An-Najah National University

Faculty of Graduate Studies

The Effect of Supplemental Enzymes in Diets Containing Two Levels of Corn Distillers' Dried Grains with solubles on Performance of Broiler Chickens

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This thesis was defended successfully on 20/2/ 2014 and approved by:

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This project is dedicated to

My Mother

My Wife and Kids **Brothers and Sisters**

Relatives and Friends

the completion of this work was not possible without their support and encouragement.

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الإقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل عنوان:

The Effect of Supplemental Enzymes in Diets Containing Two Levels of Corn Distillers' Dried Grains with solubles on Performance of Broiler Chickens

إليه الإشارة تم ما الخاص، باستثناء جهدي انتاج هي إنما الرسالة عليه هذه اشتملت ما بأن أقر أو علمي لقب أو درجة أي لنيل يقدم لم منها جزء أي أو ككل، الرسالة ورد، وأن هذه حيثما أخرى بحثية أو تعليمية مؤسسة أية بحثي لدى.

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: **إسم الطالب:**

Signature: **التوقيع:**

Date: **التاريخ:**

List of Abbreviations

ANOVA	Analysis Of Variance
Cm	Centimeter
CO_2	Carbon Dioxide
DDGS	Distillers Dried Grains With Solubles
DM	Dry Matter
FCR	Feed Conversion Ratio
FI	Feed Intake
g	Gram
Kcal	Kilocalorie
Kg	Kilogram
ME	Metabolizable Energy
NIS	New Israeli shekel
NRC	National Research Council
NSP	Non-starch poly Saccharides
BW	Body Weight

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The Effect of Supplemental Enzymes in Diets Containing Two Levels of Corn Distillers' Dried Grains with solubles on Performance of Broiler Chicken

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Abstract

This experiment was conducted at An- najah university farm in Tulkarm to investigate the effects of different levels of dietary enzyme preparations and diets formulated to contain or not distillers dried grains with solubles on performance of broiler chicks and carcass characteristics. The experiment was 2×4 factorial arrangements with diets containing two levels of DDGS (0 and 10%) and four levels (0, 0.15, 0.2, 0.25 g/kg) of commercial enzyme product (Avizyme). A total number of 256 Ross 308 one day-old commercial broiler chicks were randomly assigned to eight experimental diets which replicated four times with 8 birds per replicate. Birds were given starter diets from 1to 21 days and finisher diets from 22 to 35 days. Body weight ,feed intake, feed conversion ratio and cost of feed per kg live weight were determined at weekly basis till the end of experiment. Four chicks were selected and slaughtered to determined the carcass yield and weights of cuts. The results of this study indicated that the addition of 10% DDGS without supplemental avizyme at starting period reduced ($P<0.05$) body weight (BW) and decreased feed conversion ratio (FCR) . This trend continued until the fourth week of age, however (FCR) were the same in all treatments in the last two weeks of age

but in term of (BW) for the 35 days of experiment no significant ($P<0.05$) differences were detected between treatments but for (FCR) the results indicated that only two significant ($P<0.05$) differences were detected between treatments 0% DDGS supplemented with 200 g/ton and 10% DDGS supplemented with 0.25 g/kg which were (1.75 vs 2.08) respectively . The final cost (NIS) of kg live weight for broilers given 10% DDGS was higher ($P<0.05$) than broilers given 0% DDGS when no avizyme is added (3.7 vs 3.88). In terms of carcass cuts and dressing percentage, this study indicated no significant differences with respect to dressing percentage, drumstick, thigh and breast weights among treatment, but the intestine weight and fat bad %, were higher ($P<0.05$) for birds fed 10% DDGS compared to 0% DDGS with no supplemental avizyme (5 vs 3.87) and (1.5 vs 0.98) respectively. This study also indicated that liver, gizzard weights as percentages of live body weight were the same in all treatments except hearts weights which were higher ($P<0.05$) in diets containing 10% DDGS compared to diets containing 0% DDGS supplemented with 0, 0.2 g/kg avizyme .

Chapter One

Introduction

Worldwide every year the marketing age of broilers improves by an average of 0.75 days for the same performance and improvement is being observed in the genetic capacity of broilers (Gunasekar, 2007),as this trend is likely to continue in the same direction for the coming years and it is well known that feed cost accounts for 75% of the total production cost of poultry investment (Samara, 2000).

Therefore poultry producers need to be aware of the dynamics of feed and its influence on final product quality and quantity as one of the major obstacles facing broiler production in Palestine is the extremely high cost of feed ingredients especially protein sources. Therefore it will be wise to use other feed ingredients to replace some of soy bean meal in poultry diets.

The increase demand for biofuels from grains for ethanol production has led to increased supply of Dried distilled grains with solubles (DDGS). Dried distilled grains with solubles contain all the nutrients from grain as a concentrated form (Babcock *et al*. 2008). DDGS is a rich source of crude protein (CP), amino acids, phosphorus (P) and other nutrients required by poultry and other animals (Swiatkiewicz and Koreleski, 2008). Reliable values for the nutrient content of feed constituents of poultry rations are essential to create more precise diet formulations. Currently in Palestine, there are DDGS available to feed producers. However local feed producers

are reluctant to use DDGS in poultry diets due to technical and nutritional issues like pellet quality and amino acid bio availability . It has also been indicated by many researchers that supplementing the poultry diets with commercial enzyme preparations improves the nutritional value of grains, and increases the utilization of starch, protein, amino acids and minerals. Because most of the starch is removed from corn during ethanol production, the resultant co-product, dried distillers grains with solubles (DDGS), contains concentrated levels of protein, minerals, and fiber (Spiehs *et al*., 2002; Anderson,2009).

The objective of the current study is to evaluate the use of different levels supplemental enzymes in diets containing two levels of (DDGS) on performance of broiler chicken , carcass characteristics and to compare the cost of the feed in different diets to produce one Kg of live weight.

Chapter Two

Literature Review

2.1 Poultry Industry in Palestine:

Poultry industry in Palestine plays a very important role in national economy, it provides a source of employment and some of the most food items for the Palestinian society (eggs and white meat).

It is well known that these food items in Palestine have become the main sources of animal protein due to the exorbitant rise in the price of red meat. So the poultry sector was developed considerably over the past years, especially in terms of the number of farms and the size of production and productivity, (Darwazeh, 2010).

The results of the agricultural statistics from the year 1996 - 2008 showed a development in number of broilers raised in Palestine. This number increased from 25.5 million birds in 1997 to 48.9 million birds in 2003 . However the total production of broilers decreased to 27.6 million birds in 2007 due to higher production requirements, especially feed cost . But in 2010 the number of broiler chickens reached 31.1 million birds as a result of high prices of red meat, which encouraged the production of white meat, as a consumer's policy for minimizing total payments with white meat consumption (PCBS, 2010). The poultry sector in Palestine contributes about 13.1 % of agriculture income, (PCBS, 2006).

As feed cost constitute up to 75% of total cost of broiler investment meanwhile formulating feeds ideally requires in-depth knowledge of the several critical parameters in deciding how much energy needs to be fixed in the diet, balancing the amino acids in the diet and balancing all nutrients which otherwise, if not properly adhered, will negatively influence the performance and profitability of the broiler production.

Increasing feed ingredient prices around the world have caused animal nutritionists to search for lower cost alternative feed ingredients to minimize the cost of food animal production.

2.2 Distillers' Dried Grains with Solubles in Broilers Nutrition:

Distillers' Dried Grains with solubles that has been available during the past few decades was derived from the beverage industry based on the fermentation of many different grains, in addition the commercial production of alcohol. Supply of DDGS produced was limited to compete with other feedstuffs. In addition, DDGS produced during that time had inconsistent composition and was used for ruminants.

Corn distillers dried grains with solubles (DDGS) is a byproduct obtained from milling process of corn, and perhaps other grains, for ethanol production. The production of DDGS from ethanol bio refineries has increased dramatically over the past few years (Shurson, 2003).

This increase has resulted in the increased prices of corn and other grains in the world grain market. Moreover, as the prices of the conventional feed ingredients continue to increase, this provides the opportunity to DDGS to replace corn and soybean meals.

Researchers have reported great variation in the nutritional profile of DDGS however, with light colored DDGS are most common. Several researchers have determined the nutritional profile of DDGS. Batal and Dale (2006) reported that DDGS have a metabolizable energy (ME) of 2820 Kcal/kg for DDGS samples having a crude protein content of approximately 27%, fat of 10%, crude fiber of 6%, ash 4%, and dry matter of 89%.

It has been reported (Parsons *et al*, 1983) that some amino acids, particularly lysine, are negatively influenced due to the thermal processing that corn undergoes during ethanol manufacturing. Other studies indicated that removal of starch through ethanol fermentation increase the various nutritional contents of DDGS (Cheon *et al*, 2008).

The high energy, protein, and phosphorus content of DDGS make it a very attractive partial replacement for some of the traditional energy (corn), protein (soybean meal), and phosphorus (mono-or Dicalcium phosphate) ingredients used in animal feeds.

Poultry producers looking to reduce feed costs can consider using feed ingredients, such as DDGS, to reduce the cost of the final product. An early use of DDGS in poultry diets was primarily as a source of unidentified

factors that Promote growth. Day *et al* (1972) reported that broiler body weight improved by using DDGS in broiler diets at 2.5 and 5%.

Alenier and Combs (1981) reported that laying hens preferred rations containing 10% or 15% DDGS over a corn-soy diet. Cantor and Johnson (1983) were unable to document an effect with distillers in corn soy diets for young chicks.

The increasing supply of DDGS from fuel (ethanol) production encourages the use of higher percentages than has been used in the past. Lumpkins *et al*. (2004) indicated that DDGS from modern ethanol plants is an acceptable feed ingredient for broiler diets and can be safely used at 6% in starter diets and 12 to 15% in grower and finisher diets. Wang *et al*. (2007) concluded that inclusion of up to 20 % of good quality DDGS had little adverse effect on live performance but might result in some loss of dressing percentage or breast meat yield.

Wang *et al*. (2008) suggested that up to 30 % of corn DDGS could be used in broiler diets if price of was justified. These authors used diets with 0, 10, 20, 30, 40 and 50 % DDGS. Wang *et al*. (2008) concluded that a level of 15% DDGS of known composition is acceptable in broiler starter, grower and finisher diets formulated on the basis of digestible amino acids with no adverse effects on the performance or carcass characteristics.

Sherief *et al*. (2011) reported that significant reduction in dressing % of broilers at 12% inclusion level of DDGS from wheat and corn. Also there was significant decrease in the digestibility of total amino acids.

In studies with pigs Whitney *et al*. (2006) and Linneen *et al*. (2008), indicated that dietary inclusion of DDGS decreased the dressing percentage, presumably because of the empty entrails and water retention within the digesta attributed to an increased dietary fiber content as justified by Linneen *et al*. (2008). Although similar effects of DDGS on dressing percentage would be expected in poultry for the same reasons as in pigs, dressing percentage was not affected in broilers fed diets containing up to 30% DDGS (Lumpkins et al, 2004; Wang *et al*., 2007a,b).

In a study by Wang *et al*. (2007c), however, dressing percentage appeared to decrease linearly with increased DDGS content. Compared to traditional diet, the dressing percentage was lower when broilers were fed diets containing 15% and 25% DDGS, but not in diets containing 5%, 10%, and 20% DDGS. Despite decreased growth performance in broilers fed 18% DDGS (Lumpkins, et al.2004), breast-meat yield and other cuts were unaffected by the dietary treatments whether they were measured on a gram-per-bird basis or a percentage-of-carcass-weight basis. Similarly, (Wang *et al*., 2007a, b) observed no effects on carcass quality when broilers were fed up to 15% DDGS. However, when fed 30% DDGS, broilers had lower breast-meat yield (Wang *et al*.,2007a, b).

The above mentioned and others studies with DDGS indicated a maximum dietary inclusion levels for corn DDGS (light colored) of 10% for broiler and up to 15% for laying hens. Given an appropriate dietary formulation adjustments for ME and amino acids, high levels of corn

DDGS can be used in broiler rations. Distillers dried grains with solubles are higher in non-starch poly saccharides (NSP), crude protein, crude fat and minerals than corn grains itself. On the other hand simple stomach animals like chickens, do not digest feeds high in NSP properly. As a consequence, the ME of DDGS is lower than that of corn (2800 vs 3400 kcal/kg)(Wang *et al* ,2007; NRC, 1994). Supplementing diets of simple stomach animals with exogenous enzymes may improve the available energy of DDGS by acting on the fiber content and increasing the digestibility of other constituents. For instance, it has been reported that amylase improves starch digestion, xylanase reduces the gut viscosity and break down cell wall of cereals, and protease acts on anti nutritional factors and storage proteins of soy bean meal (Graham and Aman, 1991; Maramatsu *et al*, 1991). In a more recent research (Sundu *et al*. 2006) demonstrated that inclusion of Allzyme SSF increased body weight gain, feed conversion, dry matter digestibility and nutritional digestibility and decreased intestinal content viscosity. Few studies have been concluded with respect to the effect of enzymes on DDGS containing diets for broilers.

2.3 Enzymes in Broilers Feed:

The process of enzymatic digestion of a feed is not completely efficient especially in mono gastric. In addition feed ingredients contain anti nutritional factors that can interfere with normal digestion, this may result in low meat production and feed conversion ratio.

Recently, it has been indicated by many sources that supplementing the animal feed with enzymes improves the nutritional value of feed ingredients and increasing the utilization of starch, protein, amino acids and minerals.

Several types of commercially feed enzymes are currently available some of these enzymes break down fiber (fiber-degrading enzymes, protease (protein-digesting enzymes), and phytase. The idea behind using feed enzymes that each type of enzymes is targeting different anti-nutrients in the feed mix. Enzymes are widely used in poultry feed today. however, their use in overcoming the nutritional challenges associated with feeding DDGS is relatively new. Broiler producers looking for lower feed costs with DDGS supplemented with enzymes, without risking bird performance.

Min *et al*. (2009) concluded that adding enzymes (ALLzyme SSF or Rovabio Excel) at up to 4 times of their recommended level to corn and soy bean meal-based diets or diets containing a high level(30%) of DDGS resulted in no significant improvements in the digestibility of energy . These enzyme preparations (Allzyme SSF) contain major activities of amylase, cellulase, phytase, xylanase, ß-glucanse, pectinase, and protease and also Rovabio Excel is a source of xylanase and ß-glucanse. However their experiments lasted only few days and used only (30%) DDGS.

DDGS is produced from the fermentation process of starch in the corn grain to ethanol and CO2, with the DDGS consequently having increased levels of non-starch Polysaccharides (NSP), protein and fat (Cromwell *et*

al., 1993; Belyea *et al*., 2004) . Xylan is the predominant component of NSP in DDGS (Widyaratne and Zijlstra, 2007). Based on the reported results, DDGS is an acceptable ingredient in poultry diets and can be safely fed at 6 % in starter broiler diets, and at 12-15 % in grower–finisher broiler diets (Lumpkins *et al*., 2004).

Historically, xylanase has been widely used to reduce the anti nutritional effects of NSP and improve the nutritional values of energy and protein in wheat-based diets (Selle *et al*., 2009). Nowadays, xylanase is used increasingly in corn-based diets (Beg *et al*., 2001), sometimes in combination with other enzyme activities. However, there are few reports on the effects of different levels of DDGS with xylanase addition on growth performance and digestibility of diet components in broilers fed corn-based diets.

Barekatain *et al*., (2013) concluded that high inclusion of sorghum DDGS negatively affected the nutrient utilization and feed conversion ratio in broilers. Individual application of xylanase was beneficial for the growth performance of broiler chickens fed sorghum DDGS, particularly for the feed conversion ratio, while supplementation of the protease revealed a positive effect on body weight gain. The combination of xylanase and protease did not exhibit significant synergy for the growth performance of the birds or nutrient utilization,

Although xylanase degraded the insoluble NSP fraction to release substantial amounts of free sugars, whereas the combination of xylanase with protease appeared to diminish this effect of xylanase.

Liu *et al* (2011) concluded that dietary corn DDGS caused poor ($P<0.05$) feed conversion ratio (FCR) of broilers from 1 to 21 and 22 to 42 days, but increased ($P<0.05$) feed intake (FI) at 1–21 days, and suggested that Inclusion of xylanase increased ($P<0.05$) feed intake by 4–5% at 1–21 days, and did not affect FCR in either period.

Chapter Three

Materials and Methods

3.1 Experimental Diets:

The experiment was a 2×4 factorial arrangement with 2 levels of DDGs (0 and 10 %), and four levels of Avizyme at 0, 0.15, 0.2, 0.25 g/kg. Avizyme 1505 (Avizyme1505, Danisco Animal Nutrition, UK) is a commercial multi enzyme preparation that has xylanase, protease and amylase activity. The analysis of DDGs (**Pannonia Ethanol Zrt.,** Dunaföldvár, Tolna County, Hungary) was dry matter (DM) 901 g/kg, crude protein (CP) 283 g/kg, crude fiber 71 g/kg, metabolizable energy (ME) 9.4 MJ/kg (2800 kcal/kg) as stated by producer. The diets were based on corn and soybean meal and fed as mash throughout the experiment. The AME levels of the diets were 3030 and 3130 Kcal/kg from 1 to 21 and 22 to 35 days of age, respectively, both types of diets were formulated to meet nutrient requirements for broilers (NRC, 1994). All experimental diets were maintained iso caloric and iso nitrogenous. Tables (1) and (2) show the compositions and chemical analysis of the basal diets. Through mixing of the diets avizyme was added at levels (0, 0.15, 0.2, 0.25 g/kg) to the experimental diets. thus dietary treatments were combinations of DDGS and Avizyme 1505 that resulted in eight dietary treatment.

