasing the feeding period of finisher diet increases the body weight and decreases feed conversion , thus grower diets will have less effect on body weight and feed conversion efficiency will offset higher level of starter and lower levels of finisher diets.

CHAPTER THREE

3. MATERIALS AND METHODS

The experimental work in this study was in the form of a broiler feeding trial of seven weeks duration, conducted in the winter season of 2006 during the period 22nd January to15 march. The experiment was carried out in the Poultry Experimental Unit of The Faculty of Animal Production. It was designed to investigate the effect of applying three different feeding programmes on broiler growth, feed utilization efficiency and carcass characteristic. The first programme (treatment I) consisted of feeding a single (starter) diet throughout the whole experimental period; while in the second programme (treatment II), the starter diet was fed for the first tow weeks followed by a grower diet for tow weeks and then a finisher diet to the end of the experiment. The third programme consisted of feeding the starter diet for three weeks followed by a finisher diet for four weeks.

3.1. Experimental Diets

The diets employed in this experiment consisted of three types of diets

namely,the starter, grower and finisher broiler diets. They were formulated from the local feed ingredients and an imported super concentrate which was used to complement the dietary protein, amino acids, vitamins and minerals. The composition of the super concentrate is described in table (I).

The diets were formulated according to the recommended nutrient composition of the diets commonly used in phase feeding of broiler chicks. In this respect, the starter diet was relatively high in ME and crude protein content, which were reduced in the grower diet; and the protein content was further reduced in the finisher diet with increasing the ME content.

The formulation of the experimental diets is shown in table (2). The calculated and proximate analyses were shown in tables (3) and (4) respectively. Each diet was analyzed for its content of dry matter, crude protein, ether extract and crude fiber according to the procedure of AOAC.(1980)for proximate analysis. The metabolizable energy (ME) content of the diets were calculated according to the equation of Lodhi et al (1976) based on the determined proximate analyses values of the diets

* This equation is as fallow: M.E (Kcal kg^{-1}= (1.549+0.102(Cp) +0.275(EE) +0.148(N.F.E)-0.034(C.F) X239.

The calculated analyses of the diets were made according to the tables of NRC (1994) for ingredients composition

3.2. Birds and management

Hundred and twenty unsexed day-old broiler chicks of commercial strain (Hubbard) were purchased from a local hatchery (Coral CO.) The birds were reared on deep litter in an open sided house, with the long axis extending

from east to west. The house was built of iron posts; brick walls half a meter high, corrugated iron roofing and concrete floor. The sides were made of wire netting above the level of the brick walls.

The experimental house was aportioned in to 9 pens of equal area (I x I m). The pens were arranged in three rows, each row containing three pens, each pen was equipped with a tube feeder and a fountain waterer. In the middle of each pen 60 –watt electric bulb was hanged from the ceiling to about one meter above the floor level. Lighting was supplied continuously, provided 24 hours a day by natural light during the day and artificial light during the night. The electric bulbs were used for lighting and as a source of heat during the brooding period. The level of the hanging bulb from the floor was periodically adjusted according to the prevailing house temperature. Before the arrival of the chicks the pens were cleaned and disinfected and wood shaving litter was spread in each pen at 4cm depth. One day before the arrival of chicks, the feeders and waterers were filled, and the pen were warmed up and kept Warm. Feed and clean water were provided ad libitium 24-hours a day. Waterers were cleaned and filled with clean water twice a day, in the morning and early evening. The feed was offered in flat trays for the first few days, and then tube feeders were introduced. They were initially placed on the floor and then hanged from the ceiling and adjusted according to the age of the birds.

Upon arrival, the chicks were immediately given sugar in drinking water to reduce the transportation stress. At the age of two weeks the chicks were vaccinated against Newcastle Disease.

