An-Najah National University
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The Effect of Force Molting Method on Post Molt Performance of Laying Hens

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Dedication

This project is dedicated to my parents, brothers, sisters, all of my friends, and colleagues.

The completion of this work was not possible without their support and help.

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الإقرار

أنا الموقع ادناه مقدم الرسالة التي تحمل العنوان:

The Effect of Force Molting Method on Post Molt Performance of Laying Hens

تأثير نمط القلش على آداء دجاج البيض

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

Declaration

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

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

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List of Abbreviations

A.O.A.C	Association of Analytical Communities
BW	Body Weight
C	Control
Ca	Calcium
CF	Crude Fiber
CRD	Completely Randomized Design
CP	Crude Protein
DM	Dry Matter
FCR	Feed Conversion Ration
FI	Feed Intake
GE	Gross Energy
LSD	Least Significant Difference
ME	Metabolizable Energy
NRC	National Research Council
FAO	Food & Agricultural Organization
GP	Grape Pomace
SAS	Statistical Analysis System
FF	Full Feed

FW	Feed Withdrawal
RC	Rumen Content
RCAA	Rumen content & Alfalfa
AA	Alfalfa
EP	Egg Production
SE	Salmonella Enteritids
CSM	Cotton Seed Meal
GLM	General Liner Model
HD	Hen Day
HH	Hen Housed
T	Treatment
PPM	Part per million
BWR	Body Weight Reduction
D	Dark
L	Light
Ad lib	Add libitum
Zn	Zinc

ZnO	Zinc Oxide
Na	Sodium
Kcal	kilo calorie

The Effect of Force Molting Method on Post Molt Performance of Laying Hens

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Abstract

This experiment was conducted at An- najah farm in Tulkarm to investigate the effect of force molting methods on post molt performance of laying hens, this investigation involved feeding rumen content (RC) and rumen content mixed with alfalfa,(RCAA), (50 :50) to determine their ability to induce molt .

To achieve this ,85 Hi – line egg laying hens , 60 wk of age were exposed to one of the following molt treatments: treatment 1, full feed (FF) non – molted control ; treatment 2, feed withdrawal (FW) conventional molt ; treatment 3, rumen content (RC) molt ; treatment 4, rumen content and alfalfa (50 : 50) molt, each treatment was divided into tow replicates and each replicate contains 11hens that was housed individually

A CRD design was implemented in the experiment , the result of this study indicated that hens subject to feed withdrawal (FW) rumen content (RC) and rumen content mixed with alfalfa (RCAA) methods showed significantly greater, ($P < 0.05$) percentage of body weight loss,

(32.66 , 31.17 ,and 34.33 %) compared to those in the FF treatment .

Organ weight loss occurs simultaneously with loss in body weight(BW) at the end of the experiment, no significant differences were noticed for hens in terms of feed intake (FI) or feed conversion ratio (FCR) in all

treatments in post molt experimental period that lasts 56 days. FF hens had significantly lower, ($P < 0.05$) hen – day egg production when compared with all other treatments after 8 weeks , also RCAA hens had numerically higher egg production than FW or RC hens .

The egg weight showed no significant differences among treatments, but egg output for FF treatment has significantly lower than other treatments. Egg quality, (shell , albumin and yolk weight) were not influenced by the treatment , but numerically was in favor FF .The results of our experiment indicated that RC and RCAA represent a viable alternative to FW method for the successful induction of molt and retention of post molt performance.

Chapter one

Introduction

The poultry industry plays an important role in the world economy and in Palestine economy too. In Palestine approximately 3 million egg laying hen were raised during the years 2007/2008. It is also estimated the an average Palestinian family consumed 3.4 kg of table eggs per month at same years (Palestine Central Bureau of Statistics, 2007). In addition, the poultry sector in Palestine contributes about 13.1 % of total agriculture income (Darwazeh, 2010).

Table eggs are considered as a good source of animal protein and minerals for human.The egg contains relatively high percentages of protein, vitamins and minerals. The egg protein is of high quality, and contains the essential amino acids(Abd-Alrrahim, 2003).