Table (1) Composition of basal diets with different levels of corn distillers dried grains with soluble (DDGs).

Ingredients(g/kg)	Starter (Days 1-21)		Finisher (Days 22-35)	
	0% DDGs	10% DDGs	0% DDGs	10% DDGs
Yellow corn	608.8	549	654	600
Soybean meal (48%)	330	287	280	232
DDGS	0	100	0	100
Vegetable oil (soap stock)	24	25.3	31.5	33
Ground limestone	8.3	9.4	6.6	7.6
Dicalcium phosphate	18	17	16.34	15.47
Sodium chloride	3	3	3	3
L-lysine-HCL	0.24	1	1.5	1.5
Dl-methionine	1.67	1.66	1.5	1.5
Toxin Binder	1	1	1	1
Vitamins\minerals premix[a]	5	5	5	5
Cost per Kg of Diet (NIS)	2.260	2.263	2.034	2.026

[a] provides (/kg of diets): Amprolium HCL 45 mg; Neomycin sulfate 5 mg; vitamin A (retinyl acetate), 6875 IU; cholecalciferol, 1250 IU; vitamin E (dl-α-tocopheryl acetate), 20 IU; vitamin K, 3.125 mg; thiamin, 1.5 mg; riboflavin, 3.7 mg; calcium D-pantothinate 7.5 mg; 10 mg; pyridoxine, 2.5 mg; biotin, 0.05 mg; vitamin B12, 0.0175 mg; manganese, 75 mg; iodine, 0.70 mg; iron, 20 mg; copper, 2.5mg; selenium, 0.075 mg ;cobalt, 0.001mg;cooper,2.5 mg .

*All diets supplemented with one of four enzyme (Avizyme) levels (0,150,200,250 g\ton). The cost of avizyme is 75 NIS/Kg.

Table (2) Calculated chemical analysis of basal diets with different levels of corn distillers dried grains with solubles (DDGs).

Chemical analysis (% or as indicated)	Starter (Days 1-21)		Finisher (Days 22-35)	
	0% DDGs	10% DDGs	0% DDGs	10% DDGs
Crude Protein	21.5	21.5	19.5	19.5
Fat	4.9	4.9	5.7	5.8
Fiber	2.2	2.6	2.1	2.6
ME ,Kcal/kg	3030	3030	3130	3130
Calcium	0.9	0.9	0.8	0.8
Available phosphorus	0.4	0.4	0.41	0.41
Methionine	0.5	0.5	0.5	0.5
Cystine	0.3	0.4	0.3	0.3
Lysine	1.2	1.2	1.2	1.1
Tryptophan	0.3	0.2	0.2	0.2
Threonine	0.8	0.8	0.7	0.7

3.2 Birds Management and Housing:

A total of 256 days-old Ross 308 broiler chicks were obtained from a local hatchery. The chicks were reared at An Najah National University, College of Agriculture/Tulkarem. An open-sided poultry house was divided into 8 treatments each with 4 replicate with 8 birds to form 32 identical pens (120 cm×100 cm) , as 2×4 factorial arrangement . Each pen was separated by as wire mesh and supplied with plastic cylindrical feeder and a bell-shaped plastic drinker. The experimental house was thoroughly cleaned and disinfected before placement of the chicks. The pens were randomly assigned to each eight treatments each replicated four times, with 8 birds per replicate. Chicks were maintained under standard management conditions for 35 days on deep litter system as recommended by the management guide. The brooder temperature was maintained at about 32°c for the first week of age then 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 Infectious bronchitis and New Castle disease at 14 days of age.

3.3 Parameters Measured:

Average body weight, feed intake were recorded weekly and body gain, feed conversion ratio were then calculated. At the end of experiment (35th day) all chicks were weighed individually then 4 chicks per replicate were randomly selected, slaughtered and eviscerated to determine carcass, visceral, offal and carcass cuts weights. Plucked weight was recorded after

the removal of feathers and draining of blood. Carcass weight was recorded after the removal of the head, shanks, gastrointestinal tract, and heart.

Plucked weight, eviscerated weight, carcass yield and the visceral organs were calculated as a percentage of live weight. At the end of the experiment, economic evaluation parameters were calculated.

3.4 Statistical Analysis:

Data were analyzed using a general linear model procedure of SAS (SAS Institute, 2000). Two-way ANOVA was used to assess main effects of DDGS and Avizyme and their interactions. Differences of variables were separated using Duncan's multiple-range test at $P<0.05$ level of significance. The model for CRD with a factorial arrangement is:

$$Yijk= u + DDGSi + Avizymej + DDGSi * Avizymej + eijk$$

Where DDGsi is the main effect of the DDGS, Avizymej is the main effect of the Avizyme levels, DDGSi* Avizymej is the interaction and eijk is the error term.

Chapter Four

Results

4.1 Body Weight and Feed Conversion Ratio:

Body weight (BW) and feed conversion ratio (FCR) of broilers given dietary treatments, for first week of age are presented in (Table 3). Inclusion DDGS and Avizyme influenced body weight , broilers fed 10 % DDGS with no added Avizyme had the lowest BW ($P \leq 0.05$) at 7 days of age compared to those fed the other diets.

Birds fed the diets containing 0% DDGS with 0.2 g/kg Avizyme and the diet containing 10% DDGS supplemented with 0.25 g/kg Avizyme had better FCR (1.41 and 1.31) compared to birds fed the other diets at ($P \leq 0.05$).

The inclusion of Avizyme seems to exert its effect on broilers performance when diets containing 10% DDGS. It can be seen that higher level of Avizyme is required to be added when DDGS is added.

Table (3): Effect of dietary treatments on body weight and feed conversion ratio of chicks (at 7 days of age).

Treatments / Parameters	DDGs %	Avizyme(g/Kg) 0	0.15	0.2	0.25	Main effect of DDGs
Average body weight (g)	0	150.00 [a]	139.50 [a]	147.50 [a]	147.5 [a]	146.1 [a]
	10	128.00 [b]	142.25 [a]	146.25 [a]	145.50 [a]	140.5 [a]
Main effect of Avizyme		139.00 [a]	140.88 [a]	146.88 [a]	146.50 [a]	Main effect of DDGs
Feed conversion ratio	0	1.47 [b]	1.68 [a]	1.41 [b]	1.5 [ab]	1.51[a]
	10	1.6[ab]	1.5[ab]	1.49[ab]	1.31 [b]	1.48[a]
Main effect of Avizyme		1.54[a]	1.59[a]	1.45[a]	1.41[a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

Body weight and feed conversion ratio of broilers fed the dietary treatments at 14 days of age are shown in (Table 4). The birds given the diet containing 10% DDGS with no Avizyme had the lowest body weight ($p \leq 0.05$) at day 14 of the experiment compared to birds given the diet containing 0% DDGS and Avizyme and those given diets containing 10% DDGS and 0.2 or 0.25 g/kg avizyme. It can be seen that birds given diets containing 10% DDGS still performed the least compared to the others. Furthermore, increasing Avizyme inclusion rate to 0.2 and 0.25 g/kg resulted in better ($p \leq 0.05$) weight at 14 days. On the other hand, there was a trend for better feed conversion ratio at 0.25 g/kg inclusion rate of Avizyme regardless of the inclusion of DDGS.

Table (4): Effect of dietary treatments on body weight and feed conversion ratio of chicks (at 14 days of age).

Treatments / Parameters	DDGs %	Avizyme(g/Kg) 0	0.15	0.2	0.25	Main effect of DDGs
Average body weight (g)	0	405.25^{ab}	387.00^{bc}	407.00^{ab}	422.25^{a}	405.4^{a}
	10	356.50^{c}	380.75^{bc}	398.25^{ab}	400.75^{ab}	384.10^{b}
Main effect of Avizyme		380.87^{b}	383.88^{ab}	402.63^{ab}	411.50^{a}	Main effect of DDGs
Feed conversion ratio	0	1.48^{a}	1.50^{a}	1.53^{a}	1.48^{a}	1.49^{a}
	10	1.70^{a}	1.65^{a}	1.55^{a}	1.48^{a}	1.59^{a}
Main effect of Avizyme		1.59^{a}	1.58^{a}	1.54^{a}	1.48^{a}	

^{abc} Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

Body weight and FCR of broilers at 21 days of age given the experimental diets are presented in (Table 5). Levels of DDGS and Avizyme influenced ($p \leq 0.05$) body weight and FCR. Broilers fed 10 % DDGS with no Avizyme had the lowest($p \leq 0.05$) body weight at 21 days of age compared to those fed the diets with 0% DDGS with 0, 0.2, or 0.25 g/kg Avizyme. Birds fed the diets containing 0% DDGS and supplemented with 0.25 g/kg Avizyme and the diet containing 10% DDGS supplemented with 0.25 g/kg Avizyme had significantly ($p \leq 0.05$) different (1.23 and 1.75) in FCR compared to birds fed the other diets. On the other hand, there was a trend for better FCR and higher BW regardless of DDGS inclusion rate (0% better than 10%).

Table (5): Effect of dietary treatments on body weight and feed conversion ratio of chicks (at 21 days of age).

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Average body weight (g)	0	771.25 [a]	729[ab]	765 [a]	792.25[a]	764.40 [a]
	10	690.00 [b]	729.75[ab]	755.25[ab]	721.25[ab]	724.10[b]
Main effect of Avizyme		730.63[a]	729.38[a]	760.13[a]	756.75[a]	Main effect of DDGs
Feed conversion ratio	0	1.50 [b]	1.50 [b]	1.50 [b]	1.23 [c]	1.43 [b]
	10	1.58[ab]	1.50 [b]	1.48 [b]	1.75 [a]	1.58 [a]
Main effect of Avizyme		1.54 [a]	1.50 [a]	1.49 [a]	1.49 [a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

Body weight and feed conversion ratio of broilers at 28 days of age given the experimental diets are presented in (Table 6). Broilers fed 10% DDGS with no added Avizyme had the lowest body weight at 28 days of age compared to those fed the diets with no DDGS with 0 or 0.25 g/kg Avizyme, but in term of the main effect of DDGS the level of 10% DDGS decreased significantly($p \leq 0.05$) body BW compared to diets not containing DDGS. Regardless of FCR no significant differences ($p \leq 0.05$) were noticed at different levels of DDGS and Avizyme or their interaction.

Table (6): Effect of dietary treatments on body weight and feed conversion ratio of chicks (at 28 days of age).

Treatments / Parameters	DDGs %	Avizyme(g/Kg) 0	0.15	0.2	0.25	Main effect of DDGs
Average body weight (g)	0	1344.25 [a]	1276.25[ab]	1293.25 [ab]	1351.50 [a]	1316.3 [a]
	10	1207.50 [b]	1275.50 [ab]	1275.50 [ab]	1270.25 [ab]	1257.9[b]
Main effect of Avizyme		1275.88[a]	1275.88[a]	1284.38[a]	1312.38[a]	Main effect of DDGs
Feed conversion ratio	0	1.55 [a]	1.50 [a]	1.63 [a]	1.65 [a]	1.58 [a]
	10	1.53 [a]	1.48 [a]	1.68 [a]	1.58 [a]	1.56 [a]
Main effect of Avizyme		1.54[a]	1.49 [a]	1.65 [a]	1.61 [a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

Body weight and feed conversion ratio of broilers at 35 days given the experimental diets are presented in (Table 7). Body weight of birds fed 10% DDGs did not differ significantly from those fed diets with 0% DDGs. Inclusion of Avizyme did not affect body weight regardless of level DDGs, however feed conversion ratio was significantly ($P \leq 0.05$) influenced by avizyme level, birds given 0% DDGS diets with 0.2 gm/kg had better feed conversion ratio compared to birds given the 10% DDGs diets with 0.25gm/kg avizyme (1.75 vs 2.08). It can be seen that less than 0.15 g/kg Avizyme could be used for conventional diet (0% DDGs) and up to 0.2 g/kg Avizyme could be used when up to 10% DDGs is used. It can be seen

that inclusion of 10% DDGS after twenty eight days of age did not adversely affect body weight.

Table (7): Effect of dietary treatments on body weight and feed conversion ratio of chicks (at 35 days of age).

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Average body weight (g)	0	1946.00 [a]	1954.50[a]	1850.50 [a]	1936.25 [a]	1921.8[a]
	10	1825.75 [a]	1861.50 [a]	1870.25 [a]	1866.50 [a]	1856[a]
Main effect of Avizyme		1885.88[a]	1908.00[a]	1960.38[a]	1901.38[a]	Main effect of DDGs
Feed conversion ratio	0	1.85 [ab]	1.85 [ab]	1.75 [b]	1.85 [ab]	1.83 [a]
	10	1.93 [ab]	1.98 [ab]	1.83 [ab]	2.08 [a]	1.95 [a]
Main effect of Avizyme		1.89 [a]	1.91 [a]	1.79 [a]	1.96 [a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

Cumulative feed conversion ratio and cost of feed (NIS) per kilogram of live body weight of the broilers at 35 days of age are presented in (Table 8). Feed conversion and cost of live body weight for birds fed diets 10% DDGs were significantly higher ($p \leq 0.05$) compared to those fed diets with 0% DDGS. Feeding diets with different levels of Avizyme resulted in no significant differences in cumulative FCR and cost of feed per kilogram of live body. On the other hand, a significant differences ($P < 0.05$) of cumulative FCR were observed for birds given 0% DDGs diet supplemented with 0, 0.2, or 0.25 g/kg Avizyme levels and those given 10 % DDGs diet with no supplemental Avizyme. but in terms of cost of feed

per kilogram of live body, no significant interaction (P<0.05) was observed when different levels of DDGs and Avizyme were used but the main effect of DDGS levels show that the addition of 10% DDGS increased significantly (P<0.05) the cost of feed per kilogram of live body from 3.7 to 3.88 NIS .

Table (8): Effect of dietary treatments on cumulative FCR and cost of feed (NIS) per kilogram of live body weight of chicks at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Cumulative feed conversion ratio	0	1.57 [b]	1.6[ab]	1.57 [b]	1.55 [b]	1.57 [b]
	10	1.66 [a]	1.62[ab]	1.61[ab]	1.64[ab]	1.63 [a]
Main effect of Avizyme		1.62 [a]	1.61 [a]	1.59 [a]	1.59 [a]	Main effect of DDGs
Cost of feed / kg of live body weight	0	3.63[a]	3.77 [a]	3.79 [a]	3.62 [a]	3.7 [b]
	10	3.8 [a]	3.94 [a]	3.92 [a]	3.88 [a]	3.88 [a]
Main effect of Avizyme		3.72[a]	3.85 [a]	3.85 [a]	3.75 [a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly (p≤0.05).

Overall body weight of broiler chicks fed the experimental diets is shown in (figure 1).

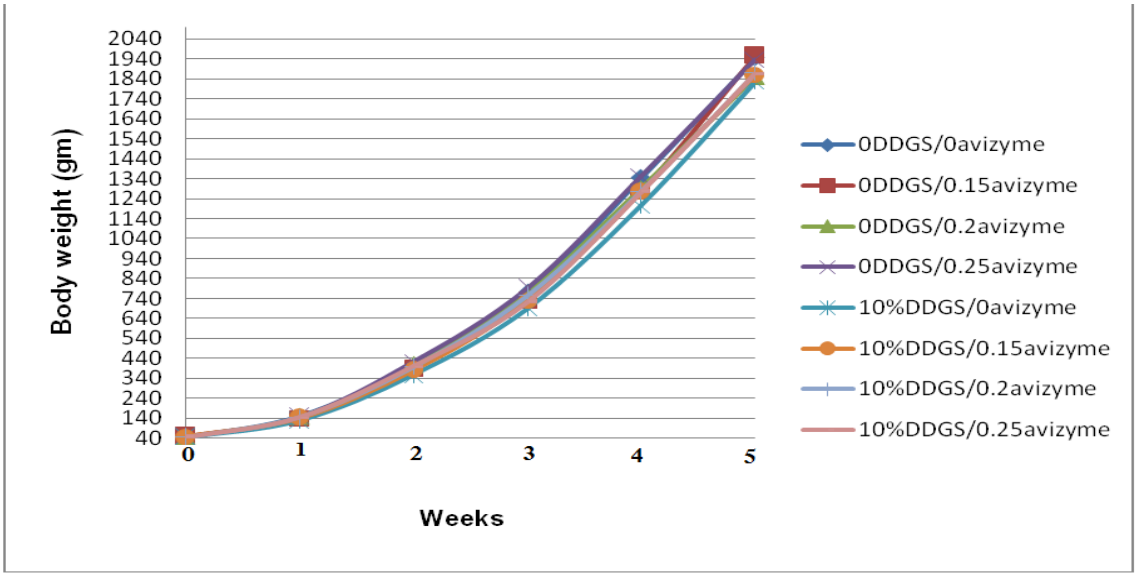

Figure (1): Body weights for experimental broilers for five weeks of the experiment

4.2 Carcass Characteristics:

The effects of DDGs and Avizyme levels on percentage carcass weight of broilers at 35 days of age are shown in (Table 9). No significant differences were found in percentage carcass weights among treatments given 0 or 10% DDGS without avizyme. However birds given the diets containing 10% DDGS had significantly lower percentage carcass weight compared to birds of the other treatments except that of the birds in the diets containing no DDGS and no supplemental Avizyme and birds give the diet containing 10% DDGS supplemented with 0.15 g/kg Avizyme.

