An-Najah National University
Faculty of Graduate Studies

The Effects of Partial Replacement of Soybean Meal in the Grower Diet with Sun-Dried Blood and Boiled Feather Meals on the Performance of Broiler Chicks

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DEDICATION

This project is dedicated to my parents, brothers, and sisters. The completion of this work was not possible without their support, courage and help.

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I would like to express my deep thanks and appreciation to Dr. Maen Samara for his continuous supervision and advises through the entire project. In addition I would like to thank my committee members, Prof. Adnan Shuqier and Prof. Jamal Abo Omar. Special thanks are extended also to all those who helped me to complete this work .

إقــرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

The Effects of Partial Replacement of Soybean Meal in the Grower Diet with Sun-Dried Blood and Boiled Feather Meals on the Performance of Broiler Chicks

تأثير الاستبدال الجزئي لكسبة فول الصويا في عليقة النمو بوجبة دم مجفف بالشمس أو وجبة ريش مغلي ومجفف على أداء صيصان اللحم

أقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء مـــا تمــت الإشارة إليه حيثما ورد، وأن هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name:	**اسم الطالب:**
Signature:	**التوقيع:**
Date:	**التاريخ:**

List of Abbreviations

AA	Amino Acids
BM	Blood Meal
BOM	Broiler Offal Meal
BY	Breast Yield
CP	Crude Protein
DAA	Digestible Amino Acids
DCP	Di Calcium Phosphate
DM	Dry Matter
EE	Ether Extract
FCR	Feed Conversion Ratio
FM	Feather Meal
GIT	Gastro Intestinal Tract
HH	Hog Hair
HBFM	Hydrolyzed Broiler Feather Meals
ME	Metabolizable Energy
NRC	National Research Council
NIS	New Israeli Shiqel
PER	The Protein Efficiency Ratio
SAS	Statistical Analysis System
SDBM	Solar Dried Blood Meal
TA	True Available
TAA	Total Amino Acids

List of Contents

List of Tables

List of Appendices

The Effects of Partial Replacement of Soybean Meal in the Grower Diet with Sun-Dried Blood and Boiled Feather Meals on the Performance of Broiler Chicks

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Abstract

This study was conducted to determine the effects of feeding feather, blood meals, separately, or combined, during the grower phase, on the performance of broiler chickens. Straight-run, one hundred and fifty one day old broiler chicks were reared in deep litter house to 18 days of age, at day 19, one hundred chicks were divided into ten equal replicate groups using completely randomized block design. Five isonitrogenous and isocaloric experimental mash growing diets were prepared as follows : control, diet 2 contained 5% feather meal (FM), diet 3 contained 5% blood meal (BM), diet 4 contained 5%FM plus 3%BM, and diet 5 contained 5%FM plus 5% BM. The chickens were randomly allocated to the five dietary treatment groups having two replicates of 20 chicks in each group . Feed intake, weight gain, feed conversion ratio, and carcass characteristics were not significantly affected by dietary treatments. Feed conversion was numerically better for the control birds followed by those fed 5% BM. Birds fed the diet that contained feather meal plus blood meal 5%BM, and 5%FM diets had feed conversion numerically lower than the birds fed the control . The results indicated that heated sun-dried blood meal up to 5% or boiled feather meal up to 5% can be incorporated in the growing broiler diet without any adverse effect on production variables during the growing and at the end of the rearing period .

Chapter One

Introduction

1. Introduction

One of the major obstacles facing broiler production, in Palestine, is the extremely high cost of feed ingredients especially protein feedstuffs. Feed cost usually goes as high as 75 % of the total production cost (Samara, 2000). Another problem facing broiler producers is the fluctuation in prices of live broiler chickens .

Given the objectives of broiler production of having chickens grow fast and attain market weight in the shortest possible period of time, one may investigate the means of reducing cost without interfering with these objectives .

A possible means of maintaining supply of broiler meat all year round at cheaper prices is by reducing the cost of production. Cost of production can be reduced by making use of poultry by-products that are produced locally and characterized by easiness of handling and low prices .

Feather and blood meals are the two major poultry by-products that have no use in the animal farming practices. These by-products are usually thrown unsupervised in dumping sites around cities and villages .

Several recent studies indicated that these by-products can be easily processed and inserted in broiler rations (Ochetim, 1993). It has been reported that blood meal is rich in lysine, arginine, methionine, cystine, and leucine , but is deficient in isoleucine (Donkoh *et al*., 1999). On the other hand, feather meal is characterized by its low digestibility for non-ruminants. Also feather meal is deficient in the above mentioned amino acids. When feather meal was used in poultry rations which were supplemented with the synthetic form of the deficient amino acids performance of the broilers was improved (Papadopulos *et al*., 1985; Luong and Payne, 1977; MacAlpine and Payne, 1977; Morris and Balloun, 1973; Moran *et al*., 1966; Naber *et al*., 1961) .

None of the previous researches has dealt with effects of a combination of both blood and feather meals on performance of broiler chickens as a phase feed (Wang and Parsons, 1997; Eissler and Firman, 1996; Latshaw *et al*., 1993; Ochetim, 1993). On the other hand, (Denton *et al*., 2005) indicated that poultry by-products can be re-utilized safely as poultry feed.

Attitude toward the utilization of animal protein sources as poultry feed especially just before marketing is of a concern to consumers . Therefore, the current research is designed to insert blood meal or feather meal in the growing ration of broiler chickens. A simple way of processing these ingredients will be implemented .

The use of these two ingredients can be benificial to growth of broilers and can improve farm profitability

It is therefore important to explore alternatives of neglected protein sources with lower cost.

Chapter Two

Literature Review

2.Literature Review

2.1 Nutrition of Poultry

Poultry feeding and nutrition have been changed more than the feeding and nutrition of any other species. The vast majority of commercial poultry feeds is produced in large feed mills wherein the maximum of science and technology exists. The current trend in poultry production is toward controlled environment , which usually resulted in lower feed consumption.. The nutrient contents of feed (energy, amino acids, vitamins, and minerals) are varied so as to compensate for the reduced feed intake and to meet the requirements which are often taken into consideration (Ensminger, 1990). According to previous studies (Samara, 2000) in Palestine, feed accounts for more than 65-75% of production broilers costs .This has been attributed to the high prices of imported feedstuffs especially cereals . Soybean meal has been traditionally used as the sole protein source in broiler diets (about 30% of the ration).

2.2 Protein in Poultry Nutrition

The usefulness of a protein feedstuff for poultry depends upon its ability to furnish the essential amino acids required by the bird, the digestibility of the protein, and the presence or absence of toxic substances. As a general rule , several sources of protein produce better results than single protein source . Both vegetable and animal protein supplements are used for poultry (Ensminger, 1990). Most of the protein supplements of animal origin contribute amino acids, minerals and vitamins which significantly affect their value in poultry rations, but they are generally more variable in composition than the vegetable protein supplements (NRC, 1994).

2.3 Animal Proteins

Protein supplements of animal origin are derived from : meat packing and rendering operations, poultry and poultry processing, milk and dairy processing, and fish and fish processing (Denton *et al*., 2005). Before the discovery of vitamin B-12, it was generally considered necessary to include one or more of these protein supplements in the rations of chickens. Many protein supplements of animal origin are difficult to process and store without some spoilage and nutrient loss . If they cannot be dried, they must be usually refrigerated. If not heated to destroy disease-producing (pathogenic) bacteria, they may be a source of infection. On the other hand , protein availability will be reduced and some nutrients are lost if the feed is heated excessively (Ensminger, 1990).

Firman and Robbins (2004) reported a long history of worldwide animal protein use in the poultry industry. Products currently being utilized include meat meals from ruminants, swine, and poultry origin, as well as the blood and fat products from each of these animals. Feather meal, hatchery by-product, spent hens, blood meals have also been used for non-ruminant animals (Cozzi *et al*., 1995; Kersey *et al*., 1997; Deshmkh and Patterson, 1997; Klemesrud *et al*., 1998; Grant and Haddad, 1998; Moritz and Latshaw, 2001).