Table (1):

The chemical composition of the super concentrate used in the formulation of the experimental diets. (LNB Concentrate 5%)

Analysis	**Min.**	**Max.**
Crude protein%	40.00	
Metabolizable Energy kcal/kg	2100	
Crude fiber %	2.00	3.00
Calcium %	10.00	
Phosphorus total %	4.00	
Lysine %	12.00	

Methionine %	3.00	
Methionine + cystine %	3.20	

Table (2):

The formulation of the experimental diets (percent as fed)

	Experimental diets		
Ingredient	**Starter**	**Grower**	**Finisher**
Sorghum	60.0	67	76.41
Dec. groundnut meal	18.0	14	10
sesame meal	14.85	11.8	6
Super- concentrate	5.0	5	5
Crushed osyster shell	1.5	1.5	1.5
Common salt	0.3	0.3	0.3

Methionine	0.1	0.15	0.21
Lysine	0.25	0.25	0.25
Vegatable. oil	-	-	0.33
Total	100.0	100.0	100.0

Table (3):

The calculated analyses of the experimental diets (percent as fed)

Items	**Experimental Diets**		
	Starter	**Grower**	**Finisher**
Metabolizable energy (kcal/kg)	3072	3118	3200
Crude protein (%N%X6.25)	23.9	21.8	18.9
Lysine %	1.34	1.25	1.20
Methionine %	0.60	0.60	0.59
Calcium %	1.4	1.3	1.2
Av. Phosphorus %	0.69	1.39	0.313

Table (4):

Proximate analysis of the experimental diets (percent)

Items	Experimental Diets		
	Starter	**Grower**	**Finisher**
Dry matter %	9486	90.45	93.87
Crude protein %	22.25	20.98	19.58
Crude fiber %	6.19	6.02	6.03
Ash %	8.57	13.87	6.64
Fat %	6.94	6.45	5.72

3.3. Experimental procedure

On arrival, the chicks were unpacked in a holding pen inside the experimental house. They were visually inspected for health and thriftiness, and the weak unhealthy and under weight chicks were excluded from the experiment. The remaining chicks were then randomly assigned to the experimental pens at the rate of 10 chicks per pen. The experimental house consisted of three rows of pens and each row contained three pens. The three experimental treatments were randomly assigned to each row of pens (block), thus giving a Randomized Complete Block Design arrangement.

Treatment I consisted of feeding the starter diet from day-old to 7 weeks of age (end of the experiment). Treatment II consisted of feeding the starter diet for the first 2 weeks of age, fallowed by the grower diet for 2 weeks and then the finisher diet to the end of the 7^{th} week of the experiment. Treatment III consisted of feeding the starter diet from day old to 3 weeks of age followed by the finisher diet to the 7^{th} week of the experiment.

Feed consumption and liveweight were weekly determined for each pen, and mortality was recorded as it occurred. At the end of the experiment the birds were fasted for over night except for water, three birds from each replicate (pen) were randomly selected, wing tagged and individually weighed. They were then slaughtered by jugular severing and left for an appropriate time to bleed. They were then scalded in hot water and plucked manually, and the head and shanks were removed. The birds were then eviscerated and the hot dressed carcass weight was recorded.

The data for weekly feed consumption, live weight gain, feed conversion ratio and dressing percentage were collected. They were then analyzed statistically for treatment differences by analysis of variance for the randomized complete block design according to Steel and Torrie (1980).

CHAPTER FOUR

4. RESULTS

The overall performance of the birds on the different experimental treatments is summarized in table (5) and figure (1). The data presents the total feed consumption ,final body weight, live weight gain, feed conversion ratio, dressing percentage and cost of feed consumed.

Table (5): Summary table of performance of the experimental birds during 0-7 weeks of age (g/bird/7week)

Experimental parameters	Treatments			
	1	2	3	SE
Number of bird/treatment	30.0	30.0	30.0	-
Initial body weight (g/bird)	40.90	43.60	42.30	-
Total feed consumption	3306.60	3080.6	3o21.6	90.68NS
Final live body weight (g/bird	1390.0	1317.0	1349.0	95.87NS
Live body weight gain (g/bird/ 7	1349.1	1253.4	1306.7	39.96NS
Feed conversion ratio (g feed/ g	2.45	2.45	2.31	.055NS
Dressing percentage	68.30	69.80	72.7	2.92 NS
Cost of feed consumed (SD)	291.80	297	296.1	NS

