An-Najah National University
Faculty of Graduate Studies

Effects of Rumen Filterate Fermented Wheat Bran on Performance of Finishing Broiler Chickens

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This thesis was successfully on 17/10/2010 and approved by

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1. Dr. Maen Samara / supervisor	
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Dedication

This project is dedicated to my parents, brothers, sisters, my wife and kids; the completion of this work was not possible without their support and help.

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I would like to express my deepest respect and most sincere gratitude to my supervisor, Dr. Maen Samara, for his guidance and encouragement at all stages of my work. In addition I would like to thank my committee members, Dr. Iyad Badran and Prof. Jamal Abo Omar.

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I would like to express my sincere thanks and appreciation to my father, mother, brothers and sisters for their support. My fervent thanks extended also to my wife and kids.

الإقرار

أنا الموقع ادناه مقدم الرسالة التي تحمل العنوان:

Effects of Rumen Filterate Fermented Wheat Bran on Performance of Finishing Broiler Chickens

تأثير كميخ نخالة القمح المخمرة بسائل الكرش على آداء دجاج اللحم

أقر بأن ما إشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص، بإستثناء مـــا تمـــت الاشارة 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

AP	Available Phosphorus
A.O.A.C	Association of Analytical Communities
BW	Body Weight
C	Control
Ca	Calcium
CF	Crude Fiber
CRD	Completely Randomized Design
CP	Crude Protein
CW	Carcass Weight
DCP	Dicalcium Phosphate
DM	Dry Matter
DG	Daily Gain
FC	Feed Conversion
FI	Feed Intake
FWB	Fermented Wheat Bran With Rumen Liquor
GE	Gross Energy
GW	Giblets Weight
LSD	Least Significant Difference
ME	Metabolizable Energy
NIS	New Israeli Shekel
NRC	National Research Council
P	Phosphorus
PI	Inorganic Phosphate
SBM	Soybean Meal
TP	Total Phosphorus

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Effects of Rumen Filtrate Fermented Wheat Bran on Performance of Finishing Broiler Chickens

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Abstract

An experiment was carried out to investigate the effect of fermented wheat bran with rumen liquor at different inclusion rates on the performance of broilers at age from 21-35 days. Rumen liquor was collected and immediately mixed with wheat bran. The ingredient was incubated in sealed bags for 24 days at room temperature and then was sun dried for approximately 30 hrs. A total of 205 one-day-old male and female Cobb broiler chicks were fed commercial diets from 1-20 days of age. Four isonitrogenous and isocaloric experimental finisher diets were prepared as follows: control (C), diet 2 contained 5% rumen filtrate fermented wheat bran (FWB5%), diet 3 contained 10% rumen filtrate fermented wheat bran (FWB10%) and diet 4 contained 15% rumen filtrate fermented wheat bran (FWB15%). At 21 days of age chicks were divided randomly into four experimental groups. Every treatment group was contained four replicates of 12 birds each using completely randomized design (CRD). The chicks were fed the experimental diets from 21-35 days of age. Body weight gain, feed consumption and feed conversion ratio were measured throughout the experiment. The measurements of carcass traits and economical parameters were determined at the end of the experiment. Feed consumption, weight

gain, feed conversion ratio and carcass characteristics were not significantly affected across treatments.

The results of this study indicated that fermented wheat bran with rumen filtrate up 15% inclusion rate can be used in the broiler finisher diet without any adverse effects on parameters during the finishing phase of broilers.

Chapter One
Introduction

Poultry industry plays a very important role in the world economy and in the Palestinian economy too. It provides a source of employment and some of the most important food items for the Palestinian society (eggs and white poultry meat). It is well known that these food items have become one of the main sources of animal protein in Palestine due to the exorbitant rise in the price of red meat. So the poultry sector has developed considerably over the past years, especially in terms of the number of farms and the size of production and productivity. In addition the poultry sector in Palestinian Authority contributes about 13.1% of the total income from agriculture. Recent statistics showed that the number of raised broilers increased by 30% (Palestinian Central Bureau of Statistics, 2006).

People in the whole World need protein for the health of their bodies, but the significant increase in the price of red meat resulted in higher demand for white meat; therefore, the researchers around the World have devoted a considerable effort to development of poultry production in terms of quality and quantity.

One of the major problems that face broiler farmers in Palestine is the cost of feed. Most of the ingredients of poultry diets are imported. This necessitates looking for local source of feedstuffs, which could help decrease the cost of production.

The improvement in poultry production is highly dependent on synergy among many factors such as science, practices, genetics, management, and nutrition. Nutrition represents approximately 70% of total broiler production costs. The main ingredient used as energy source in poultry mixed feeds is corn, whereas soybean meal is the main protein source. Corn accounts for 60% of the total amount that are fed, and approximately 30-35% of the feed cost (Samara, 2000). Therefore, the cost of the production could be reduced if cheaper alternatives to corn are used. Of these alternatives are agricultural and agro-industrial byproducts. It is expected that these by-products should be available, cheap, and have a comparative nutritional value when compared to conventional feed ingredients.

Wheat bran, on the other hand, is a by-product of flour manufacturing that is obtained from screened grains of wheat. Wheat bran may contain up to 15.2% crude protein (CP), but can contain up to 12% crude fiber (CF) which limit it's use to less than 5% as a feed ingredient in broiler rations (NRC, 1994). Wheat bran is also known for its high phytase activity. The bran's phytase may improve the absorption of phosphorus from cereals when given to simple stomach animals (Lesson and Summers, 2008). On the other hand, another by-product is the rumen contents and rumen liquor that are left after ruminant animals are slaughtered.

It is anticipated that fermentation of wheat bran with rumen liquor will have a two-fold advantages to broiler chickens. Fermentation will

probably reduce the fiber proportion in the wheat bran and will make more of the plant phosphorus available to the bird. It is generally agreed that wheat bran is not added to broiler rations because it contains excessive fiber content. Treatment of wheat bran with rumen liquor has not been investigated previously. The bacteria in the rumen liquor act on the fiber part of the bran by cellulase enzyme and act on the phytate-phosphorus by phytase enzyme which ultimately lowers fiber contents and makes more of the organic phosphorus available to the bird. Therefore, this study was conducted to evaluate the effects of substituting some of the common feed ingredients (i.e. corn, wheat and soybean meal) in the commercial broiler finisher diet with rumen filtrate fermented wheat bran on the performance of broiler chickens.

Chapter Two
Literature Review

2.1 Nutrition of broilers

It is well known that factors such as genetic improvement, selection, management and nutrition have contributed to improvement in feed efficiency and reduced metabolic disorders in broilers. Feeding programs and nutrient modeling have been designed to meet the nutrient requirement of the bird under variable conditions. As far as broilers are concerned, their nutrient requirements and diets are fairly similar worldwide. However, feeding programs are usually designed to overcome obstacles related to housing, equipment, stocking density, feed and water delivery equipment (North, 1984). Lesson and Summers (2008) indicated that the broiler industry has shown unparalleled growth over the last 30 years. These authors reported that, to a large extent, the ability of the broiler to grow well with a rang of diet densities is related to its voracious appetite, and the fact that feed intake seems to be governed by both physical satiety as well as by cues related to specific nutrients.

The diets of broilers must be formulated to provide all of the chick's nutrient requirements if optimum growth and production is to be achieved. Such nutrients are organic and inorganic compounds in feed ingredients which according to their chemical nature are classified to carbohydrates, proteins, lipids, vitamins, minerals and water. Noteworthy, many ingredients are used in formulation of the broiler diets such as corn, wheat, barley, soybean, and other cereal grains. On the other hand, many by-

products such as wheat by-products, feather meal, cottonseed meal and other agroindastrial by-products are also used, but there is considerable disagreement in the classification and description of these by-products. NRC (1994) reported that poultry diets are composed primarily of a mixture of several feedstuffs, such as cereal grains, soybean meal, animal by-product meals, fats and vitamin and mineral premixes. These feedstuffs together with water provide the energy and nutrients that are essential for birds. Lesson and Summers (2008) reported that great care must be taken when formulating diets with wheat by-products in different countries, and indicated that traditionally there are three major by-products, namely wheat bran, wheat shorts and middlings. These authors described wheat bran as the outer husk of wheat grain which is characterized by having low bulk density and thus low metabolizable energy content. On the other hand, wheat bran has relatively high protein content and its amino acid profile in comparable to than seen in whole wheat. These authors also reported that bran has been claimed to have a growth promoting effect for birds which is not directly related to any contribution of fiber to the diet, such growth promotion is possibly derived from modification of the gut micro-flora.

Overall, the nutrient requirements of broiler checks as reported by NRC (1994) are shown in (Table 1).

Table (1): Nutrient requirements of broiler as percentage or unit per kilogram of diet (90%DM).

Nutrient	Unit	0-3 weeks of age/ ME 3200kcal/kg	3-6 weeks of age /ME 3200kcal/kg	6-8 weeks of age /ME 3200kcal/kg
Crude protein	%	23.00	20.00	18.00
Lysine	%	1.1	1.00	0.85
Methionine	%	0.50	0.38	0.32
Methionine+Cystine	%	0.90	0.72	0.60
Tryptophan	%	0.20	0.18	0.16
Arginine	%	1.25	1.00	1.00
Linoleic acid	%	1.00	1.00	1.00
Calcium	%	1.00	0.90	0.80
Non-phytate phosphorus	%	0.45	0.35	0.30

NRC, 1994.