There has been also some interest in replacement of a portion of the soybean meal in poultry rations with animal products to improve performance. The addition of animal protein sources may significantly improve performance parameters over standard diets . While these results may be due to high levels of limiting amino acids, it may also be explained by the reduction of poorly digested carbohydrates in the soybean meal

(Firman and Robbins, 2004). These authors suggested that information are needed to utilize these products in ration formulation, methodology, and the economic limitations of their use as well. Ultimately, with this information in hand, proper decisions about the use of these products can be made and money can be saved.

Blood meal is a product based on a drying method from the blood processed in chicken or beef plants. A significant portion of blood meal is used for production of plasma proteins. Blood meal is generally not used in high concentration in poultry diets due to its amino acid imbalance. Constraints could be at one to two percent of the total ration (Firman and Robbins, 2004). However, previous research (Donkoh *et al*., 1999) reported that dietary sun dried blood meal up to 75g/kg had a positive effect on growth performance of broiler chickens. On the other hand, (Khawaja *et al*., 2007) reported that oven dried blood meal up to 3% of the broiler starter diet did not adversely affect production parameters through the finishing stage of growth.

Feather meal is the ground and hydrolyzed feather from chicken and turkey processing. Generally, feather meal is considered to be low in digestibility and with a poor amino acid balance and is thus not heavily used in the poultry industry (Ensminger, 1990). Higher level can be fed when careful formulations are used, but this is rarely cost effective (Firman and Robbins, 2004).

Addition of fat to rations have also proved to be a factor in increasing digestibility of animal protein (Firman and Remus, 1994). Increasing the fat content of a diet can slow gut motility, leaving more time for digestion and absorption nutrients. The micelles themselves may also help transport amino acids to the gut wall (Firman and Remus, 1994) .

Animal proteins are useful constituent of poultry rations . They provide a high level of protein/amino acids, highly available phosphorus, a number of other minerals, and moderate amounts of energy. However, benefits of animal protein, as poultry feed, depend on method of processing and cost effectiveness .

2.4 Amino Acids Nutrition of Broilers

Utilization of digestible amino acid values instead of crude protein percent in formulation of poultry diets is a mean of improving the utilization of protein sources, that are known to be less digestible than soybean meal. One of the greatest drawbacks to implementation of digestible amino acid values is the limited database for such values (Waldroup, 2000). The author reported that feather meal is high in crude protein but the digestibility of the protein is low compared to that of soybean meal . As a result , it is not considered by nutritionists to be a desirable ingredient and its usage is often limited to low levels (2-5%) in most poultry diets . One of the proposed advantages for using digestible amino acid values is that accounts for the reduced digestibility of protein sources of lesser quality such as feather meal, allowing for improved utilization in poultry feeds (Waldroup, 2000). The author suggested that the use of digestible amino acid values for more efficient formulation of broiler diets is of growing interest among nutritionists .

Some previous works demonstrated better broiler performance when digestible amino acids (DAA) levels were taken into consideration in feed formulation (Dari *et al*., 2005; Fernandez *et al*., 1995; Rostango *et al*., 1995; Elwell and Soares, 1975). These authors concluded that formulation based on DAA balance promote better weight gain in broilers than those based on total amino acids (TAA) levels . They also reported that the use of ingredients with low AA digestibility (i.e. feather meal) requires formulation based on DAA to obtain performances closer to those achieved with diets based on corn-soybean meal .

Methionine, lysine and thrionine are considered to be the first, second and third most limiting amino acids in broilers fed practical corn-soybean meal diets, respectively (Ojano-Dirain and Waldroup, 2002) .These authors reported that lysine levels had no significant effect on 21 to 42 d body weight gain, feed conversion ratio , or dressing percentage of broilers, but increasing lysine levels from 1.03 to 1.12% significantly ($P<0.05$) improved breast yield (BY) and reduced abdominal fat. Increasing methionine to 0.44% of the ration resulted in significant improvements in body weight gain, feed conversion, dressing percentage, breast yield, and a numerical ($P=0.08$) reduction of lysine and thrionine on breast yield .

Oviedo-Rondon and Waldroup (2002) suggested that computerized growth models can be a useful tool to determine more profitable and accurate concentrations and balance of dietary amino acids and other nutrients for broiler chickens . The methodology of mathematical modeling can be rapidly accepted in poultry nutrition and research due to the complexity of nutrient requirement estimations in practical and economical terms , and the necessity to have some quantitative margin of safety in the prediction of broiler performance for decision-making applications in the poultry industry .

2.5 Feather meal and Blood Meal

2.5.1 Blood Meal

Blood meal is a dark chocolate colored powder with characteristic smell . Its protein content varies from 65-85% (McDonald et al., 1992) .It is rich in lysine, arginine, methionine, cystine, and leucine but is very poor in isoleucine (NRC, 1994) .

It has been reported that 1-4% blood meal can be incorporated in the broiler diet without any adverse effects on performance (Ikram *et al*., 1989; Nuarautelli *et al*., 1987).

Donkoh *et al*. (1999) reported that solar dried blood meal (SDBM) dietary supplementation of broiler chicken up to 75g/kg increased growth and concluded that partial replacement of fish meal and groundnut cake by SDBM was a viable means .

Khawaja *et al.* (2007) investigated the effect of blood meal in broiler diet during starter (0-4weeks) and finisher (5-6 week) phases of growth. In their study fresh blood was boiled at 100 C for 45 minutes and then dried in a hot air oven at 55 C for 6 days and ground into meal. They found that chemical composition of partially dried blood meal was 92% DM 80% crude protein, 8.5% total ash, 1.2% ether extract, 1.3% crude fibre, 9% nitrogen free extract, 0.28% Calcium, 0.25 % phosphorus, 1.98% sodium chloride, and 2850 kcal/kg metabolizable energy. Amino acid profile revealed that sufficient quantity of almost all essential amino acids was present in blood meal. Isoleucine was the first limiting amino acid and methionine was the second limiting amino acid . They concluded that blood meal can be used as a supplemental source of protein and can be used to increase the crude protein content of cereal grains and plant by-products. Previous research (McDonald *et al*., 1992, and Oyenuga 1968, Onwudike 1981) reported similar findings.

Onwudike (1981) reported that the lysine level in the blood meal is relatively high (7-8%), which makes it an excellent supplemental protein source to be used with plant derived feed ingredients that are low in lysine. Schingoethe (1991) also reported that in, blood meal, isoleucine and methionine were 1st and 2nd limiting amino acids, respectively relative to milk (Protein Score).

Schingoethe (1991) concluded that during the starting and finishing periods of growth, the chickens fed diet containing 3% blood meal gained ($p<0.01$) maximum weight compared to chickens fed other diets . Similarly (Petkov *et al*., 1980; Nuarautelli *et al*. 1987; and Ikram *et al*. 1989), reported that blood meal can be effectively used up to 3% without any adverse effect on growth of broiler chickens. However, weight gain in broiler chickens was reduced with higher concentrations of blood meal due to the very low levels of the sulphur containing amino acids and isoleucine (Onwudike, 1981). This was consistent with the observations of Ikram *et al*. (1989) in which mortalities were recorded due to ascites because of rapid growth, high feed efficiency and large pectoral muscle mass. Finally, the economics of 3% blood meal diet was more encouraging, as it generated more profitability than those of control and high level blood meal diets. The above findings suggested that blood meal up to 3% can be incorporated in broiler starter and finisher diets without any adverse effect on production parameters. For optimizing the profits from feeding of blood meal, it may be used in the diets of commercial broiler chicks. Limited research has been conducted in using higher level of blood meal of broiler diets when supplemented with essential amino acids .

It is also not known whether including blood meal as a substitute for soybean meals in the grower diets make any difference compared to using blood meal in the starting, and finishing diets .

2.5.2 Feather Meal

Feather meal or hydrolyzed poultry feather meal is produced by hydrolyzing clean, undecomposed feathers of slaughtered poultry .

Feathers are known to be high in crude protein (Wessels, 1972). However, the availability of the protein in feathers is low due to the keratinized nature of the protein (Moran *et al*., 1966). The first report on using heat to improve the nutritive value of feathers was reported by Draper (1944). The availability of the protein from feather meal can be improved by processing (Latshaw and Biggert, 1983). Several researchers have investigated chemical or enzymatic methods for the hydrolysis of feathers (Steiner *et al*., 1983, Papadopoulos *et al*., 1985, Latshaw, 1990, El-Boushy *et al*., 1990) .