-Values are means of 30 birds/treatment

-NS= not statistically significant., SE= Standard error of means

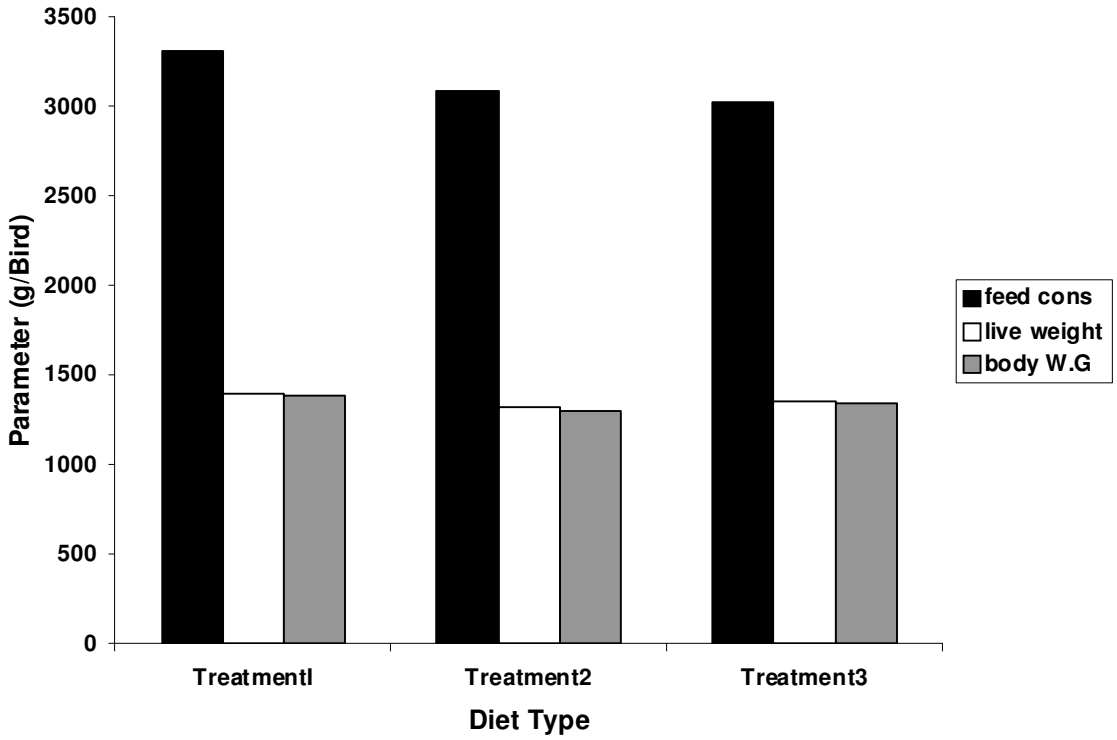


Fig.1. Total feed consumption, final liveweight and liveweight gain of the experimental birds (g/bird/7 weeks).

1= Starter Diet

2= Starter+Grower+Finisher diets

3= Starter+ finisher diets

4.1. Feed Consumption

Table (5) shows that the different treatments (feeding programmes) had no significant effects on mean total feed consumption. However, there were some marked variations in total feed intake among the experimental treatment. It can be seen that feed consumption was highest in the group of birds fed the single starter diet during the whole experimental period (Treatment I); followed by the group fed the starter, grower and finisher diets (treatment II); and was lowest in the group of birds fed the starter and finisher diets (treatment III). The weekly feed consumption (table 6 and Fig 2) followed to a great extend, the same pattern of total feed consumption. The feed consumption was gradually increased over the weeks of the experiment following the increasing growth and development of the experimental chicks. The weekly feed consumption was, however, not statistically significant among the experimental treatments, except during the 6^{th} week of the experiment. During this week, the highest feed consumption was attained by the birds reared on treatment I followed by that on treatment II and then treatment III. The feed intake of the birds on treatment I, during the 6th week, was statistically higher ($P<0.05$) than that of the birds on the other two treatments.