2.2 Wheat Bran in Broiler Nutrition

Wheat bran is a by-product of flour industry that is obtained from screened grains of wheat, which has a limited use for human, and monogastric animals due to its high fiber content. It is well known that broilers cannot properly handle fibrous materials because their enzymatic digestion cannot breakdown the cellulose cell wall. It is reported that wheat bran may contain up to 12% crude fiber (NRC, 1994). One of the ways of using feeds that are under normal circumstances denigrated is by use of fermentation techniques (Dirar, 1992). Abasiekong (1991) observed an improvement in the feeding value of spent sorghum when fermented with a stock culture of some rumen microorganism and reported direct fermentation of spent sorghum with rumen fluid produced similar results that could be utilized on farm. On the other hand, Aduku (1993) reported that wheat offal contains 1256 and 2320 kcal of metabolisable energy per

kg for poultry and swine, respectively, 15.6% crude protein and mineral elements such as calcium and phosphorus. Dale (1996) suggests that the metabolizable energy value of wheat by-products is directly proportional to their fiber content, and that metabolizable energy can be described as in the fallowing formula: 3182-161*%crude fiber (kcal/kg). Yao *et al*. (2007) reported that nutritive value of the analyzed wheat bran was as follows: dry matter 88.57%, crude protein 15.52%, total phosphorus 0.89%, calcium 0.13%, crude ash 4.70%, crude fiber 8.34% and phytase activity 2400 U/kg. Because wheat bran has some phytase activity, it can be used as a viable source of phytases. Zanini and Sazzad (1999) reported that Phytase is an enzyme that breaks down the indigestible phytic acid (phytate) portion in grains and releasing digestible phosphorus and calcium for non-ruminants. Viveros *et al*. (2000) studied the phytase and acid phosphatase activities in plant feedstuffs. In this study, 24 feedstuffs were analyzed for total phosphorus, phytate phosphorus content, phytase, and acid phosphatase activities with the objective to predict the capacity to hydrolyzed phytic acid and to contribute to formulating environmentally adequate diets for monogastric animals. These authors reported that approximately two-thirds of phosphorus in plants are in the form of phytate and concluded that wheat bran contains 4624 U/kg phytase and 14106 U/kg acid phosphatase. Pallauf *et al*. (1994) reported that phytate phosphorus is unavailable to or poorly utilized by poultry due to the very low phytase activity found in their digestive tract. Therefore phytase is added to poultry diets to improve the utilization of phytate phosphorus.

Eeckhout and de Paepe (1994) reported that some feedstuffs contain 6-phytase activities (i.e. wheat, wheat bran, rye and barley), whereas other feedstuffs have little or no phytase activity (i.e. corn, oat, sorghum and oilseeds). Barrier-Gullot *et al*. (1996b) reported that the Phytase activity in grain such as wheat has a high correlation with overall phosphorus retention in pig and broiler (r=0.83).

Cavalcanti and Behenke (2004) studied the effect of wheat bran phytase subjected to different conditioning temperatures on phosphorus utilization by broiler chicks based on body weight and toe ash measurement. These authors reported that wheat bran has high endogenous phytase enzyme activity and concluded that phytases can improve the plant phosphorus digestion by the broiler chicks. Also they revealed that wheat bran phytase resulted in an increase in growth rate and phosphorus utilization in broiler. Earlier studies have suggested that high endogenous phytase in cereals and their by-products can effectively enhance phosphorus utilization by monogastric species (Pointillart, 1991). Steiner *et al.* (2007) found that wheat bran contains 6-phytase activities ranging between 2349 and 9945 U/kg. Paik (2003) reported that the presence of 6-phytases in wheat bran is high enough to be considered in feed formulation for monogastric animals.

Previous research showed that phytase activities were lowest in legume seeds and oats (262-496 U/kg), and highest in cereal by-products such as wheat bran (2957-9945 U/kg), and differences in the phytase

activity of cereals and their by-products may come from cultivars, processing and measurement methods (Steiner *et al*. 2007).

Yao *et al*. (2007) studied the effects of wheat bran phytase on performance and nutrient utilization of laying hens and concluded that wheat bran phytase improved the performance and utilization of total phosphorus and crude protein of laying hens, and they reported that ten percent of wheat bran replacing 0.05% inorganic phosphate (Pi) did not influence either egg yield or nutrient utilization. This study suggests that wheat bran could be used successfully in laying hen diets and wheat bran and microbial phytase supplemented together could replace inorganic phosphate completely.

Wheat bran could be an economical source of protein especially in developing countries; however, its high fiber content limits its use as a feed ingredient in poultry rations, especially those of broilers. Recent studies (Abaza *et al*., 2004 and Ali *et al*., 2006) demonstrated that wheat bran alone or wheat bran supplemented with some enzyme preparations can have a positive effect on the performance of broilers and laying hens. Ali *et al*. (2006) studied the effects of using up to 50% wheat bran in the laying hens diet and concluded that the detrimental effect of inclusion of wheat bran at higher rate can be overcome by addition of sodium sulfate or enzymes. Christopher *et al* (2007) studied the effect of replacing maize with wheat offal in broiler finisher diets on bird performance and feed cost. These authors found that replacing maize with about 25 % wheat offal in

the broiler finisher diet has no adverse effects on growth, feed intake and efficiency of feed utilization; however, feed cost was reduced considerably.

On the other hand wheat bran contains a large amount of betaines, which protects chick intestinal cells from coccidian infection, alleviates symptoms and improves performance (Kettunen *et al*, 2001). Zeisel *et al*. (2003) reported that wheat bran contains betaine at a rate of 1505.6 mg/100g.

2.3 Rumen Content and Rumen Fluid in Broiler Nutrition.

Rumen liquor is the fluid left when the rumen content is filtered and large particles are discarded. It is well known that rumenal fluids contain a large amount of microorganisms. Because of the microbial enzymes, ruminants can utilize feedstuffs (cellulose, hemicelluloses, and non-protein nitrogen) that provide little to no nutritional benefit to non-ruminants. Hungate (1966) revealed that the microbes of the rumen are able to synthesis beta-glucanases, which are needed for the breakdown of cellulose, hemicelluloses and phenolic polymers.

Adeyemi and Familade (2003) studied the replacement of maize by rumen filtrate fermented corn-cob in layer diets and indicated that fermentation with rumen filtrate increased the crude protein content three folds while crude fiber decreased from 42.46% to 28.94%, and concluded that fermentation enhanced the nutrition value of this feed-stuff.

Jovanovic and Cuperlovic (1977) studied the nutritive value of rumen contents for monogastric animals and reported that an average sample of rumen content contained 21% crude protein, 30.3% crude fiber, 6.1% fat and 11.5% ash. Shebata *et al*. (1984) evaluated rumen liquor as a feed ingredient for poultry and reported that biological and chemical analyses for dried rumen liquor indicated a true metabolizable energy value of 2470kcal/kg, 25.92% crude protein and high amount of minerals. Bechdle *et al*. (1928) studied the synthesis of the vitamin B complex in the rumen of the cow, and reported that the fermented rumen content contained more of the vitamin B complex than the regular feed of the animal. Emmanuel (1978) studied the effect of rumen contents on the performance of broiler and concluded that whole rumen contents did not effect growth and feed conversion when included in the diets of broiler from 1-21 days of age. However this author expected that microbial and liquid fractions of rumen contents improved feed conversion, while the solid fraction (100g/kg diet) decreased feed conversion efficiency. Okorie (2005) studied the effect of dried pulverized rumen contents on the performance, carcass and organ characteristics of finisher broiler. The investigator used five experimental diets that contained 0, 2.5, 5, 7.5 and 10% dried pulverized rumen contents respectively .The author reported that there were no significant differences in performance parameters among birds that were given these diets, but growth was depressed at the 10 inclusion rate.

Another study about using rumen filtrate was reported by Adeyemi and Sipe (2004) who found that crude protein concentration of cassava root

increased when fermented with rumen filtrate with or without ammonium sulphate as the source of nitrogen. Adeyemi *et al*. (2004) reported an improvement in the nutrient composition of whole cassava root-meal upon fermentation with rumen filtrate. Their results showed that protein yield on a steep rise up to day 3 and crude fiber was significantly reduced by fermentation. They reported that 237.8% increase in the crude protein value of whole cassava root meal fermented with rumen filtrate when caged layer waste was used as a source of nitrogen. Adeyemi *et al*. (2008) suggested that cassava enhanced with dried cage layer waste and fermented with rumen filtrate is a potentially useful feed material for monogastric animal. In another study; fermentation of sago pith and rumen content mixture was able to reduce crude fiber content by 33% and increase crude protein by 42% (Wizna *et al*. 2008).

Wheat bran is relatively rich in nitrogen and fiber, which enhance the fermentation process. It is therefore, anticipated that fermented wheat bran could be incorporated in broiler as well as layer ration.

Chapter Three
Materials and Methods

3.1 Rumen Liquor Preparation

Bovine rumen filtrate was collected from carcasses of animals slaughtered at a local livestock slaughterhouse, (Nablus Municipality Slaughterhouse). Twelve fattening calves were slaughtered and eviscerated. Their gastrointestinal tracts were then taken into a well cleaned room. Rumen contents were immediately poured into fine mesh. Solid material was discarded while the fluid (liquor) part of the content was transferred to nylon bags. The whole process took approximately 10-15 minutes.