Ochetim (1993) suggested that the inclusion of the processed water boiled feather meal up to 3.0% in the diets did not significantly affect mean body weights, feed intake, and feed conversion ratio of broiler chickens. Also carcass data from the slaughtered chickens showed that birds fed diets containing 0, 1.5, and 3% feather meal had higher ($P<0.05$) carcass yields compared to those fed the 4.5% feather meal diet (Ochetim, 1993) .

Kim and Patterson (2000) used feather-digesting enzymes or NaOH to remove the feathers from the carcasses of dead hens and evaluated their impact on the nutritional quality of the resulting feather meal .These authors found that feathers on poultry carcasses negatively affect the quality of meals from end products because feathers have poor digestibility. The hydrolysis of feathers from carcasses required higher temperature, pressure, and greater time than conventional carcass processing. These authors concluded that enzyme treatment could improve the nutritional quality of feathers from dead hens, whereas NaOH treatment would be a faster method to separate the feathers from the hen carcasses . Autoclaving feathers reduced the improvement of feather digestibility caused by either enzyme or NaOH treatment .

Papadopoulos *et al*. (1985) reported that prolonged processing periods and elevated NaOH concentrations increased losses of cyctine, lysine, and methionine. They also found that the digestibilities of limiting essential amino acids, lysine, histidine, and methionine, were especially low .

Moritz and Latshaw (2001) collected feathers from a commercial broiler plant and feathers were hydrolyzed with saturated steam in an experimental batch hydrolyzer. A constant time series (36 min) was completed to evaluate the effect of increasing pressure (207 to 517 kPa) on nutritional value. Feather meal processed at the lowest pressure had the highest nutritional value, and vice versa. True amino acid availability determined with force-fed White Leghorn cockerels demonstrated that increasing pressure decreased true available (TA) cystine ($P<0.05$) more than any other amino acid. Several analysis showed significant linear effects ($P<0.01$) due to hydrolysis pressure. Sulfur content decreased with increasing pressure .

Several workers Mohammed *et al*. (1990), Latshaw (1990), and Isika and Agom (2005) showed that poultry offal and feather meals are alternative feed sources, but that the ingredients are abundant in some nutrients and deficient in others. Van Der-Poel and El-Boushy (1990) reported that feather meal is a good source of leucine and cystein, 4.65% and 3.92%, respectively, while lysine, tryptophan and methionine were the first limiting amino acids. Latshaw (1990) showed that poultry offal was an excellent source of lysine (5.13%) and methionine (3.71%) .

Isika *et al*. (2006) evaluated the complementary effect of broiler offal meal (BOM) and hydrolyzed broiler feather meals (HBFM) processed using simple low cost technologies on the nutrient retention, carcass characteristics and organ mass of broiler chickens. The offal included intestines, gut content, heads and feet that were cooked (wet-rendered) using firewood at a temperature range of 95-110C for 40-45 minutes to remove fat and sterilize the material. The material was pre-sun-dried at 37.5C and later oven-dried at 65C for 48 hours to obtain 90-92% dry matter, while common salt was added and mixed at the rate of 0.025% weight of the offal as preservative. Similarly, feathers from the same birds were collected and wet-rendered as in the case of broiler offal with a slight modification in cooking conditions. Feathers were cooked for four to five hours at a temperature range of 95–110C. The feathers were drained of water and further screw pressed to bring the moisture content to 50-55%. They were pre-dried under the sun at 37-38C and finally dried in an oven at 105C for 24 hours to obtain a glassy brittleness and 90-92% dry matter content. The processed material was then hammer-milled for fine and uniform consistency to obtain hydrolyzed broiler feather meal (HBFM). These authors observed that a combination of BOM and HBFM in diets for starter and finisher broiler chickens did not adversely affect the retention of dry matter, crude protein, crude fiber, calcium and phosphorus in both the starter and finisher phases, but decreased ether extract and crude protein retentions at the finisher phase more than other diets. The carcass characteristics and organ mass were also favorably comparable to the control, but a depressed abdominal fat pad and higher edible meat portion were observed in the BOM/HBFM mixed diet compared to the others. The combination of broiler offal and hydrolyzed broiler feather meals in poultry nutrition seems to have positive affect as alternative feed ingredients from broiler processing industry using simple low cost processing technologies.

Latshaw *et al*. (1994) examined feather meals of different qualities that were produced in commercial processing equipment . Feather meals were hydrolyzed by either a continuous hydrolyzer or a batch hydrolyzer under different steam pressures . These authors concluded that severe steam pressure processing was harmful to amino acids digestion .

Wang *et al*. (1997) tested the effects of five commercial processing systems and to a lesser extent, processing temperature within system , on protein quality of feather meals (FM). The six FM samples averaged 88.7% CP, 1.99% Lys, 4.83% Cys, and 0.71% Met on a DM basis .

Denton *et al*., (2005) reported that the poultry industry is still the major user of animal protein , using over 36% of all production of by-products. The increasing size of poultry processing plants has intensified the problem of disposal of poultry wastes, blood and feathers. Processing of these wastes as a feedstuff will play a part in solving the world's protein needs by producing more animal protein and creating a price structure (El Boushy *et al*., 1989)

The disposal of feather and blood from local commercial poultry processing plants are considered as a major environmental threat. On the other hand, the high costs of poultry feed ingredients compared with the cost of wastes disposal require that poultry by-products should be recycled or reused .

Processing and inclusion of poultry by-products as a substitute for soybean meal is expected to reduce the cost of feeding broiler chickens . Feeding poultry by-products in the growing phase of the broiler chicken will dissipate concerns of producers as well as consumers about the ethical or religious matters .

Chapter Three

Materials and Methods

3. Materials and Methods

3.1 Blood Meal Preparation

Fresh blood was collected from the local chicken slaughter house in Tulkarm . Blood was immediately heated in an open pan to 60- 80 C for 30- 45 min and was shacked very well in order to facilitate evaporation of water and coagulation. The coagulated blood together with the remaining small amount of the liquid fraction were transferred to a solar dryer for drying a moisture content for 3 to 4 days . Finally a hammer mill of 2 mm mesh size was used to reduce the material to a uniform particle size. The blood meal (BM) was then stored in a tightly closed nylon bags in (10-15 C) until used in the experiment .

3.2 Feather Meal Preparation

Plucked feathers were collected from the same slaughter house. Feathers were washed by fresh water on a metallic wire to let down the water and remove the foreign materials as legs and other offals cuts. Feathers were cooked and boiled in open pan at 100 C for 10 to 15 min. The feathers were drained of water on a metallic wire for 10 min to bring the moisture content to 40-50 %. Cooked feathers were then spread on clean floor and covered by a white screen and sun dried for 3 days to obtain a glassy brittleness and 94% dry matter content. Finally the processed material was then hammer-milled (2 mm sieve) to obtain fine and uniform particles. Feather meal (FM) was then stored in a tightly closed nylon bags until used in the experiment .

3.3 Experimental Diets

Five isonitrogenous and isoenergetic grower diets (Table 1) were formulated for the growing phase . A control diet did not contain FM or

BM . The second diet had part of the soybean meal substituted with boiled feather meal (FM) at a rate of 5%.The third diet had part of the soybean meal substituted with sun dried blood meal (BM) at a rate of 5%. Diets four and five had part of the soybean meal substituted with boiled feather meal and sun dried blood meal at 3%BM+5%FM and 5%BM+5%FM levels, respectively. All dietary ingredients were purchased from a local poultry feed company. The different meals at each level were used in the grower diet .

Table 1: Composition of the experimental grower diets .