Egg laying hens are usually attained sexual maturely at about 20 wks of age. Then inter the first egg production cycle which lasts for 52-60 wks . At the end of the first production cycle hens are either sold as spent hens or are undergo force molting. The choice to get rid of these spent hens or to force molting them depends on several economical factors. Among these factors are the availability and the cost of replacement pullets (North and Bell, 1990).

Mrosovsky and Sherry (1980), reported that wild birds exhibit natural molting at the end of every breeding season.

Natural molting occurs usually during winter due to short day light, when birds stop laying eggs and new plumage begins to come out. Birds usually lose weight during this period. Commercially egg production declines as the hen age .In addition, the body weight of the hen increases during the first productive cycle (McCormick and Cunnigham , 1987). Keshavers and Quimby (2002) and Donalson *et al*, (2005) reported that commercial egg laying hens can be exposed to force molting in an attempt to rejuvenate them .These authors reported that hens come into a second production cycle after molt. Traditionally, hens are fasted (feed withdrawal) for 10 -12 days before they inter a second production cycle .

Feed withdrawal is a common practice used in the commercial egg industry around the world to induce molt in egg laying hens . However, this practice of inducing molt has been under extreme scrutiny due to food safety issues and animal welfare issues.

Concerns are raised over this practice, (Webster, 2003) and others believe that feed withdrawal is inhuman. Others reported that fasted hens are more prone to bacterial infections especially salmonella enteritidis, because FW don't supply the hen in nutrients that is necessary to the immunity system. Several studies suggested a non – feed withdrawal method as alternatives to fast laying hens. For example, addition of zinc oxide to hen's diet

(McCormick and Cunnigham , 1987) , Thyroxin (Keshavars and Quimby , 2002), low sodium diets (Scheideler et al, 2002),low calcium diets (Webster , 2003) have been used as alternative to feed withdrawal methods to molt hens. Recently, diets containing agricultural products such as alfalfa, (Donalson *et al* , 2005; Kwon et al 2001; Landers et al 2005) and by-products such as rumen content , dried tomato pomace, (Mansoor *et al*., 2007), cotton meal, (Davis *et al* ., 2002), jojoba meal (Arnouts *et al* ., 1993 ; Vermaut *et al* ., 1997), wheat middlings (Seo *et al* ., 2001) have also been used instead of feed withdrawal to molt hens.

In Palestine, alfalfa and rumen content are common agricultural product and by product, that can be used as alternative to FW to induce molt in laying hens, due to their characteristics as a bulk feed that give hen the necessary nutrients for maintenance, and allowed the hen to loss weight that is the main step in inducing molt. The objective of this study was to evaluate the effectiveness of (RC) single or mixed with (AA) as an alternative to feed withdrawal on post molt performance of egg laying hens.

Chapter Tow

2-Literature review

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

In addition the poultry sector in Palestine contributes about 13.1 % of agriculture income, (Palestinian Central Bureau of Statistics, 2006).

Approximately 3 million layers were raised during the years 2007/2008 with a main consumption of a family, composed from 6 persons, is 3.4 kg per month at 2009/2010 (Palestine Central Bureau of Statistics, 2010).

2.2-Back Ground on Egg Laying Hens

Egg production depends on many factors such as genetics, weight, temperature, nutrition, method of rearing (cages versus floor), light, and diseases. Small birds give more eggs than big once during the production period. Birds who reach sexual maturity with overweight give less eggs than those reach sexual maturity with normal weight (Abd-Alrrahim, 2003).

Egg production will be influenced by high and low environmental temperature. Egg production decreases if temperature reaches more than 27c° or less than 12.8 c° (Abd-Alrahim, 2003).

Birds reared on floor give more eggs than those reared in cages, but rearing in cages can increase the density of layers per m^2 and eliminate the sitting (brooding) phenomenon. However, caged hens suffer osteoporosis and produce more eggs that have blood spots, (Abd-Alrahim, 2003).

Nutrition is another factor that influences egg production. For example, diets that contain low levels of methionine (an essential amino acid) do not support high egg production.