3.2 Wheat Bran Fermentation with Rumen Liquor

The fresh rumen liquor was sprayed on to wheat bran that had been secured from a local dealer. After spraying, the bran was stirred and pocked in polyethylene bags which were made airtight to secure anaerobic fermentation. The fermentation process lasted for 24 days at room temperature. Bags were then moved to airtight metal container for three more days after which the fermented bran was sun dried for approximately 30 hrs. Samples from dried fermented bran were taken for proximate analysis for moisture content, gross energy, crude protein, ash, fiber and ether extract according to the A.O.A.C (1995) procedure. The chemical analysis of fermented wheat bran is given in (Table 2).

Table (2): Chemical analysis of wheat bran before and after fermentation with rumen filtrate (as air dry basis)

Ingredient	Wheat bran	Fermented wheat bran
Protein	13.6%	14.2%
Ash	4%	3.9%
Fat	3.95%	7.24%
Fiber	12.5%	9.5%
Gross Energy	3905.4 kcal/g	3599 kcal/g

3.3 Experimental Diets

Prior to the initiation of the experiment, broiler chicks were given a commercial starter diet Table (3).

Four isonitrogenous and isoenergetic broiler finisher diets were formulated for the finishing phase. A control diet did not contain fermented wheat bran, however, the second, third, and fourth diets contained 5, 10, 15% fermented wheat bran respectively. Dietary ingredients were purchased from a local poultry feed dealer. Chicks were given the experimental diets and water *ad lib* from 21-35 days of age.

The composition and the chemical analysis of the experimental diets are shown in (Table 4 and 5), respectively.

Table (3): Chemical analysis of starter diet

Ingredient	percentage
Total protein	21.3%
Water	13.0%
Oil	3.5%
Fiber	3.0%
Ash	6.0%
Calcium	1.00%
P	0.65%
Salt	0.25%
Mn	100g/ton

Table (4): The ingredients of the experimental diets

Ingredients g/kg	Diets			
	C	FWB 5%	FWB 10%	FWB 15%
Corn	500	461.1	427	419
SBM	280	273	270	266
Wheat	161.1	146	120	69
Wheat bran	000	50	100	150
Oil	25	37	50	63
Dicalcium phosphate	13	13	13	13
Limestone	12	12	12	12
Premix	5	5	5	5
Salt	1.00	1.00	1.00	1.00
Methionine	2.00	2.00	2.00	2.00
Lysine-HCl	0.40	0.40	0.40	0.30
Total	1000	1000	1000.09	1000.08

Table (5): Chemical composition and calculated analysis of the experimental diets

Ingredient	Treatments			
	C	FWB 5%	FWB 10%	FWB 15%
ME(kcal/kg)	3027.4	3020.2	3011.6	3008.2
CP%	18.3%	18.2%	18.2%	18.1%
CF%	3.54%	3.84%	4.14%	4.42%
Ca%	0.86%	0.86%	0.86%	0.87%
TP%	0.73%	0.72%	0.71%	0.65%
AP%	0.38%	0.38%	0.37%	0.37%

C- Control diet

FWB 5%- Fermented wheat bran 5% inclusion rate

FWB 10%- Fermented wheat bran 10% inclusion rate

FWB 15%- Fermented wheat bran 15% inclusion rate

3.4 Birds and Management

A total of 205 days-old Cobb broiler chicks were obtained from a local hatchery. The chicks were reared in an open-sided house in Rojeeb/ South-east of Nablus (Figure 1). The experimental house was thoroughly

cleaned and disinfected before placement of chicks. Chicks were maintained under standard management conditions for 20 days on deep litter system as described by the management guide. The brooder temperature was maintained at about 32°c for the first 12 days of age and was gradually lowered by 2 degrees centigrade every week thereafter.

Chicks were provided feed and water ad lib and 23 hrs of light. Chicks were vaccinated against Gumboro and New Castle disease at 12 and 17 days of age. At 21 days of age, 192 chicks were weighed and randomly distributed to four experimental groups of four replicates each. The mean of weights for each replicate pen is given in (Table 6). At 21days of age, chicks in each dietary treatment were allowed to feed on the experimental diets. Each replicate pen was supplied with a cylindrical hanged plastic feeder and a bell-shaped drinker.

Table (6): Weights of birds in each replicate and calculated means of each treatment at 21 days of age

Replicate	Treatment			
	C	FWB5%	FWB10%	FWB15%
1	742	742	746	754
2	683	683	717	721
3	717	767	740	725
4	692	729	704	729
Mean	709	730	727	732

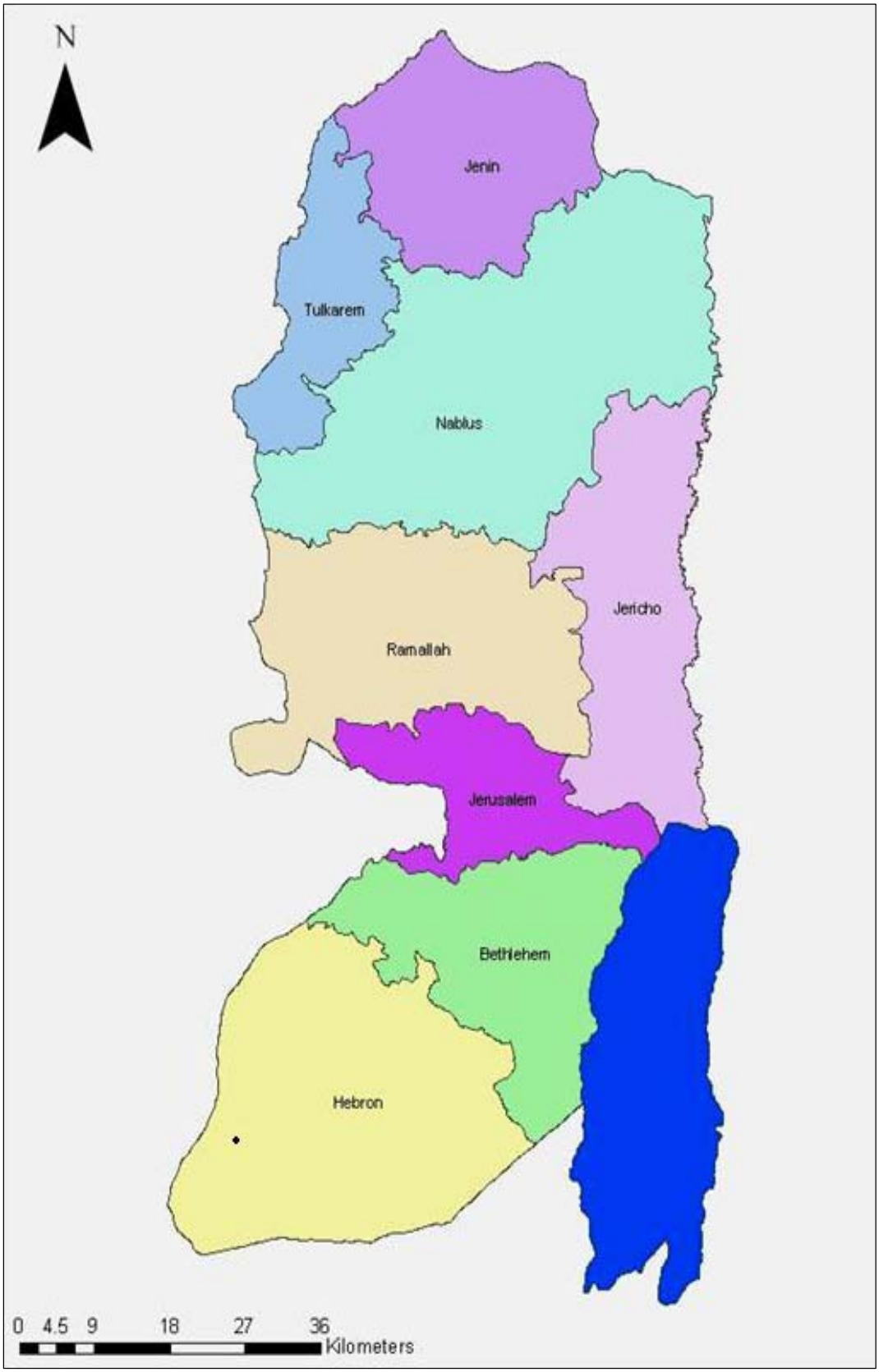

Figure (1): The experimental site

3.5 Parameters Measured

Average body weight, feed consumption were recorded weekly and body gain, feed conversion were then calculated. While daily mortality was recorded and weekly mortality rate was calculated. Etiology of the dead chicks was monitored by a veterinarian. The final body weight was recorded at 35 days of age, after which 2 chicks per replicate were randomly selected, slaughtered and eviscerated to report carcass, visceral, offal and cut parts weights. The right toe bone from each carcass was cut down and deep frozen for further analysis. Plucked weight was recorded after the removal of feathers and blood draining. Carcass weight was recorded after the removal of the head, gastrointestinal tract, heart and lungs.

Plucked weight was calculated as a percentage of the live body weight. Similarly, eviscerated weight was calculated as a percentage of plucked weight, whereas the carcass yield was calculated as a percentage of the eviscerated weight. Weights of the visceral organs were calculated as a percentage of eviscerated weight.

At the end of the experiment, economic evaluation parameters were calculated.

3.6 Statistical Analysis.

Data for all variables measured or calculated were analyzed using the general linear models procedures of SAS (2000), and Duncan's test was applied for mean comparisons. Differences at $P \leq 0.05$ were considered significant.

Chapter Four

Results

4.1 The performance of the broiler chicks

Performance parameters of the broiler chicks from day 1 to day 21 of age are shown in (Table 7).