Ingredient (%)	Treatments				
	Control	F	B	FB53	FB55
Corn	56.210	63.100	63.770	67.120	69.610
Soybean	34.700	24.100	23.980	17.690	13.610
Blood meal	0.000	0.000	5.000	3.000	5.000
Feather meal	0.000	5.000	0.000	5.000	5.000
Oil	4.210	3.120	2.650	2.410	2.000
DCP	1.815	1.692	1.692	1.680	1.670
Limestone	1.325	1.401	1.401	1.440	1.452
Salt	0.582	0.497	0.447	0.490	0.582
DL-Methionine	0.339	0.361	0.361	0.376	0.386
Lysine	0.206	0.347	0.122	0.309	0.273
Pre-mix*	0.600	0.600	0.600	0.600	0.600
Total	100.000	100.000	100.000	100.000	100.000

*Premix supplied per 4.00 kg : vitamin A, 8.50 MIU; vitamin D3, 2.50 MIU; vitamin E, 50.00 KIU; vitamin K3, 2.00 g; vitamin B1, 0.80 g; vitamin B2, 5.59 g; panototeic acid, 11.20 g; niacin, 30.00 g; vitamin B6, 2.40 g; vitamin B12, 8.00 mg; folic acid, 0.80 g; biotin, 150.00 mg; cholin chloride, 200.00 g; cobalt, 0.20 g; copper, 15.00 g; iron, 20.00 g; manganese, 80.01 g; iodine, 1.20 g; selenium, 0.20 g; zinc, 50.01 g; lime-stn, 1672.12 g; anilox, 125.00 g .

The calculated analyses of the experimental diets are shown in (Table 2).

Table 2: Calculated analyses of the experimental diets

Ingredients (%)	Treatments				
	Control	F5	B5	FB53	FB55
Dry Matter (%)	89.4	94.6	89.5	89.5	89.6
ME (Kcal/kg)	3100	3100	3100	3100	3100
Crude Protein (%)	20	20	20	20	20
Ether Extract (%)	2.48	2.98	2.74	2.13	3.21
Crude Fiber (%)	2.59	2.37	2.36	2.23	2.13
Calcium (%)	1.0	1.0	1.0	1.0	1.0
Phosphorus (%)	0.56	0.53	0.50	0.54	0.54
Arginine	1.202	1.205	1.107	1.146	1.111
Glycine	0.890	1.003	0.926	1.024	1.041
Serine	0.725	1.0	0.750	1.032	1.043
Histidine	0.431	0.402	0.531	0.461	0.501
Isoleucine	0.659	0.723	0.575	0.671	0.639
Leucine	1.332	1.513	1.696	1.726	1.871
Lysine	1.285	1.270	1.369	1.285	1.285
Methionine	0.652	0.652	0.652	0.523	0.652
Cystine	0.330	0.489	0.499	0.470	0.457
Phenylalanine	0.789	0.836	0.923	0.915	0.970
Tyrosine	0.484	0.532	0.513	0.548	0.559
Thrionine	0.759	0.788	0.755	0.783	0.783
Tryptophane	0.176	0.164	0.201	0.179	0.189
Valine	0.828	0.968	1.036	1.091	1.175

3.4 Birds and Management

A total of 150 one-day old Cobb broiler chicks were obtained from a local poultry hatchery. The chicks were reared in the experimental station of An-Najah National University-Tulkarm. The experimental house was thoroughly cleaned and disinfected before the arrival of chicks. Chicks were maintained under standard management conditions for 17 days on deep litter system as described by the management guide. The brooder temperature was maintained at about 32 C to 7 days of age and gradually decreased by 1 C every week thereafter. Chicks were provided feed and water ad libitum and 23 h of light. Chicks were vaccinated against Gumboro and New Castle diseases (12 and 17 days respectively). At 18 days old, 100 birds were choosed randomly and distributed in 5 trials groups of 2 replicates each trial. At 30 day of age , birds were allowed to feed on a commercial finisher diet until 39 day of age .

3.5 Parameters Measured

Average body weight and feed consumption data were obtained weekly until 18 days of age (last day of starter period). Body weight gain and feed intake per pen were recorded at weekly intervals. The efficiency of feed utilization was calculated as feed intake per unit body weight gain. Daily mortality and etiology of the dead birds were reported . The control and the experiment diets were given to two replicate pens to birds from day 19 to 29 .

At day 29, two birds from each replicate pen were randomly selected, slaughtered and eviscerated to record carcass, cut parts, visceral, and offal weights.

Plucked weight was recorded after removing feathers and draining the blood. Carcass weight was recorded after removing head, heart, lungs, and gastrointestinal tract (GIT).

At the end of the experiment (day 39), 4 birds from each replicate were fasted for six hours then were weighed and slaughtered . Plucked mass was obtained as a percentage of live mass after removing the feathers. The viscera and internal organs were removed and eviscerated mass obtained as a percentage of plucked mass, while the carcass yield was calculated as a percentage of eviscerated mass. Organs such as the liver, spleen, heart and gizzard were weighed and calculated as percentage of eviscerated mass.

3.5 Statistical Analysis

The dietary treatment effects for all the variables measured were analysed using the general linear models procedures of SAS (2000), and least significant difference test was applied for mean comparisons. Differences at $P \leq 0.05$ were considered significant .

Chapter Four

Results

4. Results

Body weight, feed consumption, and feed conversion of the chickens fed the grower diet supplemented with feather meal and blood meal were similar to chickens fed the control from 18-30 days of age (Table 3) .

Table 3: Effect of feather and/or blood meals on body weight, feed consumption, and feed conversion of broilers during the growing period (18-30 days) .

Variables	Treatments				
	control	F5	B5	FB53	FB55
Average body weight at 18 days(g/bird)	648.8	641.0	614.0	631.5	643.8
Total feed consumption (g)	14878	13615	13886	14000	14690
Average feed consumption (g/10bird/day)	1487.8	1361.5	1388.5	1400.0	1469.0
Body weight gain (g/bird)	783.0	706.5	757.0	644.8	728.8
FCR[1]	1.899	1.929	1.837	2.175	2.017

[1] kg feed/kg live weight.

Body weight gain of the birds receiving the control diet was numerically higher than those in the other groups. Birds receiving the feather meal alone or blood meal alone had numerically lower feed consumption/bird than the other groups, followed by the birds that received the 5% and 3% feather and blood meal, and 5% feather meal and 5% blood meal, respectively. Feed conversion ratio was lower for the B5 birds followed by that of control ,F5 ,FB55 ,and FB53, respectively .

(Table 4) shows the performance of broiler chickens from 30 through 39 days of age. No significant differences were noticed among the five experimental groups with regard to body weight , feed consumption, and feed conversion ratio. Body weight of birds receiving the control diet was numerically higher than those in the other groups. Birds receiving the diet that was supplemented with 5% feather meal plus 3% blood meal had the lowest (1276g) body weight at 39 days of age . Feed conversion ratio was lower for the control birds followed by that of B5, FB53, F5, and FB55, respectively.

Table 4: Effect of feather and/or blood meals on body weight, total feed consumption, and feed conversion of the broilers during the finishing period (30-39 days).

Variables	**Treatments**				
	Control	**F5**	**B5**	**FB53**	**FB55**
Average body weight (g/bird)	**1431.8**	**1347.5**	**1371.0**	**1276.3**	**1372.5**
Total feed consumption (g)	**12030.0**	**11847.5**	**11705.0**	**12365.0**	**12517.5**
Average feed consumption (g/10bird/day)	**1203.8**	**1184.8**	**1170.5**	**1236.5**	**1251.8**
Body weight gain (g/bird)	**716.4**	**657.9**	**682.5**	**710.0**	**646.9**
FCR[1]	**1.6844**	**1.8308**	**1.7218**	**1.7525**	**1.9354**

[1] kg feed/kg live weight.

Overall performance of the experimental birds from 18 to 39 days of age is presented in (Table 5). Birds receiving 5% blood meal had slightly higher (1.78 vs. 1.79) feed conversion compared to that of the control ones. Birds receiving feather meal alone or feather meal and blood meal had higher feed conversion ratio at the termination of the experiment .

Table 5: Effect of feather and/or blood meals on final body weight, total feed consumption, and feed conversion of the broiler chickens (18-39 days) .

Variables	Treatments				
	Control	F5	B5	FB53	FB55
Average body weight (g/bird)	2148.1	2005.4	2053.5	1986.3	2019.4
Total feed consumption (g)	26908	25463	25591	25365	27208
Average feed consumption (g/10bird/day)	2690.8	2546.3	2559.1	2536.5	2720.8
Body weight gain (g/bird)	1499.4	1364.4	1439.5	1354.8	1375.7
FCR[1]	1.7930	1.8784	1.7827	1.9469	1.9789

[1] kg feed/kg live weight.