Table (9): Dressing percentage for broilers at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Carcass weight (%)	0	66.22 [ab]	66.90 [a]	67.63 [a]	66.72 [a]	66.87 [a]
	10	64.76 [b]	65.94 [ab]	66.76 [a]	66.70 [a]	66.04[a]
Main effect of Avizyme		65.49 [a]	66.42[a]	67.12[a]	66.71[a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

The effects of DDGs and Avizyme levels on percentage plucked weight of broilers at 35 day are shown in (Table 10). No significant differences were found in percentage plucked weight among treatments given 0 or 10% DDGS. However birds given the diets containing 0% DDGS and supplemental 0.25 g/kg Avizyme had significantly lower (89.38%) percentage plucked weight compared to birds of the other treatments. On the other hand percentage plucked weight for birds in diets supplemented with 0.15 g/kg had higher percentage plucked weight compared to other levels of supplemental Avizyme levels except 0.2 mg/kg Avizyme.

Table (10): Percentage of plucked weight for chickens fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Plucked weight (%)	0	90.5 [b]	91.75 [a]	91.13 [ab]	89.38 [c]	
	10	90.13 [b]	92.00 [a]	91.00 [ab]	91.13 [ab]	90.69 [a]
Main effect of Avizyme		90.31 [b]	91.88[a]	91.06[ab]	90.25[b]	91.06[a]

[abc] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

The effects of different DDGs and Avizyme levels on percentage of thigh and drumstick weight of broilers at 35 day are shown in (Table 11). No significant differences were found in percentage of thigh and drumstick weight among treatments given 0 or 10% DDGS or supplemented with Avizyme levels.

Table (11): Percentage of thigh and drumstick weight for broilers fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Thigh weight (%)	0	10.98 [a]	11.03 [a]	10.89 [a]	10.30 [a]	10.80 [a]
	10	11.56 [a]	11.16 [a]	11.12 [a]	11.01 [a]	11.20[a]
Main effect of Avizyme		11.27 [a]	11.09[a]	11.00[a]	10.66[a]	Main effect of DDGs
Drumstick weight (%)	0	9.01[a]	8.76 [a]	8.32 [a]	8.72 [a]	
	10	9.18 [a]	8.83 [a]	8.83 [a]	9.02 [a]	8.70 [a]
Main effect of Avizyme		9.09 [a]	8.79[a]	8.59[a]	8.87[a]	8.97[a]

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

The effects of different DDGs and Avizyme levels on Percentage Beast weight of broilers at 35 day are shown in (Table 12). No significant differences were found in percentage of breast weight among treatments given 0 or 10% DDGS or supplemented with different levels of Avizyme.

Table (12): Percentage of breast weight for broilers fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Breast weight (%)	0	25.25 [a]	23.89 [a]	25.45 [a]	23.54 [a]	24.53 [a]
	10	24.74 [a]	23.85 [a]	22.87 [a]	24.10 [a]	23.89[a]
Main effect of Avizyme		25.00 [a]	23.87[a]	24.16[a]	23.82[a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

The effects of different DDGs and Avizyme levels on percentage of neck, back and wings weights of broilers at 35 day are shown in (Table13). Birds fed diets with 10% DDGs did not differ significantly from those fed diets with no DDGs in percentage of neck, back and wings weight. Feeding diets with different levels of Avizyme also resulted of no significant differences in back and wings weight percent, but in term of percentage of neck weight the birds given the diets supplemented with 0.15, 0.2mg/kg in two different levels of DDGS were lower than the diets containing 10% DDGs with no supplemental Avizyme but remained unchanged with other levels of DDGs and Avizyme levels**.**

Table (13): Percentage of neck, back and wings for broilers fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Neck weight (%)	0	4.85 [ab]	4.60 [b]	4.66 [b]	4.73 [ab]	4.71 [a]
	10	5.26 [a]	4.53 [b]	4.70 [b]	4.75 [ab]	4.81[a]
Main effect of Avizyme		5.05 [a]	4.57 [a]	4.68[a]	4.74[a]	Main effect of DDGs
Back weight (%)	0	9.05[a]	9.03 [a]	8.75 [a]	8.18 [a]	8.75 [a]
	10	9.13 [a]	8.92 [a]	9.22 [a]	9.09 [a]	9.09[a]
Main effect of Avizyme		9.09 [a]	8.97[a]	8.99[a]	8.64[a]	Main effect of DDGs
Wings weight (%)	0	6.35[a]	5.93 [a]	6.60 [a]	6.33 [a]	6.30 [a]
	10	6.77 [a]	6.56 [a]	6.76 [a]	6.63 [a]	6.68[a]
Main effect of Avizyme		6.56 [a]	6.25[a]	6.68[a]	6.48[a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

4.3 Cuts Parts Measurements:

At 35 day old chicks were weighed and slaughtered using commercial cones and plucking machine. Following bleeding and plucking the dead chicks were weighed and blood and feathers weights were determined and expressed as plucked weight percent previously in (Table 10). With regard to intestine, offal (head and shanks) and edible giblets (edible visceral

organs) of the experimental chickens also expressed as percentages of live weight.

The effects of different DDGs and Avizyme levels on percentage of fat bad weight of broilers at 35 day are shown in (Table 14). Birds given the diets containing 0% DDGS and no supplemental Avizyme had significantly higher percentage of fat bad weight compared to birds of the other treatments except birds given diets supplemented with 0.15, 0.2 mg/kg with 10% DDGS and 0.2, 0.25mg/kg with 0 DDGS. On the other hand the increasing levels of Avizyme in diets not containing DDGS increase the percentage of fat bad in broilers and decrease the percentage of fat bad in diets containing DDGS.

Table (14): Percentage of fat bad weight for broilers fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Fat bad weight (%)	0	0.98 [b]	1.13 [b]	1.22[ab]	1.3[ab]	
	10	1.5 [a]	1.22[ab]	1.2[ab]	1.03 [b]	1.16 [a]
Main effect of Avizyme		1.24 [a]	1.18[a]	1.21[a]	1.16[a]	1.24[a]

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

The effects of different DDGs and Avizyme levels on percentage of intestine weight of broilers at 35 day are shown in Table 15. Birds fed diets with 10% DDGs were higher ($p \leq 0.05$) than birds fed diets with no DDGs

in percentage of intestine weight, and broilers given diets containing 10% DDGS with different levels of Avizyme were lower in percentage of intestine weight with increase the level of Avizyme with significant interaction between DDGs and avizyme levels.

Table (15): Percentage of intestine weight of broilers fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Intestine weight (%)	0	3.87 ^{c}	4.55 ^{ab}	4.22 ^{bc}	4.55 ^{ab}	4.30 ^{b}
	10	5.00 ^{a}	4.66 ^{ab}	4.58 ^{ab}	4.37 ^{bc}	4.66 ^{a}
Main effect of Avizyme		4.44 ^{a}	4.60 ^{a}	4.40 ^{a}	4.46 ^{a}	

^{abc} Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

The effects of different DDGs and Avizyme levels on percentage of proventriculus weight of broilers at 35 day are shown in (Table 15). Birds give diets containing 10% DDGS had significantly higher (0.5%) percentage of proventriculus weight compared to birds of the other treatments except that of the birds in the diets containing no DDGS and supplemented Avizyme with 0.2, 0.25 mg/kg and birds give the diet containing 10% DDGS and 0.15, 0.25 g/kg supplemental Avizyme.

Table (16): Percentage of proventriculus weight for broilers fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Proventriculus weight (%)	0	0.48 [ab]	0.47 [ab]	0.42 [b]	0.43 [b]	0.45 [a]
	10	0.5 [a]	0.41 [c]	0.45 [ab]	0.43 [b]	0.45 [a]
Main effect of Avizyme		0.49 [a]	0.44 [a]	0.44 [a]	0.43 [a]	

[abc] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

The effects of DDGs and Avizyme levels on percentage of offal weight of broilers at 35 day are shown in (Table 17). Birds fed diets with 10% DDGs were significantly higher (5.64%) than birds fed diets with no DDGS and no supplemental Avizyme in percentage of Offal weight.

Table (17): Percentage of offal weight for broilers fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Offal weight (%)	0	4.98 [b]	5.4 [a]	5.41 [a]	5.53 [a]	5.33 [b]
	10	5.64 [a]	5.52 [a]	5.59 [a]	5.58 [a]	5.59 [a]
Main effect of Avizyme		5.31 [a]	5.46 [a]	5.5 [a]	5.56 [a]	

[ab] Means for each parameter with no common superscript within a variable differ significantly ($p \leq 0.05$).

The effects of different DDGs and Avizyme levels on edible giblets weight percent of broilers at 35 day are shown in (Table 18). Birds fed diets with 10% DDGs did not differ significantly from those fed diets with no DDGs in edible giblets weight percent except for heart weight percentage which were higher(P≤0.05) in diets containing 10% DDGS (0.5 %) compared to diets not containing DDGS with 0, 0.2 gm/kg supplemental avizyme. Feeding diets with different levels of Avizyme also resulted of no significant differences in edible giblets weight percent. In terms of interaction no significant differences (P < 0.05) of edible giblets percentage was observed for two levels of DDGs inclusion and different levels of Avizyme.

Table (18): Liver, Gizzard, Heart weight as percentage of live weight for chickens fed experimental diets at 35 days of age.

Treatments / Parameters	DDGs %	Avizyme(g/Kg)				Main effect of DDGs
		0	0.15	0.2	0.25	
Liver weight (%)	0	2.06 ^{abcd}	2.24 ^{ab}	2.27 ^{a}	2.14 ^{abcd}	2.18 ^{a}
	10	2.03 ^{cd}	2.09 ^{abcd}	1.99 ^{d}	2.22 ^{abc}	2.08^{a}
Main effect of Avizyme		2.05 ^{a}	2.17 ^{a}	2.13 ^{a}	2.18^{a}	Main effect of DDGs
Gizzard weight (%)	0	2.32^{c}	2.76 ^{a}	2.43 ^{abc}	2.21 ^{c}	2.43 ^{a}
	10	2.45 ^{abc}	2.48 ^{abc}	2.77 ^{a}	2.40 ^{abc}	2.53^{a}
Main effect of Avizyme		2.37 ^{a}	2.62^{a}	2.60^{a}	2.30 ^{a}	Main effect of DDGs
Heart weight (%)	0	0.42 ^{b}	0.49 ^{ab}	0.42 ^{b}	0.46 ^{ab}	0.45 ^{a}
	10	0.50 ^{a}	0.45 ^{ab}	0.48 ^{ab}	0.48 ^{ab}	0.48^{a}
Main effect of Avizyme		0.46 ^{a}	0.47 ^{a}	0.45^{a}	0.47^{a}	

^{abc} Means for each parameter with no common superscript within a variable differ significantly (p≤0.05).

Chapter Five

Discussion

5.1 Broiler Performance:

The effect of inclusion of DDGS in broiler diets has been a topic in several studies. In our study we found that Broilers fed 10 % DDGS with no added Avizyme had the lowest body weight from 1 to 28 days of age compared to those fed the other diets, Our results agree with those of Lumpkins *et al*. (2004) who indicated that the use of 120 g/kg DDGS numerically reduced BW gain. Liua *et al*.(2011) reported that feed intake ,and broilers BW gain were significantly decreased at 22-40 days when broilers are fed 12% DDGS from corn. These authors explained these findings by the presence of antinutritional factors such as NSP from the high corn DDGS diet thus limiting the growth of broilers. Our data are in agreement with those of Liua *et al*. (2011) and with those of Lumpkins et al.(2004). The later authors explained that the depressed performance of broilers at higher DDGS inclusion levels was properly due to the decreased in the levels of soybean protein which is considered the main lysine source in the diet, and in turn this results in a marginal lysine deficiency. Our data indicates that addition of avizyme to the experimental diets may have alleviate the adverse effect of NSP from the high (10%) DDGS diet. In contrast Wang *et al*. (2007) concluded that inclusion of up to 20 % good quality DDGS can be used in broiler diets with little adverse effect on live performance. In another study, Wang *et al*.(2007b) observed a decrease in

body weight during the initial two weeks in broilers which were fed diets containing 30% DDGS compared to 0% or 15%. These authors attributed the negative effect of DDGS in the diet of growing poultry to amino acid deficiencies because their digestibility's in DDGS was too low, and consequently, affected chicken performance.

The current study showed that the addition of avizyme to the experimental diets containing 10% DDGS in starting period significantly improved the BW and FCR of broilers. BW and FCR were comparable to those fed the diets containing 0% DDGS and avizyme. So the inclusion of Avizyme seems to have positive effect in diets containing 10% DDGS. It can be seen that higher level of Avizyme may be required to be added when DDGS is added. Our results were in disagreement with those of Liu *et al*, (2011) who suggested that Inclusion of xylanase increased ($P<0.05$) feed intake by 4–5% at 1–21 days, and did not affect feed conversion ratio in this period.

It is therefore obvious from our results that broilers body weight and feed conversion ratio were negatively ($P<0.05$) affected by inclusion of 10% DDGS in their starting diet especially when no supplemental Avizyme is used. This negative effect on body weight lasted to 28 days of age but not in FCR. Feed conversion ratio was not significantly($P<0.05$) different form that for birds given 10% DDGS and different levels of Avizyme. Our results agree with those of Liu *et al*. (2011) who reported that supplemental enzyme did not affect FCR of broilers at 21 - 42 days of age.

At 35 days of age, birds fed diets with 10% DDGs had similar body weight and feed conversion ratio to those fed diets with 0% DDGs. Addition of Avizyme to diets containing 10% DDGS did not improve body weight. These results agree with those of Lumpkins *et al*. (2004) who indicated that DDGS from modern ethanol plants is an acceptable feed ingredient for broiler diets and can be safely used at 12 to 15% in grower and finisher diets. Our data are in agree with those of Jung et al. (2012) who reported that the inclusion of up to 12% DDGS in the broilers diets did not significantly affect BW or FCR. Min *et al*. (2009) reported that supplementation of a corn-soybean meal diet containing 30% DDGS with commercial avizyme preparations did not improve gross energy digestibility by adding any level (200g/ton or 453g/ton) of two enzyme preparation (Allzyme SSF and Rovabio Excell). In our study up to 250 g/ton of avizyme improved performance of broilers which can be explained by the lower inclusion level of DDGS,

Lumpkins *et al*. (2004) showed that body weight gain and feed utilization were not affected by feeding up to 12% DDGS from 18 - 42 days of age, however body weight gain was lowered when broilers were fed 18% DDGS. These authors attributed this effect to an amino acid deficiency such as lysine. These results are in agreement with the our results in terms of cumulative feed conversion ratio for birds fed diets with 10% DDGs and no supplemental avizyme. It can be seen that older birds can be fed DDGS without any adverse effect on body weight and feed conversion ratio. However, the higher prices of DDGS at the time of mixing the diets

has resulted in numerically higher cost of feed/kg live body weight for the birds fed 10% DDGS. Therefore inclusion of DDGS in broilers ration should be justified.

5.2 Carcass Cuts Measurements:

Our data suggest that broilers fed diets containing 0 or 10% DDGS had significantly lower plucked weight than broilers fed diets containing 0 or 10% DDGS and supplemented with avizyme except that with 0.2 and 0.25 gm/kg avizyme. Wang *et al*. (2007c) reported that dressing percentage of broilers appeared to decrease linearly with increased DDGS content in the basal diet. They also showed that, compared to the control diet, the dressing percentage was lower when broilers were fed diets containing 15% and 25% DDGS, but not in diets containing 5%, 10%, and 20% DDGS. In our study inclusion of 10% DDGS showed no significant effect in percentage carcass weights among treatments except birds given the diets containing 10% DDGS had significantly lower (64.76%) carcass percentage compared to those fed other diets which contain Avizyme. These results disagree with those of Wang *et al*., (2007a, b) who indicated no effects on carcass quality when broilers were fed up to 15% DDGS, however when birds were fed a diet containing 30% DDGS, a lower breast meat yield was observed. The authors speculated that this effect was observed in both studies because tryptophan, isoleucine and arginine levels may have been marginal or deficient when 30% DDGS were included in the diets compared to soybean based diets. Our results are consistent with earlier reports and suggest that

feeding broilers diets containing up to 10% corn DDGS should not adversely affect weight of breast, thigh, and drumstick weights at 35 days of age.