Table (7): Broilers performance parameters from 1 to 3 weeks of age.

Age in weeks	Mortality %	Average body weight (g)	Average feed consumption (g)	Feed conversion
1	2.4	130	129	0.99
2	2.5	378	439	1.16
3	1.5	724	809	1.12

At 21 days of age, mean body weight, cumulative feed consumption and cumulative feed conversion are shown in (Table 8).

Table (8): Mean body weight, feed consumption and feed conversion of the broilers at 21 days of age.

Mean body weight	Cumulative feed consumption	Cumulative feed conversion
724	1377	1.9

At 28 days of age body weight, feed consumption, feed conversion and daily gain of the broilers fed the diets containing fermented wheat bran at 5%, 10% and 15% inclusion rates were similar to those fed the control diet (Table 9). Birds receiving the control diet had numerically lower body weight than birds of other groups especially those receiving the FWB15%. On the other hand, feed consumption for birds in control group was higher than those in the other groups, while birds given fermented wheat bran at 15% inclusion rate had numerically lower feed consumption. Similar trend has been noticed in regard to daily gain which was numerically higher for

birds receiving the fermented wheat bran at 15% inclusion rate than those in the other groups.

Table (9): The body weight, feed consumption, feed conversion and daily gain of the experimental birds from 21- 28 days of age

Variables / Treatment	Body weight at 28 days of age (gm)	Feed consumption (gm)	Feed conversion	Daily gain (gm)
C	1219.0	1336.7	2.2	72.9
FWB5%	1246.8	1312.4	2.2	74.2
FWB10%	1242.0	1231.4	2.1	73.6
FWB15	1257.3	1169.8	2	75

At 35 days of age, body weight, feed consumption, feed conversion and daily gain were not significantly different among the experimental birds (Table 10). Body weigh, feed consumption and daily gain of the chickens receiving fermented wheat bran at 5% inclusion rate were numerically higher than those in the other groups, followed by the chickens that received the 15% and 10% fermented wheat bran meal respectively.

Table (10): Mean body weight, feed consumption, feed conversion and daily gain of the experimental birds from 28- 35 days of age

Variables / Treatment	Body weight at 35 days of age (gm)	Feed consumption (gm)	Feed conversion	Daily gain (gm)
C	1673.3	1254.9	2.4	64.9
FWB5%	1777.3	1332.9	2.3	75.4
FWB10%	1742.8	1307.1	2.2	71.5
FWB15%	1760.5	1320.4	2.2	71.9

Overall performance of the chickens of the four treatments (21-35 days of age) is shown in Table (11). Chickens receiving 5% fermented wheat bran have slightly higher body weight, feed consumption and daily gain, followed by those receiving 15%, 10% fermented wheat bran. No

significant differences were noticed among the four treatment groups with respect to body weight, feed consumption, feed conversion and daily gain (P>0.05).

Table (11): Body weight, feed consumption, feed conversion and daily gain of the broilers from 21 to 35 days of age

Variables / Treatment	Body weight at 35 days of age (gm)	Feed consumption (gm)	Feed conversion	Daily gain (gm)
C	1673.3	3968.7	2.4	46.7
FWB5%	1777.3	4022.4	2.3	49.6
FWB10%	1742.8	3915.5	2.2	48.7
FWB15%	1760.5	3867.2	2.2	49.2

Body weight, feed conversion, daily gain and feed intake are shown in figures 2, 3, 4 and 5 respectively. It can be seen that birds received 5, 10 and 15% fermented wheat bran have similar trend with respect to the above mentioned variables compared to the birds receiving the commercial diet (the control). It is noteworthy to mention that mortality among chicks of the different groups was not reported. All chicks in the different groups were made it to the end of experiment period.

A summery of the experimental chicks performance parameters is presented in figures (2-5).

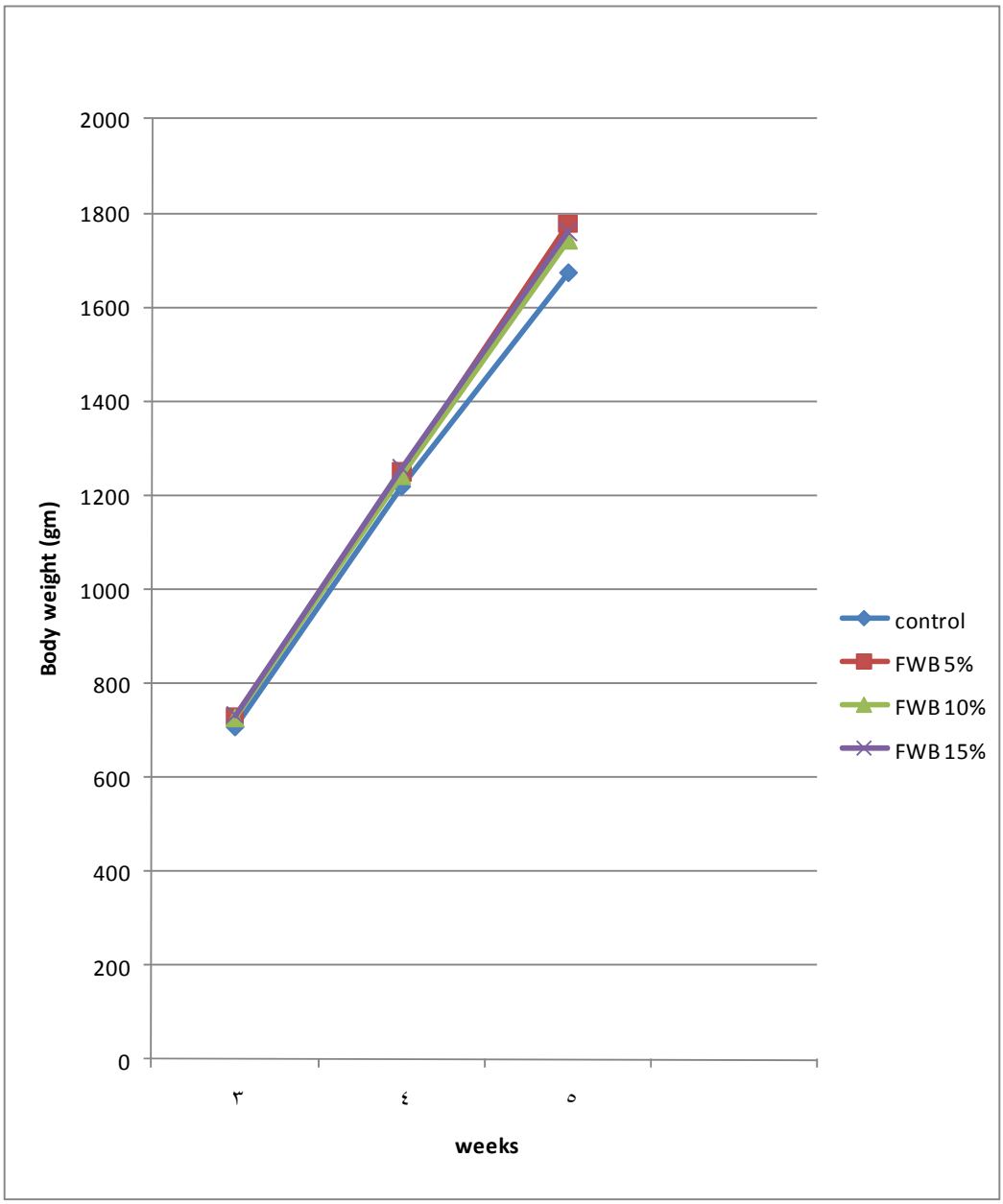

Figure (2): Body weights for experimental broilers from 21-35 days of age.