Carcass characteristics of slaughtered birds at 30 days are presented in (Table 6). Birds fed FB53 diet or B5 diet had numerically higher carcass yield compared to those fed the other diets. There were no significant differences in dressing percentages and relative weights of cut-parts among the birds. The different diets did affect broiler cut-parts to a variable degrees at 30 days of age, but differences were not significant except for the head weight .

Table 6: Carcass characteristics of chickens fed the experimental diets at 30 days of age .

Variable (%)	Treatments				
	Control	F meal	B meal	F B 5 3	F B 5 5
Dressing	69.42a	69.34a	70.05a	68.75a	70.85a
Plucked carcass	91.89a	90.1a	90.70a	91.80a	90.96a
Head	2.09b	2.11ab	2.10ab	2.26ab	2.54a
Legs	4.36a	4.24a	4.16a	4.43a	4.41a
Neck	5.31a	5.35a	5.33a	5.20a	5.64a
Wings	7.69a	7.72a	7.28a	7.28a	7.81a
Drumstick	8.34a	8.90a	8.54a	9.15a	8.97a
Thigh	10.19a	10.46a	10.41a	10.42a	11.32a
Breast	23.05a	22.73a	23.40a	22.59a	22.61a
Back	14.88a	14.03a	14.85a	13.29a	14.64a

a-b means within the same row with different superscripts are significantly different ($P<0.05$)

Percentage weights of visceral organs and offals in chickens of the five experimental diets are presented in (Table 7), With the exception of proventroculi weights, no significant differences were observed on the weights of the offals and visceral organs for the experimental birds , weights of the proventriculus were significantly higher in chicken given the control diet compared to those given FM with the BM, FB53 and FB55 were intermediate .

Table 7: Visceral and Offal characteristics of broiler chickens fed the experimental diets at 30 days of age .

Variables(%)	Treatments				
	Control	F meal	B meal	F B 5 3	F B 5 5
Blood	3.82a	4.57a	3.76a	3.67a	4.06a
Feather	4.27a	5.32a	5.53a	4.51a	4.97a
Liver	2.61a	2.47a	2.86a	2.64a	2.48a
Spleen	0.10a	0.08a	0.08a	0.08a	0.09a
GIT	10.08a	10.72a	10.00a	10.51a	9.61a
Esophagus	0.60a	0.54a	0.59a	0.58a	0.57a
Gizard	3.10a	3.70a	3.59a	3.63a	3.63a
Proventriculus	0.74a	0.47b	0.61ab	0.59ab	0.52ab
Large intestine	0.40a	0.27a	0.35a	0.32a	0.31a
Small intestine	5.23a	5.03a	4.50a	4.65a	4.08a
Ceca	1.14a	0.63a	0.68a	0.64a	0.49a

a-b means within the same row with different superscripts are significantly different ($P<0.05$) .

Percentages of dressed carcasses, and cut-parts in chickens of the five experimental diets at 39 days of age are presented in table (8) . It can be seen that no significant differences were found in percentages of plucked and dressed carcasses of chickens fed the experimental diets . Also numerical differences were noticed in percentages of these cut-parts of the experimental chickens .

Table 8: Percentages of plucked, dressing and cut-parts weights of chickens fed the experimental diets at 39 days of age .

Variables	Treatments				
	Control	F meal	B meal	F B 5 3	F B 5 5
Carcass weight	71.42	70.14	68.92	70.88	71.24
Plucked weight	89.67	89.21	89.34	90.16	90.62
Breast	25.32	23.81	23.75	24.68	24.75
Thigh	9.98	10.28	9.59	10.13	10.58
Drumstick	8.84	8.86	8.92	9.40	9.06
Wings	7.45	7.43	7.57	7.18	7.58
Neck	5.42	5.59	6.09	5.55	5.41
Back	14.07	14.51	13.95	13.76	13.76
Legs (shanks)	3.93	4.03	4.17	4.07	3.90
Head	1.94	2.13	1.96	1.94	2.00

No significant differences were noticed in percentages of visceral organs and offals of chicken fed the experimental diets as shown in table (9) . The percentages of whole gastro-intestinal tract (GIT) was found to be relatively higher for chickens, given the FM, BM, FB53, and FB55 compared control group .

Apparently numerical differences in dressing percentage and relative weights of carcasses, heads, necks, wings, and thighs were found in chickens fed diets supplemented with 5% feather meal and 5% blood meal. Legs and drumstick weights were relatively high for the birds fed 5% feather meal and 3% blood meal . However , the difference was non-significant (P>0.05). No significant differences were observed for all the parameters measured. Also the carcass yield, drumsticks, thighs, wings, neck, breasts, and backs were statistically (P>P0.05) similar .

Table 9: Percentages of visceral and offals of chickens fed the experimental diets at 39 days of age .

Variables	Treatments				
	Control	F meal	B meal	F B 5 3	F B 5 5
Blood	4.89	4.67	5.11	4.70	4.55
Feather	5.43	6.11	5.45	5.12	4.81
Esophagus	0.72	1.04	1.26	1.19	1.20
Proventriculus	0.59	0.43	0.47	0.66	0.54
Gizard	2.42	2.33	2.22	2.44	2.57
Small intestine	3.95	4.13	4.53	4.61	4.75
Large intestine	0.36	0.30	0.26	0.30	0.92
Ceca	0.80	0.85	0.73	0.71	0.59
GIT	8.85	9.25	9.62	9.89	9.93
Heart	0.68	0.59	0.64	0.61	0.65
Liver	2.17	2.34	2.07	2.08	2.22
Spleen	0.08	0.10	0.10	0.10	0.10

Proximate composition of the feather meal (FM), blood meal (BM), and the experimental diets are given in (Table 8) .

Table (10) : Proximate composition of the feather meal (FM), blood meal (BM), and the experimental diets .

Treatments	Parameters					
	Crude protein (%)	Fat (%)	Ash (%)	Gross Energy (kcal/kg)	Crude fiber (%)	DM (%)
Meals :						
BM	82.1	2.57	7.1	4407	0.25	82.4
FM	88	4.74	1.8	5033.9	1.17	94.2
Diets :						
Control	18.8	5.4	6.3	3816.4	5.53	87.6
B5	21.5	4.24	6.7	3769.4	4.28	87
F5	19.4	6.65	5.1	3953.4	3.94	88.7
FB53	23	4.12	4.5	3788.5	2.51	86.6
FB55	21	5.02	4.5	3808.1	3.82	87.5

Cost of the grower diets, and cost of weight gain is shown in (Table 11).

Table (11) :The cost of the grower diets, and the cost of weight gain (18-30 day).

Variables (NIS/kg)	Treatments				
	Control	**F meal**	**B meal**	**F B 5 3**	**F B 5 5**
Grower diet cost	**1.791**	**1.700**	**1.670**	**1.639**	**1.600**
Live body weight cost	**2.672**	**2.314**	**2.318**	**2.294**	**2.350**

Chapter Five

Discussion

5. Discussion

It has been demonstrated that crude protein, methionine plus cystine, lysine, arginine, and thrionine requirements as percentage of the growing broiler chickens are 20. 0.38, 0.72, 1.0, 1.10, 0.78, respectively, (NRC, 1994). The experimental diets in our study were formulated to contain similar proportions of the above mentioned amino acids (Table 1)

The common source of protein in broiler chickens diets are soybean meal and in certain situation fish meal or meat and bone meal (Ensminger, 1990). Several previous research works have investigated the use of other animal protein sources especially poultry by-products (Ochetim, 1993; Eissler and Firman, 1996; Denton *et al*., 2005; Isika *et al*., 2006; Khawaja *et al*., 2007) . Among these by-products are feather meal and blood meal .

Feather meal insertion in broiler chickens diet usually did not exceed 3% due to the low digestibility of its protein (Eissler and Firman, 1996) . However, inclusion of higher levels (5 to 8%) of feather meal was reported (Naber *et al*., 1961; Moran *et al*., 1966; Moris and Balloun, 1973; Luong and Payne, 1977; MacAlpine and Payne, 1977; Papadopulos *et al*., 1985) given that the diets were supplemented by methionine, lysine, histidine, and tryptophane .