Previous research (Oryschak *et al*. 2010) reported that feeding high fiber diets to broilers have been shown to affect the relative weight of organs of gastrointestinal tract which in turn raises concerns that feeding high levels of DDGS in broilers diets could reduce dressing percentage or breast meat yield. Our results indicated that broilers fed the diets containing 10% DDGS without enzyme supplementation had lower dressing percentage, however, intestine weight of broilers fed 10% DDGS was significantly higher than that of birds fed 0% DDGS (4.66 VS 4.3%) regardless of the enzyme supplementation. Similar trend has been observed for weights of proventriculus, gizzard, offals, and fat bad. These findings are in agreement with those of Loar et al.(2012).

Barekatain et al. (2013) pointed out that feeding diets containing DDGS to young broilers (7 days of age) may stimulate gut development, these authors also indicated that DDGS increased the size of the total gastrointestinal tract, they explained the effect by the greater resistance of the fibrous and coarse materials in DDGS to grinding and mechanical stimulation of the gut.

Chapter Six

Conclusions and Recommendations

1) A level of 10% DDGS is acceptable from 0 to 28 days of age in broilers diets supplemented with avizyme and acceptable in broilers diets after 28 days of age with no avizyme supplementation.

2) Inclusion of 10% DDGS has no negative effect of DDGS on dressing percentage or carcass components.

3) DDGs can be used in broiler finisher diets with 10 % inclusion levels if the cost of DDGS is justified compared to other feed ingredients like soybean meal or corn grains.

4) More research is needed to determined the optimum supplementation of exogenous enzymes when DDGS are incorporated in broilers diets.

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Appendices

Appendix 1

Analysis of variance and Least Squares Means for broilers body weight at first week of age

The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

The SAS System

The GLM Procedure

Dependent Variable: week1wt

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	1373.375000	196.196429	3.12	0.0173
Error	24	1509.500000	62.895833		
Corrected Total	31	2882.875000			

R-Square	Coeff Var	Root MSE	week1wt Mean
0.476391	5.533843	7.930689	143.3125

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	253.1250000	253.1250000	4.02	0.0562
Avizyme	3	379.1250000	126.3750000	2.01	0.1395
DDGs*Avizyme	3	741.1250000	247.0416667	3.93	0.0206

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	253.1250000	253.1250000	4.02	0.0562
Avizyme	3	379.1250000	126.3750000	2.01	0.1395
DDGs*Avizyme	3	741.1250000	247.0416667	3.93	0.0206

The SAS System

The GLM Procedure

Least Squares Means

Avizyme	week1wt LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	139.000000	2.803922	<.0001	1
0.15	140.875000	2.803922	<.0001	2
0.2	146.875000	2.803922	<.0001	3
0.25	146.500000	2.803922	<.0001	4

Least Squares Means for effect Avizyme

Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week1wt

i/j	1	2	3	4
1		0.6406	0.0586	0.0707
2	0.6406		0.1433	0.1689
3	0.0586	0.1433		0.9254
4	0.0707	0.1689	0.9254	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	week1wt LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	146.125000	1.982672	<.0001	0.0562
10	140.500000	1.982672	<.0001	

DDGs	Avizyme	week1wt LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	150.000000	3.965345	<.0001	1
0	0.15	139.500000	3.965345	<.0001	2
0	0.2	147.500000	3.965345	<.0001	3
0	0.25	147.500000	3.965345	<.0001	4
10	0	128.000000	3.965345	<.0001	5
10	0.15	142.250000	3.965345	<.0001	6
10	0.2	146.250000	3.965345	<.0001	7
10	0.25	145.500000	3.965345	<.0001	8

The SAS System

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week1wt

i/j	1	2	3	4	5	6	7	8
1		0.0734	0.6597	0.6597	0.0006	0.1797	0.5101	0.4302
2	0.0734		0.1666	0.1666	0.0514	0.6283	0.2405	0.2953
3	0.6597	0.1666		1.0000	0.0019	0.3585	0.8255	0.7245
4	0.6597	0.1666	1.0000		0.0019	0.3585	0.8255	0.7245
5	0.0006	0.0514	0.0019	0.0019		0.0179	0.0034	0.0047
6	0.1797	0.6283	0.3585	0.3585	0.0179		0.4825	0.5676
7	0.5101	0.2405	0.8255	0.8255	0.0034	0.4825		0.8947
8	0.4302	0.2953	0.7245	0.7245	0.0047	0.5676	0.8947	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 2

Analysis of variance and Least Squares Means for broilers body weight at second week of age

The SAS System

The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

The SAS System

The GLM Procedure

Dependent Variable: week2wt

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	11135.71875	1590.81696	3.52	0.0097
Error	24	10850.75000	452.11458		
Corrected Total	31	21986.46875			

R-Square	Coeff Var	Root MSE	week2wt Mean
0.506481	5.386870	21.26299	394.7188

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	3633.781250	3633.781250	8.04	0.0092
Avizyme	3	5226.843750	1742.281250	3.85	0.0221
DDGs*Avizyme	3	2275.093750	758.364583	1.68	0.1984

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	3633.781250	3633.781250	8.04	0.0092
Avizyme	3	5226.843750	1742.281250	3.85	0.0221
DDGs*Avizyme	3	2275.093750	758.364583	1.68	0.1984

The SAS System

The GLM Procedure
Least Squares Means

Avizyme	week2wt LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	380.875000	7.517601	<.0001	1
0.15	383.875000	7.517601	<.0001	2
0.2	402.625000	7.517601	<.0001	3
0.25	411.500000	7.517601	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week2wt

i/j	1	2	3	4
1		0.7802	0.0519	0.0082
2	0.7802		0.0905	0.0158
3	0.0519	0.0905		0.4121
4	0.0082	0.0158	0.4121	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	week2wt LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
0	405.375000	5.315747	<.0001	0.0092
10	384.062500	5.315747	<.0001	

DDGs	Avizyme	week2wt LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	405.250000	10.631493	<.0001	1
0	0.15	387.000000	10.631493	<.0001	2
0	0.2	407.000000	10.631493	<.0001	3
0	0.25	422.250000	10.631493	<.0001	4
10	0	356.500000	10.631493	<.0001	5
10	0.15	380.750000	10.631493	<.0001	6
10	0.2	398.250000	10.631493	<.0001	7
10	0.25	400.750000	10.631493	<.0001	8

The SAS System
The GLM Procedure
Least Squares Means
Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week2wt

i/j	1	2	3	4	5	6	7	8
1		0.2366	0.9083	0.2694	0.0035	0.1163	0.6457	0.7673
2	0.2366		0.1960	0.0277	0.0537	0.6813	0.4616	0.3695
3	0.9083	0.1960		0.3206	0.0026	0.0936	0.5660	0.6813
4	0.2694	0.0277	0.3206		0.0002	0.0109	0.1235	0.1656
5	0.0035	0.0537	0.0026	0.0002		0.1198	0.0105	0.0071
6	0.1163	0.6813	0.0936	0.0109	0.1198		0.2559	0.1960
7	0.6457	0.4616	0.5660	0.1235	0.0105	0.2559		0.8693
8	0.7673	0.3695	0.6813	0.1656	0.0071	0.1960	0.8693	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 3

Analysis of variance and Least Squares Means for broilers body weight at third week of age

The SAS System

The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

The SAS System

The GLM Procedure

Dependent Variable: week3wt

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	29997.71875	4285.38839	1.67	0.1653
Error	24	61739.75000	2572.48958		
Corrected Total	31	91737.46875			

R-Square	Coeff Var	Root MSE	week3wt Mean
0.326995	6.815162	50.71972	744.2188

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	13000.78125	13000.78125	5.05	0.0340
Avizyme	3	6521.34375	2173.78125	0.85	0.4828
DDGs*Avizyme	3	10475.59375	3491.86458	1.36	0.2796

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	13000.78125	13000.78125	5.05	0.0340
Avizyme	3	6521.34375	2173.78125	0.85	0.4828
DDGs*Avizyme	3	10475.59375	3491.86458	1.36	0.2796

The SAS System
The GLM Procedure
Least Squares Means

Avizyme	week3wt LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	730.625000	17.932128	<.0001	1
0.15	729.375000	17.932128	<.0001	2
0.2	760.125000	17.932128	<.0001	3
0.25	756.750000	17.932128	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week3wt

i/j	1	2	3	4
1		0.9611	0.2562	0.3132
2	0.9611		0.2371	0.2911
3	0.2562	0.2371		0.8952
4	0.3132	0.2911	0.8952	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	week3wt LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
0	764.375000	12.679929	<.0001	0.0340
10	724.062500	12.679929	<.0001	

DDGs	Avizyme	week3wt LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	771.250000	25.359858	<.0001	1
0	0.15	729.000000	25.359858	<.0001	2
0	0.2	765.000000	25.359858	<.0001	3
0	0.25	792.250000	25.359858	<.0001	4
10	0	690.000000	25.359858	<.0001	5
10	0.15	729.750000	25.359858	<.0001	6
10	0.2	755.250000	25.359858	<.0001	7
10	0.25	721.250000	25.359858	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week3wt

i/j	1	2	3	4	5	6	7	8
1		0.2503	0.8631	0.5636	0.0328	0.2586	0.6595	0.1760
2	0.2503		0.3255	0.0905	0.2876	0.9835	0.4713	0.8307
3	0.8631	0.3255		0.4548	0.0473	0.3355	0.7881	0.2344
4	0.5636	0.0905	0.4548		0.0088	0.0942	0.3125	0.0593
5	0.0328	0.2876	0.0473	0.0088		0.2787	0.0814	0.3922
6	0.2586	0.9835	0.3355	0.0942	0.2787		0.4839	0.8147
7	0.6595	0.4713	0.7881	0.3125	0.0814	0.4839		0.3526
8	0.1760	0.8307	0.2344	0.0593	0.3922	0.8147	0.3526	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 4

Analysis of variance and Least Squares Means for broilers body weight at forth week of age

The SAS System

The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

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The GLM Procedure

Dependent Variable: week4wt

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	57464.5000	8209.2143	1.53	0.2054
Error	24	128929.0000	5372.0417		
Corrected Total	31	186393.5000			

R-Square	Coeff Var	Root MSE	week4wt Mean
0.308297	5.694413	73.29421	1287.125

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	27261.12500	27261.12500	5.07	0.0337
Avizyme	3	7186.00000	2395.33333	0.45	0.7224
DDGs*Avizyme	3	23017.37500	7672.45833	1.43	0.2591

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	27261.12500	27261.12500	5.07	0.0337
Avizyme	3	7186.00000	2395.33333	0.45	0.7224
DDGs*Avizyme	3	23017.37500	7672.45833	1.43	0.2591

The SAS System
The GLM Procedure
Least Squares Means

Avizyme	week4wt LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	1275.87500	25.91342	<.0001	1
0.15	1275.87500	25.91342	<.0001	2
0.2	1284.37500	25.91342	<.0001	3
0.25	1312.37500	25.91342	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week4wt

i/j	1	2	3	4
1		1.0000	0.8185	0.3292
2	1.0000		0.8185	0.3292
3	0.8185	0.8185		0.4523
4	0.3292	0.3292	0.4523	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	week4wt LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
0	1316.31250	18.32355	<.0001	0.0337
10	1257.93750	18.32355	<.0001	

DDGs	Avizyme	week4wt LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	1344.25000	36.64711	<.0001	1
0	0.15	1276.25000	36.64711	<.0001	2
0	0.2	1293.25000	36.64711	<.0001	3
0	0.25	1351.50000	36.64711	<.0001	4
10	0	1207.50000	36.64711	<.0001	5
10	0.15	1275.50000	36.64711	<.0001	6
10	0.2	1275.50000	36.64711	<.0001	7
10	0.25	1273.25000	36.64711	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week4wt

i/j	1	2	3	4	5	6	7	8
1		0.2019	0.3349	0.8899	0.0144	0.1971	0.1971	0.1834
2	0.2019		0.7457	0.1595	0.1971	0.9886	0.9886	0.9543
3	0.3349	0.7457		0.2722	0.1110	0.7350	0.7350	0.7030
4	0.8899	0.1595	0.2722		0.0104	0.1555	0.1555	0.1441
5	0.0144	0.1971	0.1110	0.0104		0.2019	0.2019	0.2167
6	0.1971	0.9886	0.7350	0.1555	0.2019		1.0000	0.9657
7	0.1971	0.9886	0.7350	0.1555	0.2019	1.0000		0.9657
8	0.1834	0.9543	0.7030	0.1441	0.2167	0.9657	0.9657	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 5

Analysis of variance and Least Squares Means for broilers body weight at fifth week of age

The SAS System

The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

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The GLM Procedure

Dependent Variable: week5wt

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	67474.4688	9639.2098	0.63	0.7261
Error	24	366970.2500	15290.4271		
Corrected Total	31	434444.7188			

R-Square	Coeff Var	Root MSE	week5wt Mean
0.155312	6.546353	123.6545	1888.906

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	34650.28125	34650.28125	2.27	0.1453
Avizyme	3	10746.09375	3582.03125	0.23	0.8716
DDGs*Avizyme	3	22078.09375	7359.36458	0.48	0.6983

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	34650.28125	34650.28125	2.27	0.1453
Avizyme	3	10746.09375	3582.03125	0.23	0.8716
DDGs*Avizyme	3	22078.09375	7359.36458	0.48	0.6983

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The GLM Procedure
Least Squares Means

Avizyme	week5wt LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	1885.87500	43.71846	<.0001	1
0.15	1908.00000	43.71846	<.0001	2
0.2	1860.37500	43.71846	<.0001	3
0.25	1901.37500	43.71846	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week5wt

i/j	1	2	3	4
1		0.7236	0.6837	0.8042
2	0.7236		0.4486	0.9156
3	0.6837	0.4486		0.5136
4	0.8042	0.9156	0.5136	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	week5wt LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
0	1921.81250	30.91362	<.0001	0.1453
10	1856.00000	30.91362	<.0001	

DDGs	Avizyme	week5wt LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	0	1946.00000	61.82723	<.0001	1
0	0.15	1954.50000	61.82723	<.0001	2
0	0.2	1850.50000	61.82723	<.0001	3
0	0.25	1936.25000	61.82723	<.0001	4
10	0	1825.75000	61.82723	<.0001	5
10	0.15	1861.50000	61.82723	<.0001	6
10	0.2	1870.25000	61.82723	<.0001	7
10	0.25	1866.50000	61.82723	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: week5wt

i/j	1	2	3	4	5	6	7	8
1		0.9234	0.2856	0.9121	0.1817	0.3435	0.3949	0.3723
2	0.9234		0.2459	0.8364	0.1539	0.2981	0.3449	0.3242
3	0.2856	0.2459		0.3365	0.7796	0.9009	0.8232	0.8563
4	0.9121	0.8364	0.3365		0.2185	0.4011	0.4577	0.4329
5	0.1817	0.1539	0.7796	0.2185		0.6863	0.6154	0.6454
6	0.3435	0.2981	0.9009	0.4011	0.6863		0.9211	0.9549
7	0.3949	0.3449	0.8232	0.4577	0.6154	0.9211		0.9661
8	0.3723	0.3242	0.8563	0.4329	0.6454	0.9549	0.9661	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 6

Analysis of variance and Least Squares Means for broilers feed conversion ratio for first week of age

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The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

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The GLM Procedure

Dependent Variable: FI1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.34402188	0.04914598	2.69	0.0332
Error	24	0.43897500	0.01829062		
Corrected Total	31	0.78299688			

R-Square	Coeff Var	Root MSE	FI1 Mean
0.439366	9.048235	0.135243	1.494688

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.01240313	0.01240313	0.68	0.4183
Avizyme	3	0.15960937	0.05320312	2.91	0.0553
DDGs*Avizyme	3	0.17200938	0.05733646	3.13	0.0441

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.01240313	0.01240313	0.68	0.4183
Avizyme	3	0.15960937	0.05320313	2.91	0.0553
DDGs*Avizyme	3	0.17200938	0.05733646	3.13	0.0441

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The GLM Procedure
Least Squares Means

Avizyme	FI1 LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	1.53500000	0.04781556	<.0001	1
0.15	1.58750000	0.04781556	<.0001	2
0.2	1.44875000	0.04781556	<.0001	3
0.25	1.40750000	0.04781556	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI1

i/j	1	2	3	4
1		0.4451	0.2143	0.0715
2	0.4451		0.0512	0.0136
3	0.2143	0.0512		0.5476
4	0.0715	0.0136	0.5476	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	FI1 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	1.51437500	0.03381071	<.0001	0.4183
10	1.47500000	0.03381071	<.0001	

DDGs	Avizyme	FI1 LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	1.47000000	0.06762142	<.0001	1
0	0.15	1.67750000	0.06762142	<.0001	2
0	0.2	1.40750000	0.06762142	<.0001	3
0	0.25	1.50250000	0.06762142	<.0001	4
10	0	1.60000000	0.06762142	<.0001	5
10	0.15	1.49750000	0.06762142	<.0001	6
10	0.2	1.49000000	0.06762142	<.0001	7
10	0.25	1.31250000	0.06762142	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI1

i/j	1	2	3	4	5	6	7	8
1		0.0401	0.5196	0.7369	0.1867	0.7761	0.8361	0.1126
2	0.0401		0.0094	0.0797	0.4257	0.0720	0.0616	0.0008
3	0.5196	0.0094		0.3304	0.0555	0.3560	0.3968	0.3304
4	0.7369	0.0797	0.3304		0.3181	0.9587	0.8971	0.0585
5	0.1867	0.4257	0.0555	0.3181		0.2945	0.2614	0.0061
6	0.7761	0.0720	0.3560	0.9587	0.2945		0.9381	0.0649
7	0.8361	0.0616	0.3968	0.8971	0.2614	0.9381		0.0758
8	0.1126	0.0008	0.3304	0.0585	0.0061	0.0649	0.0758	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 7