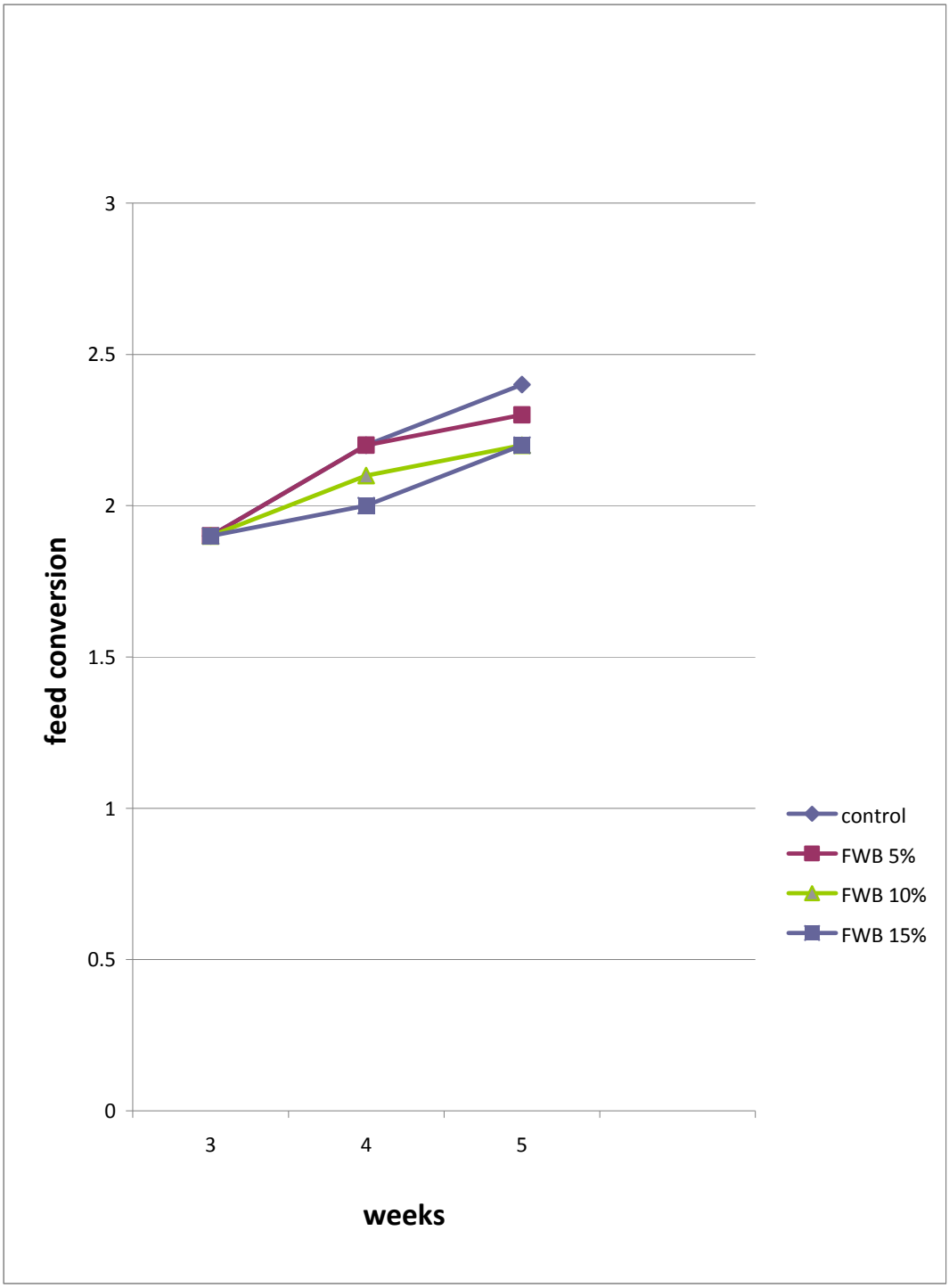

Figure (3): Feed conversion for experimental broilers from 21-35 days of age.

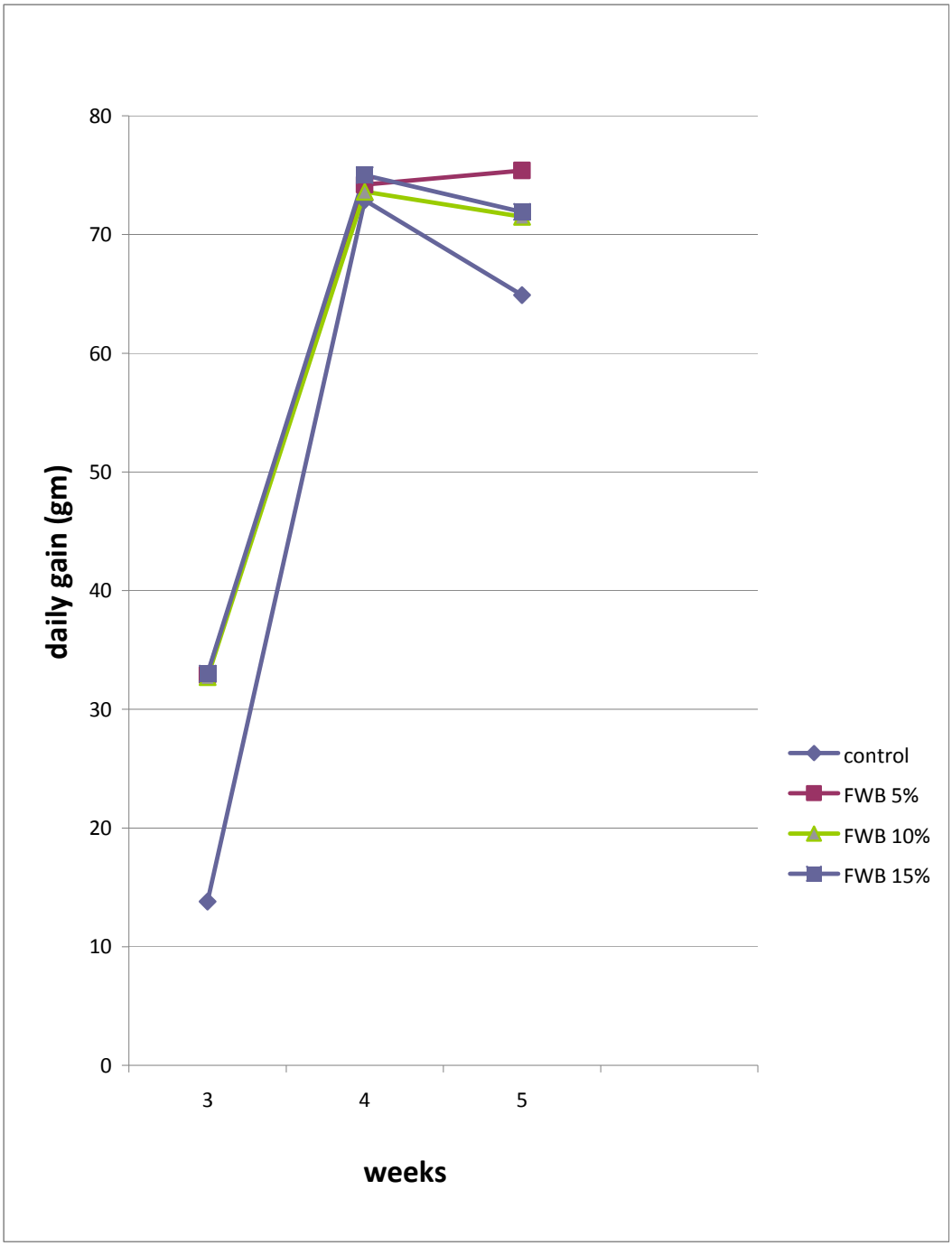

Figure (4): Daily gain for experimental broilers from 21-35 days of age

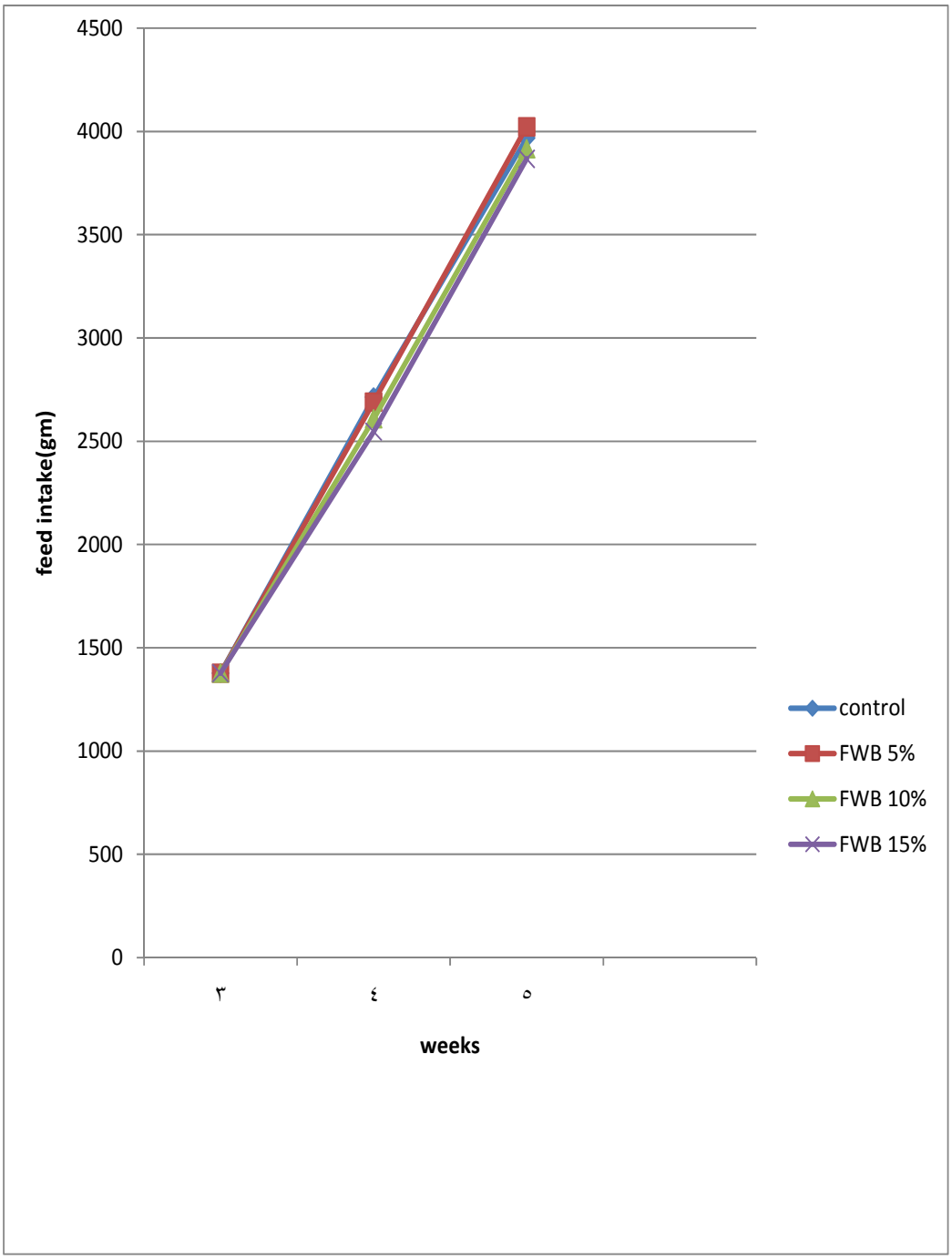

Figure (5): Feed intake for experimental broilers from 21-35 days of age

4.2 Carcass characteristics

The carcass characteristics of slaughtered birds at 35 days of age are presented in (Table 12). The analysis of variance revealed no significant differences in dressing percentage among the four experimental groups. Birds fed diets containing fermented wheat bran at 15% and 5% inclusion rate had numerically higher carcass yield compared to those fed the other diets.