Blood meal, on the other hand, is a rich source of lysine, arginine, methionine, and cystine (McDonald, 1992). Therefore, we anticipated that supplementing the experimental diets with these essential amino acids may influence broilers performance. Supplementation of these amino acids was proportionally related to whether the diets included feather meal or blood meal separately, or a combination of these two meals. Moreover, we choosed a simple technology of processing of feather and blood meals . Processing of fresh feather or blood was reported in recent works (Donkoh *et al*., 1990; Ochetim, 1993; Isika *et al*., 2006; Khawaja *et al*., 2007) .

In contrast to the above mentioned research works, only poultry blood was used since ruminants blood meal is no longer used in some Western countries for poultry. Because the usage of blood meal is limited by consumer and legislations (NRC, 1994) , we choosed to include blood and feather meals only in the growing rations .

Previously, blood meal was limited to a maximum inclusion level of 3-6% of the broilers diet, since higher levels were considered to be unpalatable or causes depressed performance (Kartzer and Green, 1957). A more recent research (Donkoh *et al*., 1999) reported that birds fed solar dried blood meal (SDBM) at 5 to 7.5% of the broiler diet result in better performance compared to birds fed diet containing 2.5% blood meal. Our results are in agreement with the above work in that birds given all four experimental diets perform similar to those in the control. At 39 days of age, the birds fed the control diet with no feather meal, blood meal or a combination of both were slightly ($P>0.05$) heavier than the birds fed the diets containing feather and/or blood meals.

No significant differences were detected among any of the diets in terms of feed conversion ratio or cut-parts weights .

Feather and/or blood meals at the levels of inclusion in the experimental diets had no detrimental effect on live performance parameters or carcass characteristics. Khawaja *et al*. (2007) indicated that blood meal up to 3% can be incorporated in broiler diets without any adverse effect on performance parameters during starting and finishing stages of growth, and that the level of inclusion reduced the relative cost per unit weight gain. In our study, inclusion of 5% blood meal in growing diet supplemented with optimal amounts of methionine and lysine improved body weight gain and feed conversion ratio, so that they were slightly better than those of the control (table 3). Inclusion of 5% feather meal in the growing diet, resulted in numerical depression in body weight gain and higher (1.78) feed conversion ratio .

Diets that contained 5% feather meal plus 5% blood meal, and 5% feather meal plus 3% blood meal resulted in lower body weight gain and higher feed conversion ratio. However, birds fed the diet containing 5% feather plus 3% blood meal performed better than the birds fed the diet containing 5% feather meal plus 5% blood meal. These observations indicated that it was not necessary to include equal proportions of both meals in the broiler diets in order to get optimal performance .

Ochetim (1993) examined the effect of boiled feather meal on performance of broilers. The author concluded that growth rate and efficiency were improved when feather meal was incorporated in broiler diet . Over processing has been reported to negatively affect feather meal fed to broiler (Papadopoulos, 1986; latshaw, 1994) . In agreement with these results, our results indicated that boiling and sun drying of feather meal was satisfactory means of processing .

Proximate analysis of our experimental blood and feather meals and diets (table 8) were in agreement with those reported by (Eissler and Firman, 1996; Donkoh *et al*., 1999; Khawaja *et al*., 2007)

Our findings regarding visceral organ mass were similar to previous research where both blood meal and feather meal had no significant effects on visceral organs and carcass cuts (Isika *et al*., 2006; khawaja *et al*., 2007)
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Chapter Six

Conclusions and Applications

6. Conclusions and Applications

- The grower diet of the broiler chickens can include up to 5% feather meal or up to 5% blood meal with no adverse effect on performance .
- Feather meal at 5% of the grower diet can be fed in combination with 3% blood meal with no adverse effect on performance .
- No complementary effect was observed by feeding feather meal in combination with increasing levels of blood meal .
- In Palestine where considerable amounts of feather meal and blood meal, it may be possible to take advantage of these findings especially by those who make their own feed .

Chapter Seven

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7. References

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Chapter Eight

Appendices

Appendix 1: Body weights of chicks at day old .

1	44.6	56	49.8	47.6
2	55.6	56.5	46.1	53.1
3	46.8	48.4	52.1	47.6
4	52.8	50	47.4	45.2
5	42	45.7	46.7	46
6	53.1	50.5	48.8	49.4
7	46.7	53	55	48.8
8	44	58.3	44	48.5
9	44.9	44.6	45.8	48
10	48.6	51.1	47.5	46.7
Total	47.91	51.41	48.32	48.09
Average	48.9325			

Appendix 2: Body weights of chicks at end of 1st week .

1	141.9	165	137.7	144.5
2	120	113.1	145	144.5
3	145.2	129.3	127.6	153.5
4	159.2	141.9	137.3	150
5	141.1	142.5	138.6	134.3
6	142.6	120.4	165.5	140.6
7	144.1	151.2	149.8	138.5
8	159.8	140.8	148.8	129.5
9	164.4	151.2	176.2	127.8
10	137.8	142.4	127	143.5
Total	145.61	139.78	145.35	140.67
Average	142.8525			

Appendix 3: Body weights of chicks at end of the 2nd week .

1	410	425	385	435
2	290	385	425	345
3	460	350	475	410
4	410	385	455	370
5	365	365	370	370
6	445	355	415	420
7	425	325	360	370
8	470	455	445	380
9	415	335	430	415
10	420	410	380	420
Total	411	379	414	393.5
Average	399.4			

Appendix 4: Body weights of chicks at the end of 3rd week .

	D2	D1	A2	A1	B2	B1	F2	F1	C2	C1
1	720	795	890	820	855	905	900	660	880	930
2	870	675	690	785	775	770	990	800	870	840
3	835	820	740	825	630	945	845	635	845	830
4	735	730	700	770	870	820	920	715	920	860
5	700	810	830	810	900	760	870	700	825	890
6	815	870	945	675	600	865	800	795	875	760
7	725	840	820	815	680	830	865	735	925	835
8	905	745	685	795	830	790	840	665	850	840
9	855	980	825	745	740	805	690	665	830	710
10	760	940	795	930	960	825	950	665	835	705
Average	792	820.5	792	797	784	831.5	867	703.5	865.5	820
	806.25		794.5		807.75		785.25		842.75	
Average	807.3									

Appendix 5: Body weights of chicks at the end of the 4th week

	D2	D1	A2	A1	B2	B1	F2	F1	C2	C1
1	1150	1310	1315	1350	1085	1400	1360	1085	1370	1515
2	1450	1170	1310	1210	1235	1215	1600	1225	1420	1245
3	1165	1315	1065	1375	805	1270	1340	995	1370	1300
4	1165	1180	990	1240	1505	1270	1435	1055	1460	1100
5	1155	1290	1250	1310	1340	1125	1340	1140	1365	1430
6	1255	1270	1420	1040	1000	1450	1275	1290	1100	1200
7	1060	1300	1160	1260	920	1330	1260	1200	1370	1345
8	1465	1195	1050	1180	1290	1075	1360	1030	1375	1440
9	1320	1270	1315	1115	1340	1275	1130	1055	1260	1065
10	1185	1520	1125	1480	1475	1430	1340	930	1350	1040
Average	1237	1282	1200	1256	1199.5	1284	1344	1100.5	1344	1268
Average	1259.5		1228		1241.75		1222.25		1306	
	1251.5									

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Appendix 6: Body weights of chicks at the end of 5^{th} week .

	D2	D1	A2	A1	B2	B1	F2	F1	C2	C1
1		1955	1885			2035	2135	1770		2055
2		1635	1975	1970	1800	1915		1720	1960	1910
3	1665	1705	1660	2120	1215	1990		1525	1925	1855
4	1465	1635	1545			2000		1580	1960	2055
5	1785			1940	1930		2010	1640	1700	
6	1830	2040		1515	1485	2120	1920	1880	1825	1750
7	1770	1880	1800	1985	1470		1955		2005	1850
8	2315	1720	1570	1995	1890	1540	2030	1515	1940	
9	2025	1690	2115	1710	1640	1955	1740	1390		1715
10	1590		1670	2215	2070	1985	1950	1355	1970	1440
Average.	1805.6	1782.5	1778	1931	1688	1942.5	1962.9	1597.2	1910.6	1828.8
Average	1794.0625		1854.375		1815		1780.039683		1869.6875	
	1822.632937									

Appendix 7: Feed consumption, body weight, and FCR of the experimental chicks .