Analysis of variance and Least Squares Means for broilers feed conversion ratio for second week of age

The SAS System

The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

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The GLM Procedure

Dependent Variable: FI2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.20875000	0.02982143	0.82	0.5782
Error	24	0.87000000	0.03625000		
Corrected Total	31	1.07875000			

R-Square	Coeff Var	Root MSE	FI2 Mean
0.193511	12.33324	0.190394	1.543750

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.08000000	0.08000000	2.21	0.1504
Avizyme	3	0.06125000	0.02041667	0.56	0.6445
DDGs*Avizyme	3	0.06750000	0.02250000	0.62	0.6085

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.08000000	0.08000000	2.21	0.1504
Avizyme	3	0.06125000	0.02041667	0.56	0.6445
DDGs*Avizyme	3	0.06750000	0.02250000	0.62	0.6085

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The GLM Procedure
Least Squares Means

Avizyme	FI2 LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	1.58750000	0.06731456	<.0001	1
0.15	1.57500000	0.06731456	<.0001	2
0.2	1.53750000	0.06731456	<.0001	3
0.25	1.47500000	0.06731456	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI2

i/j	1	2	3	4
1		0.8966	0.6042	0.2489
2	0.8966		0.6971	0.3040
3	0.6042	0.6971		0.5177
4	0.2489	0.3040	0.5177	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	FI2 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	1.49375000	0.04759858	<.0001	0.1504
10	1.59375000	0.04759858	<.0001	

DDGs	Avizyme	FI2 LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	1.47500000	0.09519716	<.0001	1
0	0.15	1.50000000	0.09519716	<.0001	2
0	0.2	1.52500000	0.09519716	<.0001	3
0	0.25	1.47500000	0.09519716	<.0001	4
10	0	1.70000000	0.09519716	<.0001	5
10	0.15	1.65000000	0.09519716	<.0001	6
10	0.2	1.55000000	0.09519716	<.0001	7
10	0.25	1.47500000	0.09519716	<.0001	8

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The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI2

i/j	1	2	3	4	5	6	7	8
1		0.8542	0.7136	1.0000	0.1077	0.2060	0.5826	1.0000
2	0.8542		0.8542	0.8542	0.1504	0.2762	0.7136	0.8542
3	0.7136	0.8542		0.7136	0.2060	0.3624	0.8542	0.7136
4	1.0000	0.8542	0.7136		0.1077	0.2060	0.5826	1.0000
5	0.1077	0.1504	0.2060	0.1077		0.7136	0.2762	0.1077
6	0.2060	0.2762	0.3624	0.2060	0.7136		0.4648	0.2060
7	0.5826	0.7136	0.8542	0.5826	0.2762	0.4648		0.5826
8	1.0000	0.8542	0.7136	1.0000	0.1077	0.2060	0.5826	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 8

Analysis of variance and Least Squares Means for broilers feed conversion ratio for third week of age

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The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

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The GLM Procedure

Dependent Variable: FI3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.57718750	0.08245536	5.31	0.0009
Error	24	0.37250000	0.01552083		
Corrected Total	31	0.94968750			

R-Square	Coeff Var	Root MSE	FI3 Mean
0.607766	8.288242	0.124583	1.503125

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.16531250	0.16531250	10.65	0.0033
Avizyme	3	0.01343750	0.00447917	0.29	0.8332
DDGs*Avizyme	3	0.39843750	0.13281250	8.56	0.0005

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.16531250	0.16531250	10.65	0.0033
Avizyme	3	0.01343750	0.00447917	0.29	0.8332
DDGs*Avizyme	3	0.39843750	0.13281250	8.56	0.0005

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The GLM Procedure

Least Squares Means

Avizyme	FI3 LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	1.53750000	0.04404661	<.0001	1
0.15	1.50000000	0.04404661	<.0001	2
0.2	1.48750000	0.04404661	<.0001	3
0.25	1.48750000	0.04404661	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI3

i/j	1	2	3	4
1		0.5528	0.4300	0.4300
2	0.5528		0.8426	0.8426
3	0.4300	0.8426		1.0000
4	0.4300	0.8426	1.0000	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	FI3 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	1.43125000	0.03114566	<.0001	0.0033
10	1.57500000	0.03114566	<.0001	

DDGs	Avizyme	FI3 LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	1.50000000	0.06229132	<.0001	1
0	0.15	1.50000000	0.06229132	<.0001	2
0	0.2	1.50000000	0.06229132	<.0001	3
0	0.25	1.22500000	0.06229132	<.0001	4
10	0	1.57500000	0.06229132	<.0001	5
10	0.15	1.50000000	0.06229132	<.0001	6
10	0.2	1.47500000	0.06229132	<.0001	7
10	0.25	1.75000000	0.06229132	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI3

i/j	1	2	3	4	5	6	7	8
1		1.0000	1.0000	0.0046	0.4030	1.0000	0.7790	0.0091
2	1.0000		1.0000	0.0046	0.4030	1.0000	0.7790	0.0091
3	1.0000	1.0000		0.0046	0.4030	1.0000	0.7790	0.0091
4	0.0046	0.0046	0.0046		0.0006	0.0046	0.0091	<.0001
5	0.4030	0.4030	0.4030	0.0006		0.4030	0.2675	0.0585
6	1.0000	1.0000	1.0000	0.0046	0.4030		0.7790	0.0091
7	0.7790	0.7790	0.7790	0.0091	0.2675	0.7790		0.0046
8	0.0091	0.0091	0.0091	<.0001	0.0585	0.0091	0.0046	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 9

Analysis of variance and Least Squares Means for broilers feed conversion ratio for fourth week of age

The SAS System

The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

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The GLM Procedure

Dependent Variable: FI4

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.14718750	0.02102679	0.98	0.4714
Error	24	0.51750000	0.02156250		
Corrected Total	31	0.66468750			

R-Square	Coeff Var	Root MSE	FI4 Mean
0.221439	9.341821	0.146842	1.571875

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.00281250	0.00281250	0.13	0.7211
Avizyme	3	0.12843750	0.04281250	1.99	0.1430
DDGs*Avizyme	3	0.01593750	0.00531250	0.25	0.8631

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.00281250	0.00281250	0.13	0.7211
Avizyme	3	0.12843750	0.04281250	1.99	0.1430
DDGs*Avizyme	3	0.01593750	0.00531250	0.25	0.8631

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The GLM Procedure
Least Squares Means

Avizyme	FI4 LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	1.53750000	0.05191640	<.0001	1
0.15	1.48750000	0.05191640	<.0001	2
0.2	1.65000000	0.05191640	<.0001	3
0.25	1.61250000	0.05191640	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI4

i/j	1	2	3	4
1		0.5024	0.1385	0.3172
2	0.5024		0.0366	0.1016
3	0.1385	0.0366		0.6142
4	0.3172	0.1016	0.6142	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	FI4 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	1.58125000	0.03671044	<.0001	0.7211
10	1.56250000	0.03671044	<.0001	

DDGs	Avizyme	FI4 LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	1.55000000	0.07342088	<.0001	1
0	0.15	1.50000000	0.07342088	<.0001	2
0	0.2	1.62500000	0.07342088	<.0001	3
0	0.25	1.65000000	0.07342088	<.0001	4
10	0	1.52500000	0.07342088	<.0001	5
10	0.15	1.47500000	0.07342088	<.0001	6
10	0.2	1.67500000	0.07342088	<.0001	7
10	0.25	1.57500000	0.07342088	<.0001	8

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The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI4

i/j	1	2	3	4	5	6	7	8
1		0.6345	0.4771	0.3451	0.8118	0.4771	0.2404	0.8118
2	0.6345		0.2404	0.1615	0.8118	0.8118	0.1049	0.4771
3	0.4771	0.2404		0.8118	0.3451	0.1615	0.6345	0.6345
4	0.3451	0.1615	0.8118		0.2404	0.1049	0.8118	0.4771
5	0.8118	0.8118	0.3451	0.2404		0.6345	0.1615	0.6345
6	0.4771	0.8118	0.1615	0.1049	0.6345		0.0660	0.3451
7	0.2404	0.1049	0.6345	0.8118	0.1615	0.0660		0.3451
8	0.8118	0.4771	0.6345	0.4771	0.6345	0.3451	0.3451	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 10

Analysis of variance and Least Squares Means for broilers feed conversion ratio for fifth week of age

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The GLM Procedure

Class Level Information

Class	Levels	Values
DDGs	2	0 10
Avizyme	4	0 0.15 0.2 0.25

Number of observations 32

The GLM Procedure

Dependent Variable: FI5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.28500000	0.04071429	1.30	0.2913
Error	24	0.75000000	0.03125000		
Corrected Total	31	1.03500000			

R-Square	Coeff Var	Root MSE	FI5 Mean
0.275362	9.365653	0.176777	1.887500

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.12500000	0.12500000	4.00	0.0569
Avizyme	3	0.13000000	0.04333333	1.39	0.2709
DDGs*Avizyme	3	0.03000000	0.01000000	0.32	0.8108

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.12500000	0.12500000	4.00	0.0569
Avizyme	3	0.13000000	0.04333333	1.39	0.2709
DDGs*Avizyme	3	0.03000000	0.01000000	0.32	0.8108

The GLM Procedure
Least Squares Means

Avizyme	FI5 LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	1.88750000	0.06250000	<.0001	1
0.15	1.91250000	0.06250000	<.0001	2
0.2	1.78750000	0.06250000	<.0001	3
0.25	1.96250000	0.06250000	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI5

i/j	1	2	3	4
1		0.7797	0.2691	0.4045
2	0.7797		0.1701	0.5769
3	0.2691	0.1701		0.0593
4	0.4045	0.5769	0.0593	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	FI5 LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	1.82500000	0.04419417	<.0001	0.0569
10	1.95000000	0.04419417	<.0001	

DDGs	Avizyme	FI5 LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	1.85000000	0.08838835	<.0001	1
0	0.15	1.85000000	0.08838835	<.0001	2
0	0.2	1.75000000	0.08838835	<.0001	3
0	0.25	1.85000000	0.08838835	<.0001	4
10	0	1.92500000	0.08838835	<.0001	5
10	0.15	1.97500000	0.08838835	<.0001	6
10	0.2	1.82500000	0.08838835	<.0001	7
10	0.25	2.07500000	0.08838835	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: FI5

i/j	1	2	3	4	5	6	7	8
1		1.0000	0.4316	1.0000	0.5541	0.3273	0.8432	0.0844
2	1.0000		0.4316	1.0000	0.5541	0.3273	0.8432	0.0844
3	0.4316	0.4316		0.4316	0.1743	0.0844	0.5541	0.0157
4	1.0000	1.0000	0.4316		0.5541	0.3273	0.8432	0.0844
5	0.5541	0.5541	0.1743	0.5541		0.6927	0.4316	0.2419
6	0.3273	0.3273	0.0844	0.3273	0.6927		0.2419	0.4316
7	0.8432	0.8432	0.5541	0.8432	0.4316	0.2419		0.0569
8	0.0844	0.0844	0.0157	0.0844	0.2419	0.4316	0.0569	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 11

Analysis of variance for broilers cumulative feed conversion ratio at 35 days of age

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The GLM Procedure

Dependent Variable: CumulativeFI

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.03869688	0.00552813	1.38	0.2578
Error	24	0.09597500	0.00399896		
Corrected Total	31	0.13467187			

R-Square	Coeff Var	Root MSE	CumulativeFI Mean
0.287342	3.950018	0.063237	1.600938

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.02702813	0.02702813	6.76	0.0157
Avizyme	3	0.00435937	0.00145312	0.36	0.7800
DDGs*Avizyme	3	0.00730938	0.00243646	0.61	0.6155

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.02702813	0.02702813	6.76	0.0157
Avizyme	3	0.00435937	0.00145312	0.36	0.7800
DDGs*Avizyme	3	0.00730938	0.00243646	0.61	0.6155

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The GLM Procedure
Least Squares Means

Avizyme	CumulativeFI LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	1.61625000	0.02235777	<.0001	1
0.15	1.60750000	0.02235777	<.0001	2
0.2	1.58625000	0.02235777	<.0001	3
0.25	1.59375000	0.02235777	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: CumulativeFI

i/j	1	2	3	4
1		0.7844	0.3522	0.4836
2	0.7844		0.5080	0.6675
3	0.3522	0.5080		0.8145
4	0.4836	0.6675	0.8145	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	CumulativeFI LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	1.57187500	0.01580933	<.0001	0.0157
10	1.63000000	0.01580933	<.0001	

DDGs	Avizyme	CumulativeFI LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	0	1.57000000	0.03161866	<.0001	1
0	0.15	1.59750000	0.03161866	<.0001	2
0	0.2	1.56750000	0.03161866	<.0001	3
0	0.25	1.55250000	0.03161866	<.0001	4
10	0	1.66250000	0.03161866	<.0001	5
10	0.15	1.61750000	0.03161866	<.0001	6
10	0.2	1.60500000	0.03161866	<.0001	7
10	0.25	1.63500000	0.03161866	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: CumulativeFI

i/j	1	2	3	4	5	6	7	8
1		0.5443	0.9559	0.6990	0.0495	0.2987	0.4414	0.1590
2	0.5443		0.5087	0.3243	0.1590	0.6587	0.8682	0.4099
3	0.9559	0.5087		0.7402	0.0441	0.2746	0.4099	0.1442
4	0.6990	0.3243	0.7402		0.0215	0.1590	0.2519	0.0774
5	0.0495	0.1590	0.0441	0.0215		0.3243	0.2107	0.5443
6	0.2987	0.6587	0.2746	0.1590	0.3243		0.7822	0.6990
7	0.4414	0.8682	0.4099	0.2519	0.2107	0.7822		0.5087
8	0.1590	0.4099	0.1442	0.0774	0.5443	0.6990	0.5087	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 12

Analysis of variance and Least Squares Means for live weight of slaughtered birds

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The GLM Procedure

Dependent Variable: live

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	312805.438	44686.491	0.92	0.4964
Error	56	2713062.500	48447.545		
Corrected Total	63	3025867.938			

R-Square	Coeff Var	Root MSE	live Mean
0.103377	10.30453	220.1080	2136.031

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	99856.0000	99856.0000	2.06	0.1567
Avizyme	3	129412.8125	43137.6042	0.89	0.4518
DDGs*Avizyme	3	83536.6250	27845.5417	0.57	0.6340

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	99856.0000	99856.0000	2.06	0.1567
Avizyme	3	129412.8125	43137.6042	0.89	0.4518
DDGs*Avizyme	3	83536.6250	27845.5417	0.57	0.6340

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The GLM Procedure
Least Squares Means

DDGs	live LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	2175.53125	38.90997	<.0001	0.1567
10	2096.53125	38.90997	<.0001	

Avizyme	live LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	2145.31250	55.02701	<.0001	1
0.15	2150.50000	55.02701	<.0001	2
0.2	2062.87500	55.02701	<.0001	3
0.25	2185.43750	55.02701	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: live

i/j	1	2	3	4
1		0.9471	0.2940	0.6082
2	0.9471		0.2650	0.6552
3	0.2940	0.2650		0.1209
4	0.6082	0.6552	0.1209	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	Standard live LSMEAN	LSMEAN Error	Pr > |t|	Number
0	0	2227.87500	77.81994	<.0001	1
0	0.15	2133.37500	77.81994	<.0001	2
0	0.2	2115.00000	77.81994	<.0001	3
0	0.25	2225.87500	77.81994	<.0001	4
10	0	2062.75000	77.81994	<.0001	5
10	0.15	2167.62500	77.81994	<.0001	6
10	0.2	2010.75000	77.81994	<.0001	7
10	0.25	2145.00000	77.81994	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: live

i/j	1	2	3	4	5	6	7	8
1		0.3942	0.3095	0.9856	0.1391	0.5862	0.0535	0.4546
2	0.3942		0.8680	0.4042	0.5237	0.7568	0.2699	0.9163
3	0.3095	0.8680		0.3180	0.6368	0.6344	0.3476	0.7862
4	0.9856	0.4042	0.3180		0.1439	0.5987	0.0556	0.4655
5	0.1391	0.5237	0.6368	0.1439		0.3447	0.6384	0.4580
6	0.5862	0.7568	0.6344	0.5987	0.3447		0.1596	0.8379
7	0.0535	0.2699	0.3476	0.0556	0.6384	0.1596		0.2276
8	0.4546	0.9163	0.7862	0.4655	0.4580	0.8379	0.2276	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Appendix 13

Analysis of variance and Least Squares Means for plucked weight of slaughtered birds

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The GLM Procedure

Dependent Variable: Plucked

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	41.00000000	5.12500000	4.86	0.0001
Error	55	58.00000000	1.05454545		
Corrected Total	63	99.00000000			