Table (6):

Weekly mean feed consumption of the experimental birds (g/bird/week

Age in weeks	Experimental treatments			
	1(S)	2(S+G+F)	3(S+F)	SE±
1	82.00	80.00	81.00	2.43 NS
2	205.67	200.00	198.00	8.90 NS
3	280.00	270.00	268.33	9.08 NS
4	521.67	498.33	495.00	22.95 NS
5	573.33	636.67	558.33	30.00 NS
6	790.00^{a}	730.33^{b}	682.33^{ab}	18.91*
7	853.33	713.33	690.67	61.67 NS

- Values are means of 30 birds /treatment/week.

- Means in the same row with different letters are statistically significant

- NS= Not statistically significant.

***Statistically significant (P<0.05)**

SE= Standard error of means.

1= Starter Diet

2= Starter+Grower+Finisher diets

3= Starter+ finisher diets

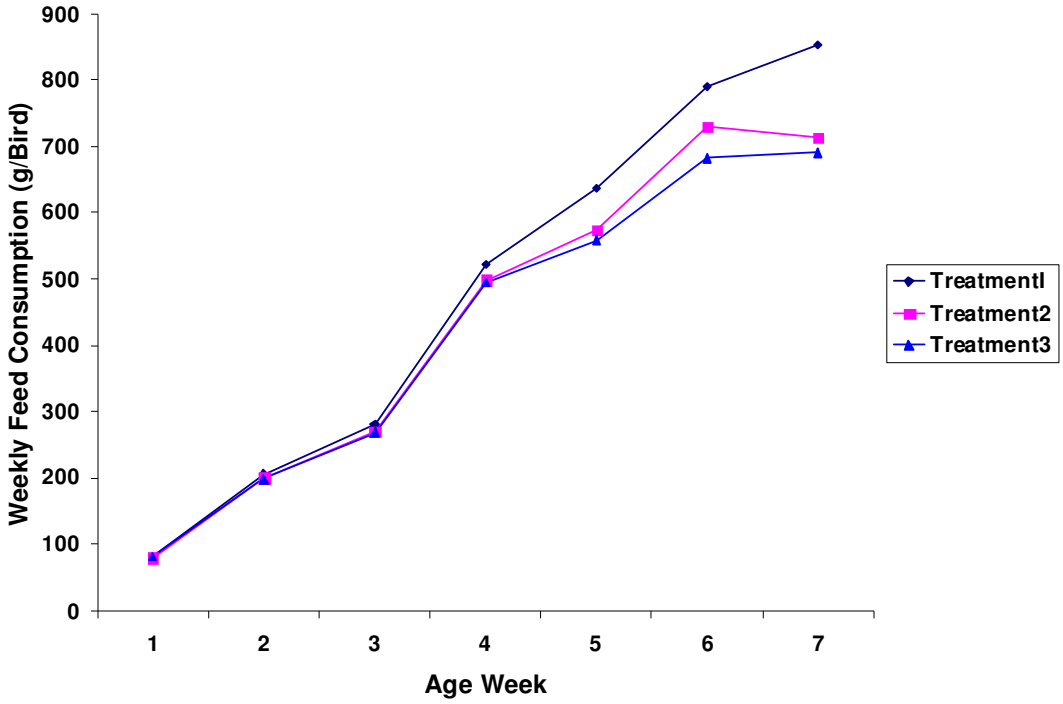


Fig (2): Weekly feed consumption of the experimental birds g/bird/week.

1= starter diet

2= starter diet + grower diet + finisher diet

3= starter diet + finisher diet

4.2. Live body weight

The data of total live body weight under the different feeding programmes (treatments) is presented in table (5) and figure (1); while table (7) and figure (3) show the weekly live body weight. It can be seen that the three feeding programmes (treatments) did not have significant effects on final live body weight at the end of the experimental period. The highest live body weight was however, attained by the birds reared on treatment I (single starter diet), followed by the birds on treatment III (starter and finisher diets) and then the birds on treatment II (starter, grower and finisher diets).