Variables	CONTROL	F MEAL	B MEAL	F B 5 3	F B 5 5
Body weight at 18 days	648.75	641	614	631.5	643.75
Body wt. at 30 d.	1431.75	1347.5	1371	1276.25	1372.5
Body wt. at 39 d.	2148.1	2005.4	2053.5	1986.3	2019.4
Feed cons. 18-30 d.	14878	13615	13886	14000	14690
Feed cons. 30-39 d.	12030	11847.5	11705	12365	12517.5
Feed cons. 18-39 d.	26908	25463	25591	25365	27208
Feed cons. 18-30 d./bird	1487.8	1361.5	1388.5	1400.0	1469.0
Feed cons. 30-39 d./bird	1203	1184.75	1170.5	1236.5	1251.75
Feed cons. 18-39 d./bird	2690.8	2546.3	2559.1	2636.5	2720.8
Gain1 18-30 d.	783	706.5	757	644.75	728.75
Gain 2 30-39 d.	716.35	657.9	682.45	710	646.9
Gain3 18-39 d.	1499.4	1364.4	1439.5	1354.8	1375.7
FCR 1 18-30 d.	1.899	1.9285	1.8376	2.1751	2.0178
FCR 2 30-39 d.	1.6844	1.8308	1.7218	1.7525	1.9354
FCR 3 18-39 d.	1.7963	1.8784	1.7827	1.9469	1.9789

Appendix 8 :Carcass characteristics of the control broilers at day 30.

Control group				
Birds no.	8/C*1	5/C1	1/C2	9/C2
Live weight	1537	1455	1425	1250
Blood	41	60	55	58
Pluk weight	1420	1332	1305	1151
Feather	76	63	65	41
Carcass	1037	1023	995	876
Head	31	29	29	29
Legs	59	63	60	54
Neck	81	67	77	75
Wings	110	114	110	101
Drumstick	131	108	123	110
Thigh	154	150	158	117
Breast	321	362	316	301
Back	240	221	210	175
Heart	10	10	11	9
Liver	44	39	38	28
Spleen	2	1	2	1
GIT	125	152	155	133
Esophagus	10	12	8	5
Gizzard	50	40	48	33
Proventriculus	9	14	10	9
Small Intestine	43	68	70	68
Large Intestine	5	6	6	6
Cecum	8	14	13	11

* C : Control

Appendix 9 :Carcass characteristics of broilers fed B5 diet at day 30.

B Group				
Birds no.	7/B*1	5/B1	4/B2	1/B2
Live weight	1480	1140	1545	1400
Blood	40	45	80	45
Pluk weight	1370	1020	1375	1285
Feather	70	75	90	70
Carcass	1052	801	1055	988
Head	29	26	35	27
Legs	68	48	62	54
Neck	84	53	82	80
Wings	110	81	115	100
Drumstick	133	102	134	106
Thigh	174	124	156	125
Breast	330	271	357	342
Back	220	161	211	235
Heart	10	8	10	9
Liver	42	36	37	43
Spleen	1	1	2	1
GIT	149	106	166	139
Esophagus	7	7	11	8
Gizzard	50	35	66	51
Proventriculus	10	7	8	9
Small Intestine	74	48	72	58
Large Intestine	4	7	3	5
Cecum	9	12	8	8

* B : 5% Blood Meal

Appendix 10 :Carcass characteristics of broilers fed F5 diet at day 30.

F group				
Birds no.	3/F*2	7/F1	2/F2	4/F2
Live weight	1430	1315	1670	1495
Blood	70	55	70	75
Pluk weight	1285	1200	1520	1320
Feather	75	60	80	100
Carcass	988	904	1172	1037
Head	29	30	36	30
Legs	63	56	73	59
Neck	74	75	89	78
Wings	117	106	115	116
Drumstick	121	116	149	141
Thigh	160	139	166	152
Breast	311	288	410	340
Back	205	184	234	206
Heart	9	9	11	10
Liver	29	32	44	42
Spleen	1	1	2	1
GIT	148	148	177	160
Esophagus	6	7	13	7
Gizzard	53	57	56	51
Proventriculus	7	6	9	6
Small Intestine	72	58	89	80
Large Intestine	4	4	4	4
Cecum	10	11	10	6

*F : 5% Blood Meal

Appendix 11:Carcass characteristics of broilers fed FB53 diet at day 30.

A group				
Birds no.	1/A*1	4/A1	6/A2	5/A2
Live weight	1270	1297	1555	1440
Blood	50	62	35	54
Pluk weight	1169	1175	1450	1315
Feather	51	60	70	71
Carcass	860	899	1124	946
Head	31	26	33	36
Legs	63	50	71	63
Neck	61	76	80	72
Wings	94	100	118	93
Drumstick	120	118	146	125
Thigh	131	126	179	146
Breast	281	299	379	300
Back	171	174	223	172
Heart	11	9	14	9
Liver	39	31	42	35
Spleen	1	1	2	1
GIT	152	137	145	147
Esophagus	15	7	5	4
Gizzard	52	46	50	53
Proventriculus	7	7	10	9
Small Intestine	65	60	67	66
Large Intestine	4	5	5	4
Cecum	8	7	12	9

*A : 5% Feather meal+3%Blood Meal

Appendix 12:Carcass characteristics of broilers fed FB55 diet at day 30.

D group				
Birds no.	10/D*1	5/D1	2/D2	1/D2
Live weight	1470	1220	1383	1150
Blood	60	40	63	50
Pluk weight	1350	1125	1260	1020
Feather	60	55	60	80
Carcass	1062	865	963	812
Head	35	31	33	33
Legs	70	54	63	45
Neck	80	68	78	68
Wings	115	94	108	91
Drumstick	136	106	122	105
Thigh	160	140	143	145
Breast	353	277	304	250
Back	222	182	212	152
Heart	10	9	11	7
Liver	36	30	36	28
Spleen	2	1	1	1
GIT	127	125	137	111
Esophagus	8	8	7	7
Gizzard	45	56	46	41
Proventriculus	6	8	7	6
Small Intestine	58	46	77	35
Large Intestine	4	7	2	3
Cecum	7	6	7	6

D : 5% Feather meal+5%Blood meal

Appendix 13: Carcass characteristics of the control broilers at day 39.

CONTROL GROUP								
Birds no.	2/C*1	4/C1	6/C1	7/C1	7/C2	10/C2	4/C2	8/C2
Live wt.	2170	2300	1915	1995	2220	2065	2120	2130
Blood	80	200	70	80	130	95	84	100
Pluk weight	1985	1950	1750	1825	1915	1890	1920	1915
Feather	105	150	95	90	175	80	116	115
Carcass	1606	1486	1390	1456	7815	1499	1557	1548
Head	43	40	37	39	41	41	41	46
Neck	117	132	114	112	114	118	96	113
Wings	167	167	154	141	179	152	154	162
Drumstick	191	181	174	167	206	195	178	203
Thigh	235	227	185	216	191	212	210	211
Breast	538	459	496	532	531	528	626	560
Back	333	317	270	288	300	283	290	299
Heart	13	11	12	11	18	17	19	15
Liver	43	45	39	46	55	50	47	43
Spleen	2	2	2	2	1	1	2	2
GIT	190	260	175	182	184	175	167	168
Esophagus	15	36	11	10	11	20	9	12
Gizzard	50	52	51	52	59	50	47	49
Proventriculus	20	13	11	13	10	12	12	9
Small Intestine	82	133	82	78	82	67	79	69
Large Iintestine	13	8	6	5	10	5	5	10
Cecum	14	17	19	21	12	16	15	21
Legs	84	94	66	72	95	92	78	87

* C : Control.

Appendix 14: Carcass characteristics of broilers fed B5 diet at day 39.