R-Square	Coeff Var	Root MSE	Plucked Mean
0.414141	1.130025	1.026911	90.87500

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	2.25000000	2.25000000	2.13	0.1498
Avizyme	3	27.87500000	9.29166667	8.81	<.0001
DDGs*Avizyme	3	10.87500000	3.62500000	3.44	0.0230
Sex	1	0.00000000	0.00000000	0.00	1.0000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	2.25000000	2.25000000	2.13	0.1498
Avizyme	3	27.87500000	9.29166667	8.81	<.0001
DDGs*Avizyme	3	10.87500000	3.62500000	3.44	0.0230
Sex	1	0.00000000	0.00000000	0.00	1.0000

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The GLM Procedure

Least Squares Means

DDGs	Plucked LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
0	90.6875000	0.1815339	<.0001	0.1498
10	91.0625000	0.1815339	<.0001	

Avizyme	Plucked LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	90.3125000	0.2567277	<.0001	1
0.15	91.8750000	0.2567277	<.0001	2
0.2	91.0625000	0.2567277	<.0001	3
0.25	90.2500000	0.2567277	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Plucked

i/j	1	2	3	4
1		<.0001	0.0436	0.8640
2	<.0001		0.0293	<.0001
3	0.0436	0.0293		0.0293
4	0.8640	<.0001	0.0293	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	Plucked LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	0	90.5000000	0.3630677	<.0001	1
0	0.15	91.7500000	0.3630677	<.0001	2
0	0.2	91.1250000	0.3630677	<.0001	3
0	0.25	89.3750000	0.3630677	<.0001	4
10	0	90.1250000	0.3630677	<.0001	5
10	0.15	92.0000000	0.3630677	<.0001	6
10	0.2	91.0000000	0.3630677	<.0001	7
10	0.25	91.1250000	0.3630677	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Plucked

i/j	1	2	3	4	5	6	7	8
1		0.0182	0.2287	0.0327	0.4683	0.0050	0.3344	0.2287
2	0.0182		0.2287	<.0001	0.0025	0.6283	0.1498	0.2287
3	0.2287	0.2287		0.0012	0.0566	0.0940	0.8086	1.0000
4	0.0327	<.0001	0.0012		0.1498	<.0001	0.0025	0.0012
5	0.4683	0.0025	0.0566	0.1498		0.0006	0.0940	0.0566
6	0.0050	0.6283	0.0940	<.0001	0.0006		0.0566	0.0940
7	0.3344	0.1498	0.8086	0.0025	0.0940	0.0566		0.8086
8	0.2287	0.2287	1.0000	0.0012	0.0566	0.0940	0.8086	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	Plucked LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	90.8750000	0.1815339	<.0001	1.0000
M	90.8750000	0.1815339	<.0001	

Appendix 14

Analysis of variance and Least Squares Means for carcass weight of slaughtered birds

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The GLM Procedure

Dependent Variable: carcass

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	40.0159813	5.0019977	1.34	0.2453
Error	55	205.8012188	3.7418403		
Corrected Total	63	245.8172000			

R-Square	Coeff Var	Root MSE	carcass Mean
0.162788	2.910817	1.934384	66.45500

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	10.85702500	10.85702500	2.90	0.0941
Avizyme	3	24.78916250	8.26305417	2.21	0.0974
DDGs*Avizyme	3	4.27828750	1.42609583	0.38	0.7670
Sex	1	0.09150625	0.09150625	0.02	0.8763

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	10.85702500	10.85702500	2.90	0.0941
Avizyme	3	24.78916250	8.26305417	2.21	0.0974
DDGs*Avizyme	3	4.27828750	1.42609583	0.38	0.7670
Sex	1	0.09150625	0.09150625	0.02	0.8763

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The GLM Procedure
Least Squares Means

DDGs	carcass LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	66.8668750	0.3419540	<.0001	0.0941
10	66.0431250	0.3419540	<.0001	

Avizyme	carcass LSMEAN	Standard Error	LSMEAN Pr > |t|	LSMEAN Number
0	65.4912500	0.4835959	<.0001	1
0.15	66.4181250	0.4835959	<.0001	2
0.2	67.1987500	0.4835959	<.0001	3
0.25	66.7118750	0.4835959	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: carcass

i/j	1	2	3	4
1		0.1809	0.0156	0.0798
2	0.1809		0.2586	0.6692
3	0.0156	0.2586		0.4795
4	0.0798	0.6692	0.4795	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	carcass LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	66.2187500	0.6839079	<.0001	1
0	0.15	66.8950000	0.6839079	<.0001	2
0	0.2	67.6337500	0.6839079	<.0001	3
0	0.25	66.7200000	0.6839079	<.0001	4
10	0	64.7637500	0.6839079	<.0001	5
10	0.15	65.9412500	0.6839079	<.0001	6
10	0.2	66.7637500	0.6839079	<.0001	7
10	0.25	66.7037500	0.6839079	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: carcass

i/j	1	2	3	4	5	6	7	8
1		0.4874	0.1492	0.6064	0.1382	0.7753	0.5754	0.6181
2	0.4874		0.4482	0.8571	0.0318	0.3284	0.8926	0.8440
3	0.1492	0.4482		0.3489	0.0044	0.0857	0.3723	0.3405
4	0.6064	0.8571	0.3489		0.0480	0.4242	0.9641	0.9867
5	0.1382	0.0318	0.0044	0.0480		0.2286	0.0434	0.0498
6	0.7753	0.3284	0.0857	0.4242	0.2286		0.3988	0.4339
7	0.5754	0.8926	0.3723	0.9641	0.0434	0.3988		0.9508
8	0.6181	0.8440	0.3405	0.9867	0.0498	0.4339	0.9508	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	carcass LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	66.4928125	0.3419540	<.0001	0.8763
M	66.4171875	0.3419540	<.0001	

Appendix 15

Analysis of variance and Least Squares Means for offal weight of slaughtered birds

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The GLM Procedure

Dependent Variable: offal

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	5.52637500	0.69079687	5.22	<.0001
Error	55	7.27291875	0.13223489		
Corrected Total	63	12.79929375			

R-Square	Coeff Var	Root MSE	offal Mean
0.431772	6.663527	0.363641	5.457188

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	1.05575625	1.05575625	7.98	0.0066
Avizyme	3	0.54068125	0.18022708	1.36	0.2637
DDGs*Avizyme	3	0.92838125	0.30946042	2.34	0.0833
Sex	1	3.00155625	3.00155625	22.70	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	1.05575625	1.05575625	7.98	0.0066
Avizyme	3	0.54068125	0.18022708	1.36	0.2637
DDGs*Avizyme	3	0.92838125	0.30946042	2.34	0.0833
Sex	1	3.00155625	3.00155625	22.70	<.0001

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The GLM Procedure
Least Squares Means

DDGs	offal LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	5.32875000	0.06428328	<.0001	0.0066
10	5.58562500	0.06428328	<.0001	

Avizyme	offal LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	5.31062500	0.09091029	<.0001	1
0.15	5.45750000	0.09091029	<.0001	2
0.2	5.50187500	0.09091029	<.0001	3
0.25	5.55875000	0.09091029	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: offal

i/j	1	2	3	4
1		0.2582	0.1426	0.0588
2	0.2582		0.7313	0.4344
3	0.1426	0.7313		0.6600
4	0.0588	0.4344	0.6600	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	Standard offal LSMEAN	LSMEAN Error	Pr > |t|	Number
0	0	4.97750000	0.12856656	<.0001	1
0	0.15	5.39500000	0.12856656	<.0001	2
0	0.2	5.41000000	0.12856656	<.0001	3
0	0.25	5.53250000	0.12856656	<.0001	4
10	0	5.64375000	0.12856656	<.0001	5
10	0.15	5.52000000	0.12856656	<.0001	6
10	0.2	5.59375000	0.12856656	<.0001	7
10	0.25	5.58500000	0.12856656	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: offal

i/j	1	2	3	4	5	6	7	8
1		0.0255	0.0209	0.0035	0.0006	0.0042	0.0013	0.0015
2	0.0255		0.9345	0.4527	0.1768	0.4947	0.2791	0.3006
3	0.0209	0.9345		0.5033	0.2040	0.5477	0.3166	0.3400
4	0.0035	0.4527	0.5033		0.5431	0.9454	0.7375	0.7739
5	0.0006	0.1768	0.2040	0.5431		0.4990	0.7843	0.7478
6	0.0042	0.4947	0.5477	0.9454	0.4990		0.6866	0.7221
7	0.0013	0.2791	0.3166	0.7375	0.7843	0.6866		0.9618
8	0.0015	0.3006	0.3400	0.7739	0.7478	0.7221	0.9618	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	offal LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	5.24062500	0.06428328	<.0001	<.0001
M	5.67375000	0.06428328	<.0001	

Appendix 16

Analysis of variance and Least Squares Means for intestine weight of slaughtered birds

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The GLM Procedure
Dependent Variable: intestine

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	6.33918750	0.79239844	2.91	0.0088
Error	55	14.96579844	0.27210543		
Corrected Total	63	21.30498594			

R-Square	Coeff Var	Root MSE	intestine Mean
0.297545	11.65548	0.521637	4.475469

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	2.05563906	2.05563906	7.55	0.0081
Avizyme	3	0.39166719	0.13055573	0.48	0.6977
DDGs*Avizyme	3	3.88059219	1.29353073	4.75	0.0051
Sex	1	0.01128906	0.01128906	0.04	0.8394

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	2.05563906	2.05563906	7.55	0.0081
Avizyme	3	0.39166719	0.13055573	0.48	0.6977
DDGs*Avizyme	3	3.88059219	1.29353073	4.75	0.0051
Sex	1	0.01128906	0.01128906	0.04	0.8394

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The GLM Procedure
Least Squares Means

DDGs	intestine LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
0	4.29625000	0.09221331	<.0001	0.0081
10	4.65468750	0.09221331	<.0001	

Avizyme	intestine LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	4.43562500	0.13040931	<.0001	1
0.15	4.60625000	0.13040931	<.0001	2
0.2	4.40125000	0.13040931	<.0001	3
0.25	4.45875000	0.13040931	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: intestine

i/j	1	2	3	4
1		0.3589	0.8528	0.9007
2	0.3589		0.2712	0.4273
3	0.8528	0.2712		0.7564
4	0.9007	0.4273	0.7564	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	intestine LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	3.86500000	0.18442662	<.0001	1
0	0.15	4.54875000	0.18442662	<.0001	2
0	0.2	4.21875000	0.18442662	<.0001	3
0	0.25	4.55250000	0.18442662	<.0001	4
10	0	5.00625000	0.18442662	<.0001	5
10	0.15	4.66375000	0.18442662	<.0001	6
10	0.2	4.58375000	0.18442662	<.0001	7
10	0.25	4.36500000	0.18442662	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: intestine

i/j	1	2	3	4	5	6	7	8
1		0.0113	0.1805	0.0109	<.0001	0.0034	0.0079	0.0604
2	0.0113		0.2111	0.9886	0.0850	0.6610	0.8937	0.4841
3	0.1805	0.2111		0.2060	0.0038	0.0936	0.1673	0.5773
4	0.0109	0.9886	0.2060		0.0875	0.6714	0.9051	0.4753
5	<.0001	0.0850	0.0038	0.0875		0.1946	0.1110	0.0171
6	0.0034	0.6610	0.0936	0.6714	0.1946		0.7602	0.2570
7	0.0079	0.8937	0.1673	0.9051	0.1110	0.7602		0.4053
8	0.0604	0.4841	0.5773	0.4753	0.0171	0.2570	0.4053	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	intestine LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
F	4.48875000	0.09221331	<.0001	0.8394
M	4.46218750	0.09221331	<.0001	

Appendix 17

Analysis of variance and Least Squares Means for heart weight of slaughtered birds

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The GLM Procedure
Dependent Variable: heart

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	0.05155000	0.00644375	1.24	0.2960
Error	55	0.28669375	0.00521261		
Corrected Total	63	0.33824375			

R-Square	Coeff Var	Root MSE	heart Mean
0.152405	15.57889	0.072198	0.463438

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.01380625	0.01380625	2.65	0.1094
Avizyme	3	0.00413125	0.00137708	0.26	0.8509
DDGs*Avizyme	3	0.03220625	0.01073542	2.06	0.1162
Sex	1	0.00140625	0.00140625	0.27	0.6056

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.01380625	0.01380625	2.65	0.1094
Avizyme	3	0.00413125	0.00137708	0.26	0.8509
DDGs*Avizyme	3	0.03220625	0.01073542	2.06	0.1162
Sex	1	0.00140625	0.00140625	0.27	0.6056

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The GLM Procedure
Least Squares Means

DDGs	heart LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	0.44875000	0.01276300	<.0001	0.1094
10	0.47812500	0.01276300	<.0001	

Avizyme	heart LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0.46000000	0.01804961	<.0001	1
0.15	0.47125000	0.01804961	<.0001	2
0.2	0.45187500	0.01804961	<.0001	3
0.25	0.47062500	0.01804961	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: heart

i/j	1	2	3	4
1		0.6611	0.7515	0.6789
2	0.6611		0.4511	0.9806
3	0.7515	0.4511		0.4657
4	0.6789	0.9806	0.4657	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	heart LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	0.42375000	0.02552600	<.0001	1
0	0.15	0.49250000	0.02552600	<.0001	2
0	0.2	0.42125000	0.02552600	<.0001	3
0	0.25	0.45750000	0.02552600	<.0001	4
10	0	0.49625000	0.02552600	<.0001	5
10	0.15	0.45000000	0.02552600	<.0001	6
10	0.2	0.48250000	0.02552600	<.0001	7
10	0.25	0.48375000	0.02552600	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: heart

i/j	1	2	3	4	5	6	7	8
1		0.0621	0.9450	0.3539	0.0495	0.4702	0.1094	0.1022
2	0.0621		0.0534	0.3365	0.9176	0.2441	0.7828	0.8094
3	0.9450	0.0534		0.3197	0.0424	0.4292	0.0954	0.0890
4	0.3539	0.3365	0.3197		0.2878	0.8362	0.4915	0.4702
5	0.0495	0.9176	0.0424	0.2878		0.2055	0.7047	0.7305
6	0.4702	0.2441	0.4292	0.8362	0.2055		0.3719	0.3539
7	0.1094	0.7828	0.0954	0.4915	0.7047	0.3719		0.9725
8	0.1022	0.8094	0.0890	0.4702	0.7305	0.3539	0.9725	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	heart LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	0.45875000	0.01276300	<.0001	0.6056
M	0.46812500	0.01276300	<.0001	

Appendix 18

Analysis of variance and Least Squares Means for liver weight percentage of slaughtered birds

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The GLM Procedure

Dependent Variable: liver

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	0.66381250	0.08297656	2.21	0.0404
Error	55	2.06401094	0.03752747		
Corrected Total	63	2.72782344			

R-Square	Coeff Var	Root MSE	liver Mean
0.243349	9.090172	0.193720	2.131094

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.14535156	0.14535156	3.87	0.0541
Avizyme	3	0.17635469	0.05878490	1.57	0.2079
DDGs*Avizyme	3	0.28862969	0.09620990	2.56	0.0640
Sex	1	0.05347656	0.05347656	1.42	0.2377

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.14535156	0.14535156	3.87	0.0541
Avizyme	3	0.17635469	0.05878490	1.57	0.2079
DDGs*Avizyme	3	0.28862969	0.09620990	2.56	0.0640
Sex	1	0.05347656	0.05347656	1.42	0.2377

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The GLM Procedure
Least Squares Means

DDGs	liver LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	2.17875000	0.03424520	<.0001	0.0541
10	2.08343750	0.03424520	<.0001	

Avizyme	liver LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	2.04562500	0.04843002	<.0001	1
0.15	2.16750000	0.04843002	<.0001	2
0.2	2.13125000	0.04843002	<.0001	3
0.25	2.18000000	0.04843002	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: liver

i/j	1	2	3	4
1		0.0807	0.2165	0.0548
2	0.0807		0.5987	0.8559
3	0.2165	0.5987		0.4796
4	0.0548	0.8559	0.4796	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	liver LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	0	2.05750000	0.06849039	<.0001	1
0	0.15	2.24250000	0.06849039	<.0001	2
0	0.2	2.27250000	0.06849039	<.0001	3
0	0.25	2.14250000	0.06849039	<.0001	4
10	0	2.03375000	0.06849039	<.0001	5
10	0.15	2.09250000	0.06849039	<.0001	6
10	0.2	1.99000000	0.06849039	<.0001	7
10	0.25	2.21750000	0.06849039	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: liver

i/j	1	2	3	4	5	6	7	8
1		0.0614	0.0306	0.3840	0.8072	0.7192	0.4888	0.1043
2	0.0614		0.7579	0.3064	0.0355	0.1272	0.0117	0.7973
3	0.0306	0.7579		0.1851	0.0169	0.0685	0.0051	0.5725
4	0.3840	0.3064	0.1851		0.2664	0.6078	0.1211	0.4421
5	0.8072	0.0355	0.0169	0.2664		0.5466	0.6533	0.0631
6	0.7192	0.1272	0.0685	0.6078	0.5466		0.2946	0.2023
7	0.4888	0.0117	0.0051	0.1211	0.6533	0.2946		0.0225
8	0.1043	0.7973	0.5725	0.4421	0.0631	0.2023	0.0225	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	liver LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	2.16000000	0.03424520	<.0001	0.2377
M	2.10218750	0.03424520	<.0001	