The mean weekly liveweight of the experimental birds is presented in table (7) and fig (4).It can be seen that body weight was progressively increased over the experimental period. The highest weekly liveweight was attained by the broiler reared on treatment I, followed by treatment II and then treatment III.

The weekly live weight gain (table 8 and figure 4) reveal progressive increases of live weight gain over the experimental period. These increases in weekly live weight gain follow closely the same pattern of increased weekly feed intake. The gain was markedly higher in the group of birds fed on the single starter diet (treatment I).

Table (7):

Weekly mean live body weight of the experimental birds (g/bird)

Age in weeks	Experimental Treatments			
	1	2	3	SE
1	78	83.3	80.00	3.47 NS
2	155.00	166.6	158.3	6.80 NS
3	285.8	316.6	311.6	13.15 NS
4	520.00	530.00	540.00	20.88 NS
5	785.00	785.00	813.3	20.57 NS
6	1088.3	1055.6	1067.00	31.67 NS
7	1370.00	1330.9	1355.00	41.53 NS

-Values are means of 30 bird/treatment/ week.

-NS= not statistically significant.

-SE= standard error of means.

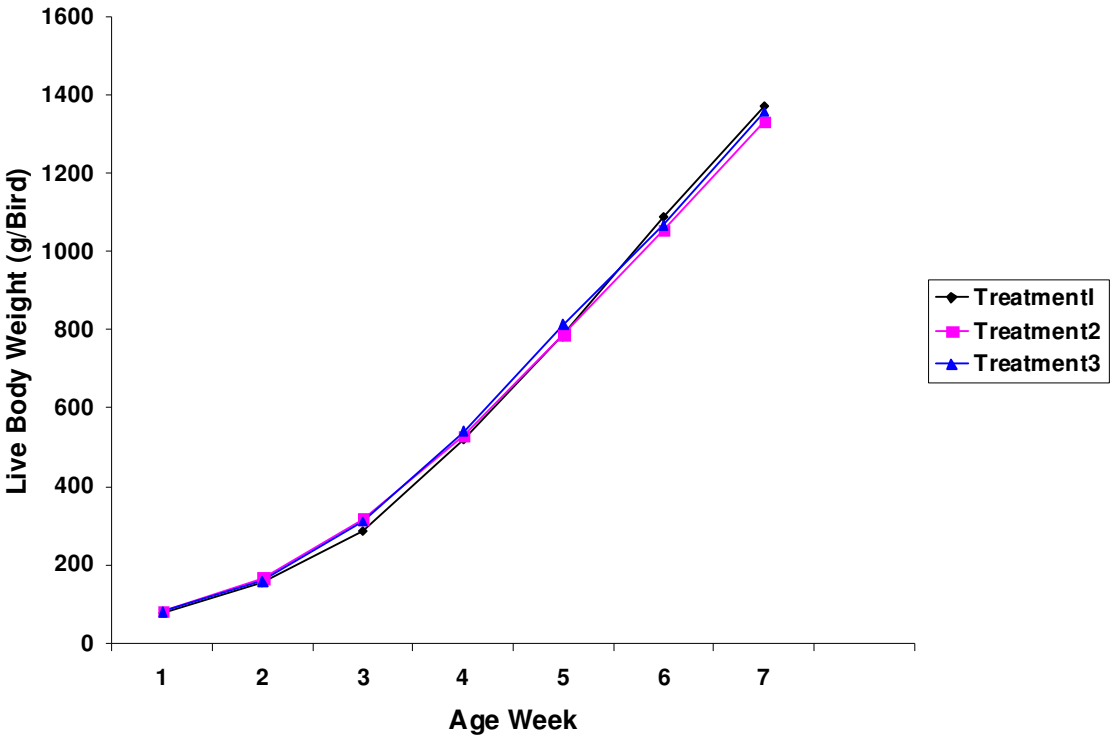


Fig. (3) Weekly mean live body weight of the experimental birds

1= starter diet,

2= starter diet + grower diet +finisher diet

3= starter diet + finisher diet

Table (8):