B GROUP								
birds no.	2/B*1	3/B1	8/B1	10/B1	8/B2	10/B2	7/B2	9/B2
Live wt.	2045	2220	1710	2045	2130	2340	1675	1840
Blood	95	75	85	105	210	115	75	65
Pluk weight	1850	2055	1470	1775	1790	2130	1540	1705
Feather	100	90	155	165	130	95	60	70
Carcass	1456	1622	1037	1351	1357	1657	1202	1364
Head	41	42	33	40	42	42	36	37
Neck	102	111	195	88	127	115	100	114
Wings	151	170	125	152	133	193	143	144
Drumstick	190	196	136	181	185	204	166	169
Thigh	221	227	140	183	173	241	170	184
Breast	533	574	338	480	442	583	377	492
Back	282	334	207	265	286	354	252	260
Heart	13	15	13	11	12	15	13	10
Liver	51	50	32	35	42	44	40	38
Spleen	2	2	1	1	3	4	2	2
GIT	167	195	180	233	228	205	167	160
Esophagus	8	16	28	69	42	15	14	10
Gizzard	50	53	31	45	37	46	47	45
Proventriculus	9	9	9	8	9	10	12	9
Small Intestine	72	97	96	102	129	119	40	79
Large Iintestine	6	9	4	2	4	6	6	5
Cecum	21	13	12	19	12	13	14	12
Legs	95	102	69	85	90	97	64	70

*B : 5% Blood Meal

Appendix 15: Carcass characteristics of broilers fed F5 diet at day 39 .

F GROUP								
Birds no.	1/F*1	1/F2	4/F1	6/F1	8/F2	10/F2	5/F2	9/F2
Live wt.	2010	2370	1730	2010	2145	2160	2210	1950
Blood	60	115	55	70	160	150	85	95
Pluked weight	1820	2135	1450	1805	1915	1905	2050	1770
Feather	130	120	225	135	70	105	75	85
Carcass	1409	1735	1114	1438	1505	1450	1646	1434
Head	50	42	36	41	53	45	45	37
Neck	119	154	86	107	112	116	129	96
Wings	158	188	115	154	153	154	169	162
Drumstick	186	206	145	185	179	187	211	161
Thigh	224	237	190	215	208	201	224	190
Breast	462	604	397	492	505	488	545	475
Back	260	338	174	285	348	304	368	345
Heart	14	14	7	11	16	13	13	13
Liver	55	62	28	47	61	47	46	41
Spleen	2	2	2	3	1	3	5	2
GIT	185	196	193	185	144	258	183	158
Esophagus	11	12	31	11	15	51	19	15
Gizzard	47	51	44	60	44	51	42	41
Proventriculus	9	8	8	10	9	8	12	8
Small Intestine	96	94	82	75	58	113	84	75
Large Iintestine	9	3	5	8	3	5	11	10
Cecum	16	25	20	18	11	15	19	11
Legs	96	75	64	74	105	95	80	65

* F : Feather Meal .

Appendix 16: Carcass characteristics of broilers fed FB53 dietat day 39.

A GROUP								
Birds no.	8/A*1	10/A1	5/A1	9/A1	1/A2	2/A2	3/A2	7/A2
Live wt.	2190	2345	2030	1900	2190	2170	1900	1995
Blood	80	155	110	75	115	60	100	95
Pluk weight	2005	2115	1840	1760	1930	1990	1720	1715
Feather	105	75	80	65	145	120	80	185
Carcass	1581	1697	1495	1459	1463	1555	1367	1230
Head	44	50	36	37	40	47	36	36
Neck	151	130	110	117	94	129	103	95
Wings	179	172	144	147	154	169	132	107
Drumstick	211	214	184	181	201	212	186	182
Thigh	213	216	209	173	191	222	303	156
Breast	527	617	559	535	516	470	465	434
Back	309	336	292	288	307	352	178	256
Heart	18	17	14	11	11	11	11	10
Liver	44	57	42	37	38	46	43	42
Spleen	3	2	2	2	3	3	2	1
GIT	194	177	162	142	289	201	177	310
Esophagus	16	13	11	11	20	21	13	91
Gizzard	64	59	55	41	66	42	47	36
Proventriculus	9	9	10	9	47	9	5	15
Small Intestine	87	72	65	67	139	109	90	140
Large Iintestine	7	6	5	3	6	5	10	9
Cecum	10	23	18	11	11	16	12	19
Legs	103	104	71	66	86	104	72	80

* A : 5%FM+3%BM.

Appendix 17: Carcass characteristics of broilers fed FB55 diet at day 39.

D GROUP								
Birds no.	1/D*1	3/D1	7/D1	8/D1	8/D2	9/D2	6/D2	5/D2
Live wt.	2070	1825	2070	1830	2495	2155	2080	1915
Blood	120	120	70	60	90	140	60	85
Pluk weight	1830	1625	1910	1685	2290	1880	1925	1755
Feather	120	80	90	85	115	135	95	75
Carcass	1395	1246	1511	1315	1857	1446	1565	1392
Head	44	37	40	38	54	37	36	43
Neck	111	93	112	100	128	117	133	96
Wings	154	136	161	144	194	139	156	161
Drumstick	175	160	188	179	224	187	192	183
Thigh	198	261	216	172	284	182	222	201
Breast	470	450	491	444	648	556	560	460
Back	285	146	342	273	379	261	300	291
Heart	14	10	12	14	20	13	13	13
Liver	40	45	52	40	52	41	44	50
Spleen	2	2	2	3	1	2	3	2
GIT	221	203	205	188	200	241	175	190
Esophagus	25	27	25	18	16	44	12	28
Gizzard	57	50	42	52	50	62	52	55
Proventriculus	8	8	9	13	13	14	12	12
Small Intestine	106	105	106	92	100	108	81	78
Large Iintestine	5	5	6	6	14	7	4	3
Cecum	19	8	15	10	11	9	17	9
Legs	91	81	72	71	100	84	73	69

* D : 5%FM+5%BM .

جامعة النجاح الوطنية
كلية الدراسات العليا

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اعداد
رأفت محمد صالح نخاش

اشراف
د. معن حلمي سمارة

قدمت هذه الأطروحة استكمالا لمتطلبات درجة الماجستير في الانتاج الحيواني بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس،فلسطين
2008

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الملخص

أجريت هذه الدراسة لمعرفة تأثير استخدام وجبة الريش ووجبة الدم بشكل منفصل او بشكل مكمل لبعضهما البعض في علائق النمو للدجاج اللاحم ومعرفة تاثير هذه الوجبات على اداء النمو للصيصان . قمنا بتربية 150 صوص لاحم من عمر يوم نوع كوب كأي قطيع تجاري لصيصان اللاحم حتى عمر 18 يوما . في اليوم 19 من عمر الصيصان تم توزيع 100 صوص الى 5 مجموعات بشكل عشوائي بموجب معاملتين لكل مجموعة (كل معاملة 10 صيصان) . تم تقديم 5 علائق مختلفة من علف النمو ومتساوية في كل من الطاقة والبروتين وهي كالتالي : 1. معاملة الشاهد 2. 5% وجبة الريش 3. 5% وجبة الدم 4. 5% وجبة الريش مع 3% وجبة الدم 5. 5% وجبة الريش مع 5% وجبة الدم . تم توزيع العلائق الخمسة المختلفة على المجموعات بشكل عشوائي ,بينت النتائج انه لم يلاحظ وجود أي فروقات معنوية على الصيصان فيما يخص القياسات التالية : تناول العلف و الكسب الوزني و نسبة تحويل العلف إلى وزن حي . كان هناك فرق بسيط وغير معنوي في مجموعة الشاهد في نسبة تحويل العلف افضل من باقي المجموعات . وكانت نسبة تحويل العلف في المجموعتين اللتان تحتويان على 5% وجبة الريش مع 3% وجبة الدم و العليقة 5% وجبة الريش مع 5% وجبة الدم اقل من باقي المجموعات . تم استنتاج ان استخدام طريقة تسخين الدم وتجفيفه بالشمس واستخدام نسبة 5% من الريش المغلي بالماء أو أكثر لكل منهما وبشكل منفصل يمكن أن يؤدي ذلك إلى تحسين أداء صيصان اللحم خلال فترة النمو أو المدة التي تلي فترة الحضانة مباشرة .