Table (12): Carcass characteristics of broilers fed the experimental diets at 35 days of age as percentage of live body weight.

Treatments	Variables				
	Body weight	Plucked weight	Carcass weight	plucked weight %	Dressing weight %
C	1801.3	1538.8	1306.3	85.4	72.5
FWB 5%	1811.3	1566.3	1315	86.5	72.5
FWB 10%	1665	1435	1196.3	86.2	71.8
FWB 15%	1755	1538.8	1272.5	87.7	72.5

4.3 Visceral organs

Chicks were slaughtered using commercial cones and plucking machine. Following bleeding and plucking the dead chicks were weighed and blood and feathers weights were determined.

There were no significant differences among the treatments ($P>0.05$) with regard to weights of feather and blood, viscera and giblets (edible visceral organs) of the experimental chickens when expressed as percentages of live weight (Table 13). Feathers and blood weight were numerically higher for birds fed the control diet and lowest for birds fed the fermented wheat bran at 15% inclusion rate. In addition the birds fed

fermented wheat bran at 10% level had numerically higher visceral giblets weights.

Table (13): Visceral and offal characteristics as percentage of carcass weight for broilers fed the experimental diets at 35 days of age.

Variables	Treatment			
	control	FWB 5%	FWB 10%	FWB 15%
Feathers and blood (%)	14.5	13.5	13.8	12.3
Viscera (%)	12.4	12.7	13.1	12.8
Giblets (%)	7.7	7.5	8.3	8

4.4 Carcass cuts

No significant differences (P>0.05) were noticed in the percentage of cut-parts of chickens fed the experimental diets (Table 14). The percentage of breast was found to be relatively higher for chickens fed fermented wheat bran 10% and lower for birds receiving control diet. There were also no significant differences in wings; thigh, drum and fat pad weights, although numerical differences were noticed.

Table (14): Carcass cuts as percentage of the carcass weight for chickens fed experimental diets at 35 days of age.

Variable	Treatment			
	Control	FWB 5%	FWB 10%	FWB 15%
Breast %	18.9	19.5	19.9	19.3
Wings %	4.9	4.6	4.7	4.9
Thigh %	12.3	11.8	11.8	12.4
Drum %	6.9	7	6.5	6.5
Fat pad %	2.8	2.5	2.4	2.8

4.5 Economical evaluation

The cost of the control diet is higher than the cost of each of other three experimental diets. The percentage decline in the cost of the

experimental diets is given in (Table 15). The cost of production per kg of live body weight for the four experimental diets is given in (Table 16). The economical benefit for incorporating fermented wheat bran in the diet of broiler in the finisher phase of production is appeared in (Table 17).

Table (15): The cost of the experimental diets in NIS per kg diet

Treatments	C (kg)	FWB5% (kg)	FWB10% (kg)	FWB15% (kg)
Cost(NIS)	1.9	1.87	1.85	1.82
Reduction %	0	-1.58%	-2.63%	-4.21%

Table (16): The cost of production per kg of live body weight

Diet / Cost (NIS)	C (kg)	FWB5% (kg)	FWB10% (kg)	FWB15% (kg)
1-21 days	4.26	4.26	4.26	4.26
21-28 days	4.18	4.11	3.89	3.64
28-35 days	4.56	4.30	4.07	4.00

Table (17): The economical benefit for incorporating 5%, 10% and 15% inclusion rates of fermented wheat bran in the diet of broilers.

Cost of production / Period	C (NIS)	FWB5% (NIS)	FwB10% (NIS)	FWB15% (NIS)
1-21 days	3.02	3.11	3.10	3.12
21-28 days	2.13	2.14	2.00	1.91
28-35 days	2.07	2.27	2.04	2.01
Total of cost	7.22	7.52	7.14	7.04
Live body weight at the end of experiment	1.67 kg	1.78 kg	1.74 kg	1.76 kg
Cost per kg live body weight (NIS)	4.32	4.22	4.10	4.00

Chapter Five
Discussion

5.1 Birds performance

The optimal growth and productivity of the broiler chicks depend on the diet, which must be formulated to meet all the nutrient requirements. It has been demonstrated that crude protein, methionine, methionine plus cystine, lysine, arginine, calcium and non-phytate phosphorus as percentage of the finisher broiler chickens are 18, 0.32, 0.60, 0.85, 1, 0.80, 0.30, respectively, (NRC, 1994). The experimental diets in this study were formulated to contain approximately similar proportions of those nutrients as recommended by NRC (Table 4, 5). On the other hand NRC (1994) reported that poultry diets are composed primary of a mixture of several feedstuffs such as cereal grains, soybean meal, animal by-product meals, fat and premix. The experimental diets were formulated from corn, soybean meal, wheat, fermented wheat bran with rumen liquor, oil, dicalcium phosphate DCP, limestone, salt and premix. It can be seen that average body weight, feed consumption and feed conversion are approximately similar to those in the management guide (Cobb- vantress, 2008). Table (8) shows mean body weight, cumulative feed intake and cumulative feed conversion of chicks that were measured at 21 days of age.

Lesson and Summers (2008) reported that wheat bran has relatively high protein content and has a growth promoting effect. However, these authors reported that inclusion of wheat bran alone and at low level will have positive effects on broilers and this effect is not connected the fiber

content of wheat bran. In our study, inclusion of fermented wheat bran up to 15% of broiler finisher diet did not have any adverse effect in the performance of broilers.

Lack of significant differences in the production parameters of the control birds and those fed fermented wheat bran in the current study can be attributed to several factors. One of these factors is that diets were formulated to contain nutrients in excess of the chick requirements, feed practice is usually followed in commercial operation. The other factor is that chicks were raised straight-run rather than one sex (males or females) distribution. A final factor is that diets were formulated in a manner that all diets were isonitrogenous and isoenergetic. Thus ensured that chicks have obtained similar daily energy and protein allowance regardless of the diet fibers content. Similar arguments have been presented by Lesson and Summers (2008). They have reported that broiler's final body weight differences can't be attributed to fiber content of the diet.

Wheat bran insertion in the broiler diet usually does not exceed 5% due to its high fiber content (NRC, 1994). Dirar (1992) reported that one of the ways of using feeds that are under normal circumstances denigrated is by use of fermentation techniques. Other investigators (Abaza *et al*., 2004 and Ali *et al*., 2006) reported that wheat bran alone or wheat bran supplemented with some enzyme preparations can have a positive effect on the performance of broilers and laying hens at 35% inclusion rate of wheat bran. This was the case in this study although broilers rather than laying hens were used.

5.2 Fermented wheat bran

It is more probable that fermentation of wheat bran caused a decrease in its fiber content. In our study, the bran's fiber content decreased from 12% to 9.5% when the wheat bran is fermented for the specified period of time. Adeyemi and Familade (2003) did notice similar effect when corn-cobs were fermented with rumen filtrate and suggested that fermented corn-cob could provide a material that holds as a good alternative to maize because of its enhanced crude protein value and reduced crude fiber contents. In fact, the crude protein content in wheat bran increased from 13.6% to 14.2% when fermented with rumen filtrate. Although working with fermented corn-cobs, Adeyemi and Familade (2003) reported that fermentation of corn-cobs with rumen liquor did raise protein content three folds and lower crud fiber content from 42.46% to 28.94%. It is therefore, obvious that fermentation enhanced the nutritive value of wheat bran. Unfortunately, wheat bran fermentation in our study, took place in cool months of the year (February and March). This probably caused a slower fermentation of the wheat bran. We think that fermentation of wheat bran in hotter months (July and August) could have resulted in faster fermentation of wheat bran. We could have seen more decline in the fiber content of wheat bran has the fermentation process took place in summer months.

In our study the chemical analysis of fermented wheat bran indicated that it contains 12.5% crud fiber, 13.6% crude protein, 3.96% fat, 4% ash,

13.87% moisture and 3905.4 kcal/kg of gross energy. Yao *et al.* (2007) reported that wheat bran contain 15.52% crude protein, 0.89% total phosphorus, 0.13% calcium, 4.70% ash, 8.34% crude fiber, 88.57% dry matter and 2400 U/kg phytase activity. It is normal that different wheat bran may contain different proportion of these nutrients. However, such results support our results in regard to bran analysis. Literature lacks data on fermented wheat bran which make the comparison of our results with the other author's results more difficult.

Christopher *et al*. (2007) reported that replacing maize with 25% wheat offal (short and meddling) in the broiler finisher diet did not adversely effect growth, feed intake and feed efficiency of broilers while feed cost was reduced considerably. These results are in agreement with the results in our study.

5.3 phosphorus utilization

Due to unexpected technical errors, available phosphorous from the measurements of toes ash content for slaughtered birds were not determined. But phosphorus as percentage in each gram of ash was determined by using sub-samples of toe ash taken from each replicate bird.