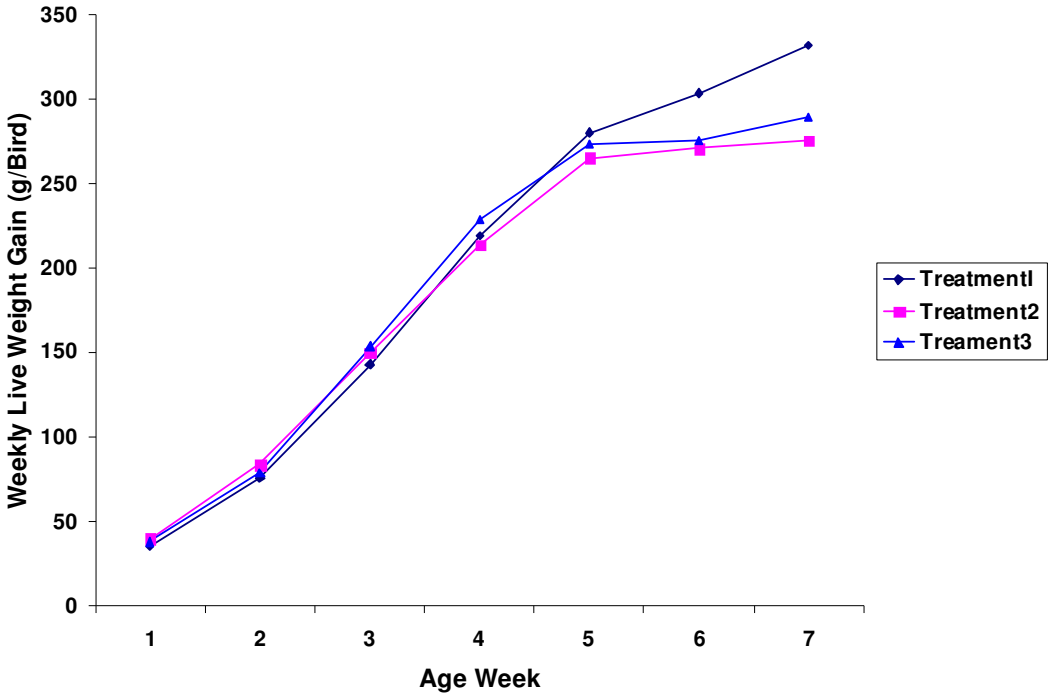
Weekly mean live weight gain of the experimental birds (g/bird/ week)

Age in weeks	Experimental treatments			
	1	2	3	SE
1	35.33	39.67	37.67	2.31 NS
2	75.00	83.33	78.33	5.18 NS
3	142.83	150.00	153.33	8.49 NS
4	219.17	213.33	228.33	14.65 NS
5	280.00	265	273.33	11.09 NS
6	303.33	270.67	275.33	18.30 NS
7	331.67	275.00	289.00	26.38 NS

- **Values are means of 30 birds/treatment/week.**

-NS= Not statistically significant.

-SE= Standard Error of means.



diet+ finisher diet

Fig.4. Weekly mean liveweight gain of the experimental birds (g/bird/week)

1=starter diet,

2=starter diet +Grower diet + finisher diet,

3=starter diet+ finisher diet

4.3. Weekly Feed conversion Ratio

The data on mean feed conversion ratio for the whole experimental period and on weekly basis are presented in table (9) and figure (5) . There were no significant differences in total or weekly feed conversion ratio among the different treatments. It can, however, be noticed that the mean feed conversion ratio was slightly higher than normal values for broiler chicks. The lowest feed conversion was recorded in the third week, at the end of feeding the starter diet to all the experimental bird.

4.4. Dressing percentage

The results for mean dressing percentage (table 5) are significantly affected by the experimental treatments. The highest dressing percentage was attained by the birds fed the starter and finisher diets (treatment III) followed by the birds fed the starter, grower and finisher diets (treatment II) and the least was attained by the birds reared on a single starter diet (treatment I)The differences in mean dressing percentage were not statistically significant among the treatments . It can, however, be noticed that the values for dressing percentage do not follow the pattern of feed consumption and live weight gain

4.5 Cost of feeding

The cost of feed consumed by the experimental birds per each treatment are shown in (table 5). The highest cost of feeding was attained on treatment II followed by treatment III and then treatment I. This does not, however, follow the pattern of total feed consumption, due to the unexceptionally high price of grain sorghum which was included at high levels in the grower and finisher

diets of the experimental birds (table 5).