Appendix 19

Analysis of variance and Least Squares Means for gizard weight percentage of slaughtered birds

Dependent Variable: gizard

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	2.27178750	0.28397344	1.99	0.0651
Error	55	7.85534844	0.14282452		
Corrected Total	63	10.12713594			

R-Square	Coeff Var	Root MSE	gizard Mean
0.224327	15.25703	0.377921	2.477031

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.15701406	0.15701406	1.10	0.2990
Avizyme	3	1.16297969	0.38765990	2.71	0.0536
DDGs*Avizyme	3	0.83362969	0.27787656	1.95	0.1330
Sex	1	0.11816406	0.11816406	0.83	0.3670

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.15701406	0.15701406	1.10	0.2990
Avizyme	3	1.16297969	0.38765990	2.71	0.0536
DDGs*Avizyme	3	0.83362969	0.27787656	1.95	0.1330
Sex	1	0.11816406	0.11816406	0.83	0.3670

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The GLM Procedure
Least Squares Means

DDGs	gizard LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
0	2.42750000	0.06680768	<.0001	0.2990
10	2.52656250	0.06680768	<.0001	

Avizyme	gizard LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	2.38687500	0.09448033	<.0001	1
0.15	2.61875000	0.09448033	<.0001	2
0.2	2.59812500	0.09448033	<.0001	3
0.25	2.30437500	0.09448033	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: gizard

i/j	1	2	3	4
1		0.0883	0.1196	0.5395
2	0.0883		0.8779	0.0222
3	0.1196	0.8779		0.0321
4	0.5395	0.0222	0.0321	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	gizard LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	2.32000000	0.13361536	<.0001	1
0	0.15	2.75500000	0.13361536	<.0001	2
0	0.2	2.42500000	0.13361536	<.0001	3
0	0.25	2.21000000	0.13361536	<.0001	4
10	0	2.45375000	0.13361536	<.0001	5
10	0.15	2.48250000	0.13361536	<.0001	6
10	0.2	2.77125000	0.13361536	<.0001	7
10	0.25	2.39875000	0.13361536	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: gizard

i/j	1	2	3	4	5	6	7	8
1		0.0251	0.5807	0.5629	0.4820	0.3935	0.0204	0.6785
2	0.0251		0.0863	0.0056	0.1166	0.1549	0.9318	0.0647
3	0.5807	0.0863		0.2601	0.8796	0.7621	0.0723	0.8900
4	0.5629	0.0056	0.2601		0.2025	0.1549	0.0044	0.3222
5	0.4820	0.1166	0.8796	0.2025		0.8796	0.0986	0.7721
6	0.3935	0.1549	0.7621	0.1549	0.8796		0.1322	0.6593
7	0.0204	0.9318	0.0723	0.0044	0.0986	0.1322		0.0537
8	0.6785	0.0647	0.8900	0.3222	0.7721	0.6593	0.0537	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	gizard LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	2.52000000	0.06680768	<.0001	0.3670
M	2.43406250	0.06680768	<.0001	

Appendix 20

Analysis of variance and Least Squares Means for stomach weight percentage of slaughtered birds

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The GLM Procedure

Dependent Variable: stomach

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	0.10685625	0.01335703	3.12	0.0055
Error	55	0.23511875	0.00427489		
Corrected Total	63	0.34197500			

R-Square	Coeff Var	Root MSE	stomach Mean
0.312468	14.59026	0.065383	0.448125

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.00022500	0.00022500	0.05	0.8194
Avizyme	3	0.03491250	0.01163750	2.72	0.0531
DDGs*Avizyme	3	0.02221250	0.00740417	1.73	0.1711
Sex	1	0.04950625	0.04950625	11.58	0.0012

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.00022500	0.00022500	0.05	0.8194
Avizyme	3	0.03491250	0.01163750	2.72	0.0531
DDGs*Avizyme	3	0.02221250	0.00740417	1.73	0.1711
Sex	1	0.04950625	0.04950625	11.58	0.0012

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The GLM Procedure
Least Squares Means

DDGs	stomach LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
0	0.45000000	0.01155812	<.0001	0.8194
10	0.44625000	0.01155812	<.0001	

Avizyme	stomach LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0.48750000	0.01634565	<.0001	1
0.15	0.44187500	0.01634565	<.0001	2
0.2	0.43625000	0.01634565	<.0001	3
0.25	0.42687500	0.01634565	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: stomach

i/j	1	2	3	4
1		0.0534	0.0308	0.0113
2	0.0534		0.8087	0.5191
3	0.0308	0.8087		0.6866
4	0.0113	0.5191	0.6866	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	stomach LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	0.47875000	0.02311625	<.0001	1
0	0.15	0.47375000	0.02311625	<.0001	2
0	0.2	0.41875000	0.02311625	<.0001	3
0	0.25	0.42875000	0.02311625	<.0001	4
10	0	0.49625000	0.02311625	<.0001	5
10	0.15	0.41000000	0.02311625	<.0001	6
10	0.2	0.45375000	0.02311625	<.0001	7
10	0.25	0.42500000	0.02311625	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: stomach

i/j	1	2	3	4	5	6	7	8
1		0.8790	0.0719	0.1319	0.5946	0.0401	0.4477	0.1058
2	0.8790		0.0982	0.1742	0.4942	0.0563	0.5432	0.1416
3	0.0719	0.0982		0.7608	0.0213	0.7900	0.2890	0.8491
4	0.1319	0.1742	0.7608		0.0437	0.5686	0.4477	0.9091
5	0.5946	0.4942	0.0213	0.0437		0.0108	0.1990	0.0336
6	0.0401	0.0563	0.7900	0.5686	0.0108		0.1863	0.6482
7	0.4477	0.5432	0.2890	0.4477	0.1990	0.1863		0.3830
8	0.1058	0.1416	0.8491	0.9091	0.0336	0.6482	0.3830	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	stomach LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
F	0.47593750	0.01155812	<.0001	0.0012
M	0.42031250	0.01155812	<.0001	

Appendix 21

Analysis of variance and Least Squares Means for fat pad weight percentage of slaughtered birds

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The GLM Procedure

Dependent Variable: fatpad

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	1.78648750	0.22331094	2.25	0.0368
Error	55	5.44908594	0.09907429		
Corrected Total	63	7.23557344			

R-Square	Coeff Var	Root MSE	fatpad Mean
0.246903	26.26083	0.314761	1.198594

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.11306406	0.11306406	1.14	0.2901
Avizyme	3	0.06037969	0.02012656	0.20	0.8938
DDGs*Avizyme	3	1.28671719	0.42890573	4.33	0.0082
Sex	1	0.32632656	0.32632656	3.29	0.0750

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.11306406	0.11306406	1.14	0.2901
Avizyme	3	0.06037969	0.02012656	0.20	0.8938
DDGs*Avizyme	3	1.28671719	0.42890573	4.33	0.0082
Sex	1	0.32632656	0.32632656	3.29	0.0750

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The GLM Procedure
Least Squares Means

DDGs	fatpad LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	1.15656250	0.05564235	<.0001	0.2901
10	1.24062500	0.05564235	<.0001	

Avizyme	fatpad LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	1.24250000	0.07869017	<.0001	1
0.15	1.17687500	0.07869017	<.0001	2
0.2	1.21125000	0.07869017	<.0001	3
0.25	1.16375000	0.07869017	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: fatpad

i/j	1	2	3	4
1		0.5578	0.7799	0.4822
2	0.5578		0.7586	0.9065
3	0.7799	0.7586		0.6712
4	0.4822	0.9065	0.6712	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	fatpad LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	0.98125000	0.11128471	<.0001	1
0	0.15	1.13250000	0.11128471	<.0001	2
0	0.2	1.21750000	0.11128471	<.0001	3
0	0.25	1.29500000	0.11128471	<.0001	4
10	0	1.50375000	0.11128471	<.0001	5
10	0.15	1.22125000	0.11128471	<.0001	6
10	0.2	1.20500000	0.11128471	<.0001	7
10	0.25	1.03250000	0.11128471	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: fatpad

i/j	1	2	3	4	5	6	7	8
1		0.3407	0.1390	0.0512	0.0016	0.1330	0.1608	0.7459
2	0.3407		0.5913	0.3063	0.0219	0.5751	0.6469	0.5278
3	0.1390	0.5913		0.6244	0.0744	0.9811	0.9370	0.2449
4	0.0512	0.3063	0.6244		0.1902	0.6412	0.5697	0.1010
5	0.0016	0.0219	0.0744	0.1902		0.0781	0.0629	0.0041
6	0.1330	0.5751	0.9811	0.6412	0.0781		0.9181	0.2355
7	0.1608	0.6469	0.9370	0.5697	0.0629	0.9181		0.2778
8	0.7459	0.5278	0.2449	0.1010	0.0041	0.2355	0.2778	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	fatpad LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	1.27000000	0.05564235	<.0001	0.0750
M	1.12718750	0.05564235	<.0001	

Appendix 22

Analysis of variance and Least Squares Means for neck weight percentage of slaughtered birds

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The GLM Procedure

Dependent Variable: neck

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	4.52067500	0.56508438	1.94	0.0725
Error	55	16.03841094	0.29160747		
Corrected Total	63	20.55908594			

R-Square	Coeff Var	Root MSE	neck Mean
0.219887	11.34357	0.540007	4.760469

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.17118906	0.17118906	0.59	0.4468
Avizyme	3	2.10345469	0.70115156	2.40	0.0772
DDGs*Avizyme	3	0.55927969	0.18642656	0.64	0.5930
Sex	1	1.68675156	1.68675156	5.78	0.0196

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.17118906	0.17118906	0.59	0.4468
Avizyme	3	2.10345469	0.70115156	2.40	0.0772
DDGs*Avizyme	3	0.55927969	0.18642656	0.64	0.5930
Sex	1	1.68675156	1.68675156	5.78	0.0196

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The GLM Procedure
Least Squares Means

DDGs	neck LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	4.70875000	0.09546064	<.0001	0.4468
10	4.81218750	0.09546064	<.0001	

Avizyme	neck LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	5.05437500	0.13500173	<.0001	1
0.15	4.56500000	0.13500173	<.0001	2
0.2	4.67937500	0.13500173	<.0001	3
0.25	4.74312500	0.13500173	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: neck

i/j	1	2	3	4
1		0.0131	0.0546	0.1088
2	0.0131		0.5516	0.3549
3	0.0546	0.5516		0.7397
4	0.1088	0.3549	0.7397	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	neck LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	4.84500000	0.19092128	<.0001	1
0	0.15	4.60000000	0.19092128	<.0001	2
0	0.2	4.65750000	0.19092128	<.0001	3
0	0.25	4.73250000	0.19092128	<.0001	4
10	0	5.26375000	0.19092128	<.0001	5
10	0.15	4.53000000	0.19092128	<.0001	6
10	0.2	4.70125000	0.19092128	<.0001	7
10	0.25	4.75375000	0.19092128	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: neck

i/j	1	2	3	4	5	6	7	8
1		0.3682	0.4903	0.6785	0.1267	0.2484	0.5966	0.7367
2	0.3682		0.8321	0.6256	0.0171	0.7964	0.7091	0.5714
3	0.4903	0.8321		0.7822	0.0288	0.6386	0.8719	0.7228
4	0.6785	0.6256	0.7822		0.0542	0.4565	0.9083	0.9376
5	0.1267	0.0171	0.0288	0.0542		0.0088	0.0419	0.0642
6	0.2484	0.7964	0.6386	0.4565	0.0088		0.5285	0.4109
7	0.5966	0.7091	0.8719	0.9083	0.0419	0.5285		0.8465
8	0.7367	0.5714	0.7228	0.9376	0.0642	0.4109	0.8465	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	neck LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	4.92281250	0.09546064	<.0001	0.0196
M	4.59812500	0.09546064	<.0001	

Appendix 23

Analysis of variance and Least Squares Means for thigh weight percentage of slaughtered birds

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The GLM Procedure

Dependent Variable: Thigh

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	8.4017250	1.0502156	0.55	0.8128
Error	55	104.8336500	1.9060664		
Corrected Total	63	113.2353750			

R-Square	Coeff Var	Root MSE	Thigh Mean
0.074197	12.54168	1.380604	11.00813

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	2.70602500	2.70602500	1.42	0.2386
Avizyme	3	3.15371250	1.05123750	0.55	0.6493
DDGs*Avizyme	3	0.95438750	0.31812917	0.17	0.9182
Sex	1	1.58760000	1.58760000	0.83	0.3654

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	2.70602500	2.70602500	1.42	0.2386
Avizyme	3	3.15371250	1.05123750	0.55	0.6493
DDGs*Avizyme	3	0.95438750	0.31812917	0.17	0.9182
Sex	1	1.58760000	1.58760000	0.83	0.3654

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The GLM Procedure
Least Squares Means

DDGs	Thigh LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	10.8025000	0.2440585	<.0001	0.2386
10	11.2137500	0.2440585	<.0001	

Avizyme	Thigh LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	11.2700000	0.3451509	<.0001	1
0.15	11.0962500	0.3451509	<.0001	2
0.2	11.0056250	0.3451509	<.0001	3
0.25	10.6606250	0.3451509	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Thigh

i/j	1	2	3	4
1		0.7232	0.5903	0.2172
2	0.7232		0.8534	0.3760
3	0.5903	0.8534		0.4827
4	0.2172	0.3760	0.4827	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	Thigh LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	10.9800000	0.4881171	<.0001	1
0	0.15	11.0337500	0.4881171	<.0001	2
0	0.2	10.8937500	0.4881171	<.0001	3
0	0.25	10.3025000	0.4881171	<.0001	4
10	0	11.5600000	0.4881171	<.0001	5
10	0.15	11.1587500	0.4881171	<.0001	6
10	0.2	11.1175000	0.4881171	<.0001	7
10	0.25	11.0187500	0.4881171	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Thigh

i/j	1	2	3	4	5	6	7	8
1		0.9382	0.9010	0.3307	0.4044	0.7966	0.8429	0.9554
2	0.9382		0.8400	0.2941	0.4491	0.8570	0.9039	0.9827
3	0.9010	0.8400		0.3954	0.3387	0.7025	0.7471	0.8570
4	0.3307	0.2941	0.3954		0.0739	0.2201	0.2428	0.3040
5	0.4044	0.4491	0.3387	0.0739		0.5634	0.5242	0.4364
6	0.7966	0.8570	0.7025	0.2201	0.5634		0.9526	0.8400
7	0.8429	0.9039	0.7471	0.2428	0.5242	0.9526		0.8868
8	0.9554	0.9827	0.8570	0.3040	0.4364	0.8400	0.8868	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	Thigh LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	11.1656250	0.2440585	<.0001	0.3654
M	10.8506250	0.2440585	<.0001	

Appendix 24

Analysis of variance and Least Squares Means for breast weight percentage of slaughtered birds

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The GLM Procedure

Dependent Variable: Breast

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	85.3207000	10.6650875	1.08	0.3929
Error	55	544.7572937	9.9046781		
Corrected Total	63	630.0779937			

R-Square	Coeff Var	Root MSE	Breast Mean
0.135413	12.99929	3.147170	24.2103

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	6.60490000	6.60490000	0.67	0.4177
Avizyme	3	14.21795625	4.73931875	0.48	0.6986
DDGs*Avizyme	3	22.41018750	7.47006250	0.75	0.5247
Sex	1	42.08765625	42.08765625	4.25	0.0440

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	6.60490000	6.60490000	0.67	0.4177
Avizyme	3	14.21795625	4.73931875	0.48	0.6986
DDGs*Avizyme	3	22.41018750	7.47006250	0.75	0.5247
Sex	1	42.08765625	42.08765625	4.25	0.0440

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The GLM Procedure
Least Squares Means

DDGs	Breast LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	24.5315625	0.5563463	<.0001	0.4177
10	23.8890625	0.5563463	<.0001	

Avizyme	Breast LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	24.9950000	0.7867925	<.0001	1
0.15	23.8668750	0.7867925	<.0001	2
0.2	24.1593750	0.7867925	<.0001	3
0.25	23.8200000	0.7867925	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Breast

i/j	1	2	3	4
1		0.3151	0.4559	0.2956
2	0.3151		0.7936	0.9665
3	0.4559	0.7936		0.7615
4	0.2956	0.9665	0.7615	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	Breast LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
0	0	25.2500000	1.1126926	<.0001	1
0	0.15	23.8862500	1.1126926	<.0001	2
0	0.2	25.4512500	1.1126926	<.0001	3
0	0.25	23.5387500	1.1126926	<.0001	4
10	0	24.7400000	1.1126926	<.0001	5
10	0.15	23.8475000	1.1126926	<.0001	6
10	0.2	22.8675000	1.1126926	<.0001	7
10	0.25	24.1012500	1.1126926	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Breast

i/j	1	2	3	4	5	6	7	8
1		0.3899	0.8987	0.2816	0.7471	0.3767	0.1357	0.4685
2	0.3899		0.3243	0.8260	0.5896	0.9804	0.5201	0.8918
3	0.8987	0.3243		0.2294	0.6531	0.3126	0.1063	0.3947
4	0.2816	0.8260	0.2294		0.4485	0.8452	0.6714	0.7221
5	0.7471	0.5896	0.6531	0.4485		0.5729	0.2392	0.6864
6	0.3767	0.9804	0.3126	0.8452	0.5729		0.5360	0.8725
7	0.1357	0.5201	0.1063	0.6714	0.2392	0.5360		0.4364
8	0.4685	0.8918	0.3947	0.7221	0.6864	0.8725	0.4364	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	Breast LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	25.0212500	0.5563463	<.0001	0.0440
M	23.3993750	0.5563463	<.0001	