Birds fed fermented wheat bran had 7.9% compared to 6.7% phosphorus per gram ash for the birds receiving the control diet. These results are in agreement with those of Cavalcanti and Behenke (2004) who reported that wheat bran phytase resulted in higher growth rate and higher

phosphorus utilization by broiler. Earlier studies (Pointillar, 1991) suggested that endogenous phytase of cereal and cereal by-products enhance phosphorus utilization by monogastric species. We believe that further studies need to be conducted to study the effects of FWB inclusion at graded levels in broiler diets at the same time when phosphorus content of the diet is held constant.

5.4 Cost evaluation

It is clear that the cost of the broiler finisher diets was lower when fermented wheat bran is incorporated on the expense of other traditional ingredients (Table 15-17). Given acceptable transportations fermentation and packaging costs for wheat bran, our results suggest that fermented bran is a viable alternative when formulating diets for broilers because of its enhanced crude protein and reduced crude fiber content.

Chapter six
Conclusions and Recommendations

6.1 Conclusions

The data obtained from this study indicate that fermented wheat bran with rumen liquors holds a beneficial feedstuff for broilers. The productive results are similar when diets containing this alternative feedstuff in 5, 10 or 15% inclusion rates. It could be concluded that not only 15% fermented wheat bran can be incorporated into broiler finisher diets without adverse effect on performance, but also it may have a beneficial effects on phosphorus utilization. Further studies are necessary to evaluate the effect of fermented wheat bran inclusion into the broiler diets on digestibility and on plasma antioxidant capacity, phosphorus and other blood parameters.

6.2 Practical and Recommendations

* Fermentation of wheat bran with rumen liquor resulted in an increased in crude protein while crude fiber decreased.

* The insertion of fermented wheat bran with rumen liquor up to 15% in the finisher broiler diets did not negatively affect the performance of broilers.

* Use of fermented wheat bran in the diet of broiler at finisher stage will reduce the cost of broiler nutrition.

* Insertion of fermented wheat bran may improve the utilization of phytate phosphorus by the broiler chicks.

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Appendices

Appendix 1

Analysis of variance for body weight at 21 days of age

The SAS **System**

The GLM Procedure

Dependent Variable: body weight at 21 days of age

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1416.687500	472.229167	0.74	0.5485
Error	12	7661.250000	638.437500		
Corrected Total	15	9077.937500			

Appendix 2

(Dunn) t Tests for body weight at 21 days of age

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	638.4375
Critical Value of t	3.15268
Minimum Significant Difference	56.328

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	732.25	4	b15
A			
A	730.25	4	b5
A			
A	726.75	4	b10
A			
A	708.50	4	c

Appendix 3

Analysis of variance for body weight at 28 days of age

The SAS System

The GLM Procedure

Dependent Variable: body weight 28 days of age.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	3286.50000	1095.50000	0.56	0.6545
Error	12	23681.50000	1973.45833		
Corrected Total	15	26968.00000			

Appendix 4

(Dunn) t tests for body weight at 28 days of age

The SAS System

The GLM Procedure

(Dunn) t Tests for body weight 28

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	1973.458
Critical Value of t	3.15268
Minimum Significant Difference	99.033

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	Treatment
A	1257.25	4	b15
A			
A	1249.75	4	b5
A			
A	1242.00	4	b10
A			
A	1219.00	4	c

Appendix 5

Analysis of variance for body weight at 35 days of age

The SAS System

The GLM Procedure

Dependent Variable: body weight 35

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	25044.6875	8348.2292	1.31	0.3178
Error	12	76735.2500	6394.6042		
Corrected Total	15	101779.			

Appendix 6

Dunn t tests for body weight 35 days of age

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	6394.604
Critical Value of t	3.15268
Minimum Significant Difference	178.27

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	1777.25	4	b5
A			
A	1760.50	4	b15
A			
A	1742.75	4	b10
A			
A	1673.25	4	c

Appendix 7

Analysis of feed intake at 21 days of age

The SAS System

The GLM Procedure

Dependent Variable: feed intake 21 days of age

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0	0		
Error	12	0	0		
Corrected Total	15	0			

Appendix 8

(Dunn) t Tests for feed intake at 21 days of age

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	0
Critical Value of t	3.15268
Minimum Significant Difference	0

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	1377	4	b10
A			
A	1377	4	b15
A			
A	1377	4	b5
A			
A	1377	4	c

Appendix 9

Analysis of variance for feed intake at 28 days of age

The SAS System

The GLM Procedure

Dependent Variable: feed intake 28 days

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	70261.6275	23420.5425	3.02	0.0714
Error	12	92912.6700	7742.7225		
Corrected Total	15	163174.2975			

Appendix 10

(Dunn) t Tests for feed intake at 28 days

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	7742.723
Critical Value of t	3.15268
Minimum Significant Difference	196.16

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	1336.73	4	c
A			
A	1312.43	4	b5
A			
A	1231.43	4	b10
A			
A	1169.78	4	b15

Appendix 11

Analysis of variance for feed intake at 35 days of age

The SAS System

The GLM Procedure

Dependent Variable: feed intake 35 days

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	14087.63672	4695.87891	1.31	0.3178
Error	12	43163.57813	3596.96484		
Corrected Total	15	57251.21484			

Appendix 12

(Dunn) t Tests for feed intake at 35 days of

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	3596.965
Critical Value of t	3.15268
Minimum Significant Difference	133.7

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	1332.94	4	b5
A			
A	1320.38	4	b15
A			
A	1307.06	4	b10
A			
A	1254.94	4	c

Appendix 13

Analysis of variance for feed intake for all experimental period

The SAS System

The GLM Procedure

Dependent Variable: feed intake for all period

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	53865.7580	17955.2527	1.46	0.2745
Error	12	147521.8856	12293.4905		
Corrected Total	15	201387.6436			

Appendix 14

(Dunn) t Tests for feed intake for all experimental period

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	12293.49
Critical Value of t	3.15268
Minimum Significant Difference	247.17

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	4022.36	4	b5
A			
A	3968.66	4	c
A			
A	3915.49	4	b10
A			
A	3867.15	4	b15

Appendix 15

Analysis of variance for daily gain at 21 days of age

The SAS System

The GLM Procedure

Dependent Variable: daily gain at 21 days of age

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	3.21244331	1.07081444	0.74	0.5485
Error	12	17.37244898	1.44770408		
Corrected Total	15	20.58489229			

Appendix 16

(Dunn) t Tests for daily gain at 21 days of age

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	1.447704
Critical Value of t	3.15268
Minimum Significant Difference	2.6823

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	32.9643	4	b15
A			
A	32.8690	4	b5
A			
A	32.7024	4	b10
A			
A	31.8333	4	c

Appendix 17

Analysis of variance for daily gain from 21-28 days of age

The SAS System

The GLM Procedure

Dependent Variable: daily gain from 21-28 days of age

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	9.3303571	3.1101190	0.13	0.9405
Error	12	287.5663265	23.9638605		
Corrected Total	15	296.8966837			

Appendix 18

(Dunn) t Tests for daily gain from 21-28 days of age

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	23.96386
Critical Value of t	3.15268
Minimum Significant Difference	10.913

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	75.000	4	b15
A			
A	74.214	4	b5
A			
A	73.607	4	b10
A			
A	72.929	4	c

Appendix 19

Analysis of variance for daily gain from 28-35 days of age

The SAS System

The GLM Procedure

Dependent Variable: daily gain from 28-35 days

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	229.360969	76.453656	1.17	0.3605
Error	12	781.739796	65.144983		
Corrected Total	15	1011.100765			

Appendix 20

(Dunn) t Tests for daily gain from 28-35 days of age

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	65.14498
Critical Value of t	3.15268
Minimum Significant Difference	17.993

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	75.357	4	b5
A			
A	71.893	4	b15
A			
A	71.536	4	b10
A			
A	64.893	4	c

Appendix 21

Analysis of variance for daily gain for all experimental period (21-35 days)

The SAS System

The GLM Procedure

Dependent Variable: daily gain for all period from 21-35 days

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	20.44464286	6.81488095	1.31	0.3178
Error	12	62.64102041	5.22008503		
Corrected Total	15	83.08566327			

Appendix 22

(Dunn) t Tests for daily gain for all experimental period from 21-35 days of age

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	5.220085
Critical Value of t	3.15268

Minimum Significant Difference 5.0934

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	49.636	4	b5
A			
A	49.157	4	b15
A			
A	48.650	4	b10
A			
A	46.664	4	c

Appendix 23

Analysis of variance for feed conversion at 28 days of age

The SAS System

The GLM Procedure

Dependent Variable: feed conversion at 28 days of age

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.08354462	0.02784821	1.99	0.1691
Error	12	0.16778594	0.01398216		

Corrected Total 15 0.25133056

Appendix 24

(Dunn) t Tests for feed conversion at 28 days of age

The SAS System

The GLM Procedure

Alpha 0.05

Error Degrees of Freedom 12

Error Mean Square 0.013982

Critical Value of t 3.15268

Minimum Significant Difference 0.2636

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	2.22721	4	c
A			
A	2.15462	4	b5
A			
A	2.10334	4	b10
A			
A	2.02937	4	b15

Appendix 25

Analysis of variance for feed conversion at 35 days of age

The SAS System

The GLM Procedure

Dependent Variable: feed conversion at 35 days

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.06549144	0.02183048	3.22	0.0613
Error	12	0.08135142	0.00677928		
Corrected Total	15	0.14684286			

Appendix 26

(Dunn) t Tests for feed intake at 35 days of age

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	0.006779
Critical Value of t	3.15268
Minimum Significant Difference	0.1836