Table (9):

Weekly mean feed conversion ratio of the experimental birds (g feed intake/g live weight gain)

Age in weeks	**Experimental treatments**			
	1	2	3	SE±
1	2.32	2.01	2.15	0.14 NS
2	2.74	2.40	2.52	0.15 NS
3	1.96	1.8	1.75	0.12 NS
4	2.38	2.33	2.16	0.25 NS
5	2.04	2.4	2.4	0.12 NS
6	2.60	2.6	2.47	0.14 NS
7	2.57	2.59	2.38	0.26 NS

-Values are means /treatment/week.

-NS= Not statistically significant.

- SE= Standard Error of the means.

-1= starter diet, 2= starter diet+ grower diet + finisher diet, 3= starter diet + finisher diet

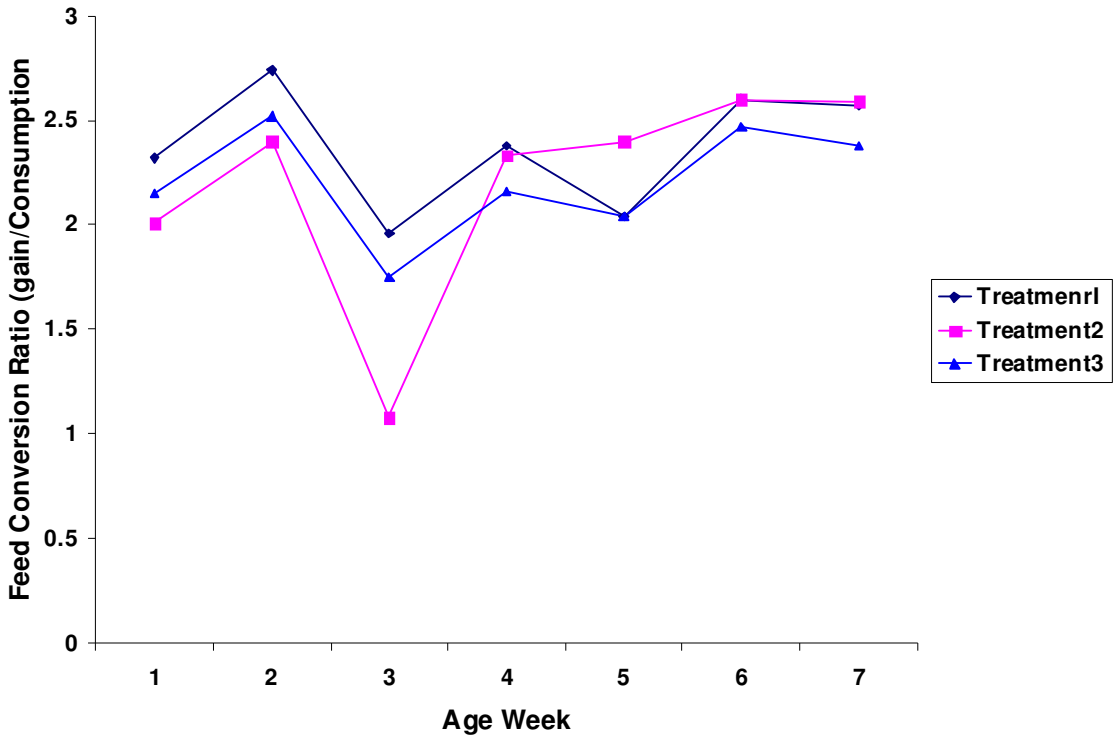


Fig.(5): Weekly feed conversion ratio of the experimental birds

1=starter diet,

2= starter diet grower diet +finisher diet,

3= starter diet +finisher diet.

Table (10) shows the total nutrient consumption under the different experimental treatments. It can be seen that the consumption of all nutrients was higher on treatment I under which the birds were fed the starter diet in the whole growing period.