Appendix 25

Analysis of variance and Least Squares Means for back weight percentage of slaughtered birds

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The GLM Procedure

Dependent Variable: back

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	6.20037500	0.77504687	0.56	0.8032
Error	55	75.68304844	1.37605543		
Corrected Total	63	81.88342344			

R-Square	Coeff Var	Root MSE	back Mean
0.075722	13.14922	1.173054	8.921094

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	1.85981406	1.85981406	1.35	0.2500
Avizyme	3	1.87005469	0.62335156	0.45	0.7162
DDGs*Avizyme	3	2.45974219	0.81991406	0.60	0.6204
Sex	1	0.01076406	0.01076406	0.01	0.9298

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	1.85981406	1.85981406	1.35	0.2500
Avizyme	3	1.87005469	0.62335156	0.45	0.7162
DDGs*Avizyme	3	2.45974219	0.81991406	0.60	0.6204
Sex	1	0.01076406	0.01076406	0.01	0.9298

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The GLM Procedure
Least Squares Means

DDGs	back LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	8.75062500	0.20736859	<.0001	0.2500
10	9.09156250	0.20736859	<.0001	

Avizyme	back LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	9.09000000	0.29326347	<.0001	1
0.15	8.97375000	0.29326347	<.0001	2
0.2	8.98500000	0.29326347	<.0001	3
0.25	8.63562500	0.29326347	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)
Dependent Variable: back

i/j	1	2	3	4
1		0.7803	0.8011	0.2780
2	0.7803		0.9785	0.4184
3	0.8011	0.9785		0.4032
4	0.2780	0.4184	0.4032	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	back LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	9.04750000	0.41473718	<.0001	1
0	0.15	9.02875000	0.41473718	<.0001	2
0	0.2	8.74750000	0.41473718	<.0001	3
0	0.25	8.17875000	0.41473718	<.0001	4
10	0	9.13250000	0.41473718	<.0001	5
10	0.15	8.91875000	0.41473718	<.0001	6
10	0.2	9.22250000	0.41473718	<.0001	7
10	0.25	9.09250000	0.41473718	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: back

i/j	1	2	3	4	5	6	7	8
1		0.9746	0.6111	0.1443	0.8853	0.8271	0.7665	0.9391
2	0.9746		0.6335	0.1530	0.8602	0.8519	0.7424	0.9138
3	0.6111	0.6335		0.3364	0.5143	0.7714	0.4215	0.5588
4	0.1443	0.1530	0.3364		0.1096	0.2124	0.0807	0.1250
5	0.8853	0.8602	0.5143	0.1096		0.7169	0.8786	0.9459
6	0.8271	0.8519	0.7714	0.2124	0.7169		0.6066	0.7682
7	0.7665	0.7424	0.4215	0.0807	0.8786	0.6066		0.8254
8	0.9391	0.9138	0.5588	0.1250	0.9459	0.7682	0.8254	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	back LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	8.93406250	0.20736859	<.0001	0.9298
M	8.90812500	0.20736859	<.0001	

Appendix 26

Analysis of variance and Least Squares Means for drumstick weight percentage of slaughtered birds

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The GLM Procedure

Dependent Variable: Drum

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	4.80270000	0.60033750	0.68	0.7088
Error	55	48.71094844	0.88565361		
Corrected Total	63	53.51364844			

R-Square	Coeff Var	Root MSE	Drum Mean
0.089747	10.65469	0.941092	8.832656

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	1.11566406	1.11566406	1.26	0.2666
Avizyme	3	2.16515469	0.72171823	0.81	0.4911
DDGs*Avizyme	3	0.43246719	0.14415573	0.16	0.9210
Sex	1	1.08941406	1.08941406	1.23	0.2722

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	1.11566406	1.11566406	1.26	0.2666
Avizyme	3	2.16515469	0.72171823	0.81	0.4911
DDGs*Avizyme	3	0.43246719	0.14415573	0.16	0.9210
Sex	1	1.08941406	1.08941406	1.23	0.2722

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The GLM Procedure
Least Squares Means

DDGs	Drum LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	8.70062500	0.16636308	<.0001	0.2666
10	8.96468750	0.16636308	<.0001	

Avizyme	Drum LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	9.09250000	0.23527293	<.0001	1
0.15	8.79125000	0.23527293	<.0001	2
0.2	8.57812500	0.23527293	<.0001	3
0.25	8.86875000	0.23527293	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Drum

i/j	1	2	3	4
1		0.3692	0.1279	0.5041
2	0.3692		0.5245	0.8167
3	0.1279	0.5245		0.3862
4	0.5041	0.8167	0.3862	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	Drum LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	9.00500000	0.33272617	<.0001	1
0	0.15	8.75750000	0.33272617	<.0001	2
0	0.2	8.32375000	0.33272617	<.0001	3
0	0.25	8.71625000	0.33272617	<.0001	4
10	0	9.18000000	0.33272617	<.0001	5
10	0.15	8.82500000	0.33272617	<.0001	6
10	0.2	8.83250000	0.33272617	<.0001	7
10	0.25	9.02125000	0.33272617	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: Drum

i/j	1	2	3	4	5	6	7	8
1		0.6010	0.1534	0.5420	0.7114	0.7035	0.7153	0.9726
2	0.6010		0.3607	0.9305	0.3732	0.8865	0.8739	0.5774
3	0.1534	0.3607		0.4078	0.0742	0.2914	0.2843	0.1440
4	0.5420	0.9305	0.4078		0.3287	0.8181	0.8058	0.5196
5	0.7114	0.3732	0.0742	0.3287		0.4538	0.4633	0.7371
6	0.7035	0.8865	0.2914	0.8181	0.4538		0.9873	0.6783
7	0.7153	0.8739	0.2843	0.8058	0.4633	0.9873		0.6899
8	0.9726	0.5774	0.1440	0.5196	0.7371	0.6783	0.6899	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	Drum LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	8.96312500	0.16636308	<.0001	0.2722
M	8.70218750	0.16636308	<.0001	

Appendix 27

Analysis of variance and Least Squares Means for wings weight percentage of slaughtered birds

The SAS System 07:07 Saturday, September 18, 2004 118

The GLM Procedure

Dependent Variable: wings

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	7.76707500	0.97088437	1.14	0.3490
Error	55	46.64226875	0.84804125		
Corrected Total	63	54.40934375			

R-Square	Coeff Var	Root MSE	wings Mean
0.142753	14.18734	0.920892	6.490938

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	2.28010000	2.28010000	2.69	0.1068
Avizyme	3	1.60810625	0.53603542	0.63	0.5975
DDGs*Avizyme	3	0.48406250	0.16135417	0.19	0.9026
Sex	1	3.39480625	3.39480625	4.00	0.0504

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	2.28010000	2.28010000	2.69	0.1068
Avizyme	3	1.60810625	0.53603542	0.63	0.5975
DDGs*Avizyme	3	0.48406250	0.16135417	0.19	0.9026
Sex	1	3.39480625	3.39480625	4.00	0.0504

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The GLM Procedure
Least Squares Means

DDGs	wings LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	6.30218750	0.16279217	<.0001	0.1068
10	6.67968750	0.16279217	<.0001	

Avizyme	wings LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	6.55750000	0.23022289	<.0001	1
0.15	6.24500000	0.23022289	<.0001	2
0.2	6.67937500	0.23022289	<.0001	3
0.25	6.48187500	0.23022289	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: wings

i/j	1	2	3	4
1		0.3414	0.7096	0.8172
2	0.3414		0.1877	0.4700
3	0.7096	0.1877		0.5466
4	0.8172	0.4700	0.5466	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	Avizyme	wings LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	6.34875000	0.32558433	<.0001	1
0	0.15	5.92875000	0.32558433	<.0001	2
0	0.2	6.60125000	0.32558433	<.0001	3
0	0.25	6.33000000	0.32558433	<.0001	4
10	0	6.76625000	0.32558433	<.0001	5
10	0.15	6.56125000	0.32558433	<.0001	6
10	0.2	6.75750000	0.32558433	<.0001	7
10	0.25	6.63375000	0.32558433	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: wings

i/j	1	2	3	4	5	6	7	8
1		0.3657	0.5856	0.9677	0.3685	0.6463	0.3786	0.5385
2	0.3657		0.1498	0.3873	0.0744	0.1751	0.0774	0.1315
3	0.5856	0.1498		0.5582	0.7215	0.9311	0.7356	0.9440
4	0.9677	0.3873	0.5582		0.3476	0.6175	0.3572	0.5122
5	0.3685	0.0744	0.7215	0.3476		0.6579	0.9849	0.7746
6	0.6463	0.1751	0.9311	0.6175	0.6579		0.6716	0.8755
7	0.3786	0.0774	0.7356	0.3572	0.9849	0.6716		0.7891
8	0.5385	0.1315	0.9440	0.5122	0.7746	0.8755	0.7891	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Sex	wings LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
F	6.72125000	0.16279217	<.0001	0.0504
M	6.26062500	0.16279217	<.0001	

Appendix 28

Analysis of variance and Least Squares Means for cost from feed of live body weight for broilers.

The SAS System 13:16 Tuesday, June 1, 2004 202

The GLM Procedure

Dependent Variable: price

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.39079688	0.05582813	1.16	0.3591
Error	24	1.15112500	0.04796354		
Corrected Total	31	1.54192187			

R-Square	Coeff Var	Root MSE	price Mean
0.253448	5.773281	0.219006	3.793438

Source	DF	Type I SS	Mean Square	F Value	Pr > F
DDGs	1	0.25740313	0.25740313	5.37	0.0294
Avizyme	3	0.11553437	0.03851146	0.80	0.5045
DDGs*Avizyme	3	0.01785938	0.00595313	0.12	0.9449

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DDGs	1	0.25740313	0.25740313	5.37	0.0294
Avizyme	3	0.11553437	0.03851146	0.80	0.5045
DDGs*Avizyme	3	0.01785938	0.00595313	0.12	0.9449

The SAS System 13:16 Tuesday, June 1, 2004 203

The GLM Procedure
Least Squares Means

Avizyme	price LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	3.71875000	0.07743024	<.0001	1
0.15	3.85250000	0.07743024	<.0001	2
0.2	3.85250000	0.07743024	<.0001	3
0.25	3.75000000	0.07743024	<.0001	4

Least Squares Means for effect Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: price

i/j	1	2	3	4
1		0.2338	0.2338	0.7778
2	0.2338		1.0000	0.3586
3	0.2338	1.0000		0.3586
4	0.7778	0.3586	0.3586	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

DDGs	price LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
0	3.70375000	0.05475145	<.0001	0.0294
10	3.88312500	0.05475145	<.0001	

DDGs	Avizyme	price LSMEAN	Standard Error	LSMEAN Pr > |t|	Number
0	0	3.63250000	0.10950290	<.0001	1
0	0.15	3.77000000	0.10950290	<.0001	2
0	0.2	3.79000000	0.10950290	<.0001	3
0	0.25	3.62250000	0.10950290	<.0001	4
10	0	3.80500000	0.10950290	<.0001	5
10	0.15	3.93500000	0.10950290	<.0001	6
10	0.2	3.91500000	0.10950290	<.0001	7
10	0.25	3.87750000	0.10950290	<.0001	8

The GLM Procedure
Least Squares Means

Least Squares Means for effect DDGs*Avizyme
Pr > |t| for H0: LSMean(i)=LSMean(j)

Dependent Variable: price

i/j	1	2	3	4	5	6	7	8
1	0.3834	0.3193	0.9490	0.2764	0.0625	0.0806	0.1267	
2	0.3834	0.8983	0.3504	0.8231	0.2973	0.3584	0.4942	
3	0.3193	0.8983	0.2902	0.9236	0.3584	0.4275	0.5773	
4	0.9490	0.3504	0.2902	0.2502	0.0549	0.0711	0.1127	
5	0.2764	0.8231	0.9236	0.2502	0.4095	0.4844	0.6439	
6	0.0625	0.2973	0.3584	0.0549	0.4095	0.8983	0.7137	
7	0.0806	0.3584	0.4275	0.0711	0.4844	0.8983	0.8107	
8	0.1267	0.4942	0.5773	0.1127	0.6439	0.7137	0.8107	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

جامعة النجاح الوطنية

كلية الدراسات العليا

تأثير إضافة مستحضرات الإنزيمات إلى علائق الدجاج اللاحم المحتوية على مستويين من نواتج مجففة لتقطير الحبوب بالسوائل

إعداد

هاني كامل زيدان

إشراف

د. معن سمارة

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الماجستير في الإنتاج الحيواني بكلية الدراسات العليا في جامعة النجاح الوطنية نابلس فلسطين.

2014

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الملخص

أُجريتْ هذه التجربة في مزرعة جامعة النجاح الوطنية في طولكرم؛ لدراسة تأثير إضافة أربعة مستويات من مستحضرات الإنزيمات إلى علائق الدجاج اللاحم المحتوية على مستويين من نواتج مجففة لتقطير الحبوب بالسوائل في أداء الدجاج اللاحم، ومواصفات الدجاجة الذبيحة.

وقد استعمل في التجربة (256) كتكوتًا لاحمًا (ذكورًا وإناثًا)، عمر كلّ واحد منها يوم واحد، وهي من نوع(روس 308)؛ وقُسّمت الكتاكيتُ إلى ثماني معاملات اشتملت كل معاملة على أربع مكررات، واحتوى كلّ واحد منها على ثمانية كتاكيت, ثمّ وُزّعت توزيعًا عشوائيا، وكانت قد رُتّبت ْ ترتيبًا متفقًا والمعايير المعمولة بها تجارياْ- كما في دليل الشركة المنتجة للكتاكيت- وقد قدّم للكتاكيت عليقتين، هما : عليقة في البداية(1-21 يومًا)، وعليقة أخرى في النهاية (22-35 يومًا) احتوى كلّ منهما إما على صفر أو 10 % نواتج مجففة لتقطير الحبوب بالسوائل، ثم أضيف إلى كل عليقة إما (صفر) ،(0.15) ، (0.2) أو (0.25) غم/ كغم علف من مستحضر الأنزيم؛ ليتشكّل في النهاية ثمانية مجموعات غذائية. وقِيسَ كلٌّ من معدل الوزن ونسبة التحويل الغذائي أسبوعيًّا، وتكلفة العلائق لكلّ (كغم) وزن حي، وفي نهاية التجربة ذُبحَ أربعة فراريج من كل مكرر من أجل قياس قطعيات الذبيحة المختلفة.

وكان تبين لنا من نتائج التجربة هذه، أنَّ إضافة نواتج مجففة لتقطير الحبوب بالسوائل إلى علائق كتاكيت اللاحم أثرّ سلبًا في معدل الوزن، ومعدل التحويل الغذائي عند عمر 21 يوما، واستمر هذا التأثيرالسلبيّ إلى بداية الأسبوع الرابع، وبخاصة الكتاكيتُ التي تناولت عليقة

احتوت 10% من نواتج لتقطير الحبوب دون أنزيم، أما في الأسبوع الرابع والخامس فقد انتهى التاثير السلبيّ؛ إذ تقارب معدل النمو ونسبة التحويل الغذائي للمجموعات الغذائية المختلفة.

أما بالنسبة لتكلفة الكيلوغرام من الوزن الحي فقد لُوحظَ وجودُ فرقٍ واضحٍ بين العلائق المحتوية وغير المحتوية على نواتج مجففة لتقطير الحبوب بالسوائل، كتأثير أساسي له (3.7 و 3.88 شيكل/كغم حي)، كما لُوحظَ أنّه عند إضافة مستحضرات الأنزيمات تلاشى هذا الفرق بين العلائق، فلم نجد فروقاً معنوية بين المعاملات الثمانية من حيثُ تكلفة الكيلوغرام من الوزن الحي، ولم تكن ثمة فروق معنوية بين المعاملات الثمانية من حيث مواصفات الذبيحة، ما عدا وزن الأمعاء؛ إذ وجد فرق معنوي بين مستويي نواتج مجففة لتقطير الحبوب بالسوائل- مع أو دون - إضافة مستحضرات الأنزيمات، فكانت النتيجة (3.87 و5 %) على التوالي، مما أثّر ذلك في نسبة التصافي لهذه الفراريج، إذ تناسبت تناسبًا عكسيًّا بين العلائق التي لم تحتوِ على نواتج مجففة لتقطير الحبوب بالسوائل، والتي احتوت على 10% من نواتج مجففة لتقطير الحبوب بالسوائل مع عدم إضافة مستحضرات الأنزيمات.