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	2.37518	4	c
A			
A	2.26335	4	b5
A			
A	2.24853	4	b10
A			
A	2.20057	4	b15

Appendix 27

Analysis of variance for feed conversion for all experimental period (21-35 days)

The SAS System

The GLM Procedure

Dependent Variable: feed conversion from (21-35 days)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.06549144	0.02183048	3.22	0.0613
Error	12	0.08135142	0.00677928		
Corrected Total	15	0.14684286			

Appendix 28

(Dunn) t Tests for feed conversion for all experimental period (21-35 days)

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	0.006779
Critical Value of t	3.15268
Minimum Significant Difference	0.1836

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	2.37518	4	c
A			
A	2.26335	4	b5
A			
A	2.24853	4	b10
A			
A	2.20057	4	b15

Appendix 29

Analysis of variance for live weight

The SAS System

The GLM Procedure

Dependent Variable: live weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	53456.2500	17818.7500	0.94	0.4496
Error	12	226287.5000	18857.2917		
Corrected Total	15	279743.7500			

Appendix 30

(Dunn) t Tests for live weight

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	18857.29
Critical Value of t	3.15268
Minimum Significant Difference	306.13

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	1811.25	4	b5
A			
A	1801.25	4	c
A			
A	1755.00	4	b15
A			
A	1665.00	4	b10

Appendix 31

Analysis of variance for plucked weight

The SAS System

The GLM Procedure

Dependent Variable: plucked weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	40267.1875	13422.3958	1.04	0.4119
Error	12	155556.2500	12963.0208		
Corrected Total	15	195823.4375			

Appendix 32

(Dunn) t Tests for plucked weight

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	12963.02
Critical Value of t	3.15268
Minimum Significant Difference	253.82

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	1566.25	4	b5
A			
A	1538.75	4	b15
A			
A	1538.75	4	c
A			
A	1435.00	4	b10

Appendix 33

Analysis of variance for carcass weight

The SAS System

The GLM Procedure

Dependent Variable: carcass weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	35037.5000	11679.1667	0.92	0.4621
Error	12	152912.5000	12742.7083		
Corrected Total	15	187950.0000			

Appendix 34

(Dunn) t Tests for carcass weight

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	12742.71
Critical Value of t	3.15268
Minimum Significant Difference	251.65

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	1315.00	4	b5
A			
A	1306.25	4	c
A			
A	1272.50	4	b15
A			
A	1196.25	4	b10

Appendix 35

Analysis of variance for dressing weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: dressing percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.54048363	0.51349454	0.33	0.8011
Error	12	18.45521491	1.53793458		
Corrected Total	15	19.99569854			

Appendix 36

(Dunn) t Tests for dressing weight as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	1.537935
Critical Value of t	3.15268
Minimum Significant Difference	2.7646

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	72.5128	4	b5
A			
A	72.5116	4	c
A			
A	72.4900	4	b15
A			
A	71.7885	4	b10

Appendix 37

Analysis of variance for feather and blood weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: feather and blood weight as percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	10.03076755	3.34358918	1.51	0.2614
Error	12	26.52105548	2.21008796		
Corrected Total	15	36.55182302			

Appendix 38

(Dunn) t Tests for feather and blood as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	2.210088
Critical Value of t	3.15268
Minimum Significant Difference	3.3141

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	14.538	4	c
A			
A	13.757	4	b10
A			
A	13.510	4	b5
A			
A	12.330	4	b15

Appendix 39

Analysis of variance for visceral weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: visceral weight as percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.03722848	0.34574283	0.29	0.8344
Error	12	14.48925544	1.20743795		
Corrected Total	15	15.52648392			

Appendix 40

(Dunn) t Tests for visceral weight as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	1.207438
Critical Value of t	3.15268
Minimum Significant Difference	2.4496

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	13.1470	4	b10
A			
A	12.8290	4	b15
A			
A	12.7167	4	b5
A			
A	12.4362	4	c

Appendix 41

Analysis of variance for giblets weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: giblets weight as percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.52161483	0.50720494	0.88	0.4790
Error	12	6.91995550	0.57666296		
Corrected Total	15	8.44157033			

Appendix 42

(Dunn) t Tests for giblets weight as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	0.576663
Critical Value of t	3.15268

Minimum Significant Difference 1.6929

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	8.3360	4	b10
A			
A	8.0458	4	b15
A			
A	7.6896	4	c
A			
A	7.5467	4	b5

Appendix 43

Analysis of variance for breast weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: breast weight as percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	2.08686219	0.69562073	0.76	0.5398
Error	12	11.03930029	0.91994169		
Corrected Total	15	13.12616249			

Appendix 44

(Dunn) t Tests for breast weight as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	0.919942
Critical Value of t	3.15268
Minimum Significant Difference	2.1382

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	19.9046	4	b10
A			
A	19.5040	4	b5
A			
A	19.3583	4	b15
A			
A	18.8945	4	c

Appendix 45

Analysis of variance for wings weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: wings weight as percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.31430313	0.10476771	0.53	0.6707
Error	12	2.37578105	0.19798175		
Corrected Total	15	2.69008418			

Appendix 46

(Dunn) t Tests for wings weight as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	0.197982
Critical Value of t	3.15268
Minimum Significant Difference	0.9919

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	4.8958	4	c
A			
A	4.8916	4	b15
A			
A	4.7221	4	b10
A			
A	4.5561	4	b5

Appendix 47

Analysis of variance for thigh weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: thigh weight as percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.18659448	0.39553149	0.39	0.7656
Error	12	12.31934219	1.02661185		
Corrected Total	15	13.50593667			

Appendix 48

(Dunn) t Tests for thigh weight as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	1.026612
Critical Value of t	3.15268
Minimum Significant Difference	2.2588

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	12.3830	4	b15
A			
A	12.2459	4	c
A			
A	11.7831	4	b5
A			
A	11.7739	4	b10

Appendix 49

Analysis of variance for drum weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: drum weight as percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.85526504	0.28508835	1.40	0.2918
Error	12	2.45111021	0.20425918		
Corrected Total	15	3.30637525			

Appendix 50

(Dunn) t Tests for drum weight as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	0.204259
Critical Value of t	3.15268
Minimum Significant Difference	1.0075

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	6.9592	4	b5
A			
A	6.9091	4	c
A			
A	6.4769	4	b10
A			
A	6.4693	4	b15

Appendix 51

Analysis of variance for fat pad weight as percentage

The SAS System

The GLM Procedure

Dependent Variable: fat pad weight as percentage

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.54966555	0.18322185	0.85	0.4919
Error	12	2.58030688	0.21502557		
Corrected Total	15	3.12997243			

Appendix 52

(Dunn) t Tests for fat pad weight as percentage

The SAS System

The GLM Procedure

Alpha	0.05
Error Degrees of Freedom	12
Error Mean Square	0.215026
Critical Value of t	3.15268
Minimum Significant Difference	1.0337

Means with the same letter are not significantly different.

Bon Grouping	Mean	N	treatments
A	2.8443	4	b15
A			
A	2.7778	4	c
A			
A	2.5027	4	b5
A			
A	2.3988	4	b10

جامعة النجاح الوطنية
كلية الدراسات العليا

تأثير كميخ نخالة القمح المخمرة بسائل الكرش على آداء دجاج اللحم

إعداد
مهند مازن ظاهر دروزه

إشراف
د. معن سماره

قدمت هذه الاطروحة إستكمالاً لمتطلبات درجة الماجستير في الانتاج الحيـــواني بكليـــة الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.

2010م

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الملخص

أجريت هذه التجربة لدراسة تأثيرإضافة كميخ نخالة القمح المخمرة بسائل كرش عجول، إلى علائق دجاج اللحم من عمر 21–35 يوم. أستخدمت في التجربة 205 صوص (ذكور وإناث) من صنف كوب. قدم للصيصان عليقة بادىء (ستارتر) من عمر يوم وحتى 20 يوم، حيث تم تربية الصيصان تبعاً للمعايير التجارية المعمول بها محلياً. تم تقسيم الصيصان عند عمر 21 يوم إلى اربعة مجموعات عشوائياً. واعتبرت المجموعة الاولى الشاهد، الثانية، الثالثة، الرابعة قدم لها علائق تحتوي على 5، 10، 15% نخالة قمح مخمرة على التوالي. تكونت كل معاملة من اربعة تكرارات، 12 طير لكل تكرار. اعطيت طيور المجموعات المختلفة علائق تشابهت في محتواها من الطاقة التمثيلية والبروتين. تم جمع سائل الكرش من ذبائح عجول ذبحت في مسلخ بلدية نابلس، بعد ذلك تم رش سائل الكرش على نخالة القمح ثم وضعت في اكياس نايلون احكم إغلاقها. إستمرت عملية التخمير لمدة 24 يوم بعدها جفف الكميخ لمدة 30 ساعة.

تم قياس الكسب الوزني، الكفاءة التحويلية، وزن ذبائح الطيور، تكليفة العلائق المختلفة من اليوم الاول وحتى 20 يوم، ثم اثناء فترة التجربة (21–35 يوم). لم يتأثر أي من المتغيرات التي تم قياسها نتيجة لاضافة كميخ نخالة القمح بمستويات مختلفة في علائق دجاج اللحم، يستدل من نتائج التجربة هذه أنه يمكن إضافة نخالة القمح المخمرة بسائل الكرش حتى 15% إلى العليقة النهائية لدجاج اللحم دون أن يكون لها آثار سلبية على آداء دجاج اللحم.