Table (10):

Total nutrients consumption of the experimental birds (g/bird/ 7week)

Item	**Treatments**		
	I	2	3
ME Kcal	10132	9575	9587
Crude protein	788	669	566
Lysine	44	38	35
Methionine	19	18	17
Calcium	48	42	37
Av. Phosphorus	11	10	9

1= starter diet

2= starter diet + grower diet + finisher diet

3= starter diet + finisher diet

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CHAPTER FIVE

DISCUSSION

The present study was conducted to assess the effect of phase feeding in supporting performance of broiler chicks. The experimental work consisted of feeding broiler chicks one of three different feeding programmes, namely a broiler starter diet for the whole 7-weeks experimental period, or feeding the starter diet followed by a grower diet and finisher diet, or feeding the starter diet followed by the finisher diet to the end of the experimental period. The results of performance did not show significant differences in total feed consumption, live weight gain or feed conversion efficiency among the experimental birds.

These results are in line with several reports on the effects of phase feeding of broiler chicks, which include reports by Skinner et al (2000), Warma and Emmert (2000), Pope and Emmert (2001) and Roush (2004). These workers indicated that phase feeding can support similar feed intake growth, carcass yield and feed efficiency to that of feeding a single starter diet based on NRC recommendations.

Despite the insignificant differences in performance among the different feeding programmes, the results revealed certain trends in insignificant differences in performance among the experimental feeding programmes. The highest feed intake and live weight gain were attained by feeding the single starter diet throughout the experimental period; while

feeding the starter diet accompanied by the grower and finisher diets resulted in the lowest body weight gain; and feeding the starter diet followed by the finisher diet to the end of the experimental period resulted in the lowest feed intake and lowest feed conversion ratio.

These trends in performance generally follow the pattern of nutrients intake, resulting from the differences in feed consumption of the experimental diets. In this respect, the intake of all essential nutrients was highest under programme (I), where the chicks were fed the nutrient dense starter diet during the whole experimental period. This was followed by the birds reared on programme (2), and was least on phase feeding programme (3).

No differences in feed intake, body weight gain, or feed conversion efficiency were observed among the experimental birds during the three weeks starting period. This can be attributed to the fact that all the birds during this period received the same starter diet and almost consumed the same amounts of feed and nutrients. The amount of feed consumed during this period was only a small fraction of the total feed consumed by the birds over the 7 weeks growth period. Consequently, the highest amount of feed and nutrients were consumed during the grower and finisher periods, thus having a greater impact on body weight gain and feed utilization during the later phases of the growth period. These effects were clearly marked in the work of Warma and Emmert (2000) and Skinner *et al* (2001) and Rouch (2004). These workers indicated that body weight and feed conversion were not sensitive to the grower diet feeding in a three- diets phase feeding programme. On the other hand increasing the starter diet feeding period had the strongest effect on increasing body weight and decreasing feed conversion ratio; while decreasing the feeding period of the finisher diet increased the body weight and decreased the

feed conversion ratio,. It has also been indicated that broiler performance under phase feeding programmes is influenced by the length of the growing period and the proportion of time that the starter, grower and finisher diets are fed, as well as the stage of growth at which these diets are introduced.

The absence of significant differences among the results of the present study indicates that the three tested feeding programmes were capable of supporting similar productive performance of broilers. This is irrespective of the marked differences in nutrients intake, particularly crude protein and lysine. This, however, did not reflect any differences in the cost of feed consumed under the different feeding programmes, due to the unexceptionally high prices of grain sorghum in the particular season, which was used at high percentages in the grower and finisher diets. Under normal price conditions, the cost of feeding will be lowest in the programme which consisted of feeding the starter diet followed by the finisher diet. The same programme seemed to be more appropriate for supporting broiler production in the light of the attained lowest feed consumption, reasonably high live weight gain and lowest feed conversion ratio among the experimental treatments.

It can be considered that the conditions of the present experiment though limited, reflects the advantage of phase feeding of broiler chicks, particularly the programme of feeding the starter diet followed by finisher diet.

CHAPTER SIX

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