Diseases influence egg production negatively and flock never return to normal egg production after being exposed to diseases. Light is very important to maintenance of production. Laying hens must be exposed to 16 hr of light during the production cycle. Pullets reach sexual maturity at 20 weeks and peak production is attained at 28-30 wks. The first production cycle lasts for 12-14 months, and the egg laying hens is able to produce 280-300 eggs, (North and Bell, 1990). Upon the termination of the first production cycle, laying hens are either sold as spent hens or are undergo force molting. Post-molt performance of hens lasts for 6 months and each hen may produce up to 180 eggs.

2.3-The Use of alfalfa in Poultry Rations

Alfalfa is a readily available , high protein , high fiber feed stuff , with one of the slowest rates of passage through the avian digestive system (Matsushima , 1972 ;Sibbald , 1979 ; Giarcia el al ., 2000).

Alfalfa is well balanced in amino acids and rich in vitamins, carotenoids, and xanthophylls that give poultry carcasses their desirable yellow color (Sen et al ., 1998 ; Ponte el al ., 2004).Alfalfa is extremely advantageous due to the fermentation proprieties by ceca micro flora that are capable of limiting in vitro growth of salmonella Enteritids when alfalfa is present (Donalson et al., 2004 a,b).

Alfalfa with its high fiber content, has been shown to have a very long transit time in gastrointestinal tract of chickens. This increase in transit time favors bacterial degradation of dietary fiber into fermentable substrates such as fructooligo-sacharides to sort chain fatty acids. Increasing the fiber content of a diet benefits the digestive system by normalizing colonic function and by increasing fecal weights and evacuation frequency, (Salvin et al ., 1985). These actions would help maintain the small and large intestine by increasing mucosal structure and function as well as increasing the commensal bacteria in the gastrointestinal tract, (Buddington et al ., 1999) .

Alfalfa is very high in crud fiber (24.1%), has a moderate protein level (17.5 %) and has a low metabolizable energy (ME) value (1.200 k cal / kg)

(NRC, 1994) .

2.4- The Use of Rumen Contents in Poultry Ration

Composition of rumen content, (table1) was found to be quite variable depending upon what species (goats , cattle , buffaloes) from which is collected (FAO , 1993). Rumen content from goats tended to have the highest dry matter (DM) and CP content. Rumen content was found to be a good source of water soluble vitamins and protein (FAO, 1993).

Table (1): The analysis of rumen content of calves as dried basis

DM	CP	CF	ash	EE	NFE
91.3%	19.7%	12.1%	10.8%	23.1%	25.5%

(FAO, 1993).

Including dried rumen contents up to 9 % in the diets of layers had no negative effect on yolk color (FAO, 1993).

Increased digestible DM, digestible CF, and egg yield was observed when layers were fed the dried rumen contents from goats (FAO, 1993). Performance of quail fed dried rumen contents was depressed as the level increased in the diet, (FAO, 1993).

It is well known that amino acids, nucleic acids and a wide variety of other organic compounds are synthesized from dietary and recycled endogenous constituents by a dense rumen microbial population , which usually includes a mixture of many species of bacteria , protozoa and possibly fungi, (Bryant , 1975 ; Hungate , 1975) . The extent of degradation of feed and conversion to microbial matter depends primarily on the degradability of the feed, its viable energy content and the time it is retained within the rumen. For a wide range of normal diets, it has been shown that 60 -85% of the protein passing to the small intestine is of microbial origin, (Smith, 1975; Agricultural Research Council , 1980).

Although bacteria usually represent the major part of the microbial biomass in the rumen, protozoa may also form a considerable proportion under certain feeding regimens (Eadie *et al* . , 1970 ; Harrison *et al* ., 1979).

However, differential retention of the larger protozoa in the rumen is considered to reduce their actual contribution to the dry matter (DM) leaving the rumen , to a value of less than 0-1 (Leng *et al* . 1980) Or 0-2 (Weller and Pilgeim , 1974) of their proportion . It is anticipated that rumen content may be used as a feed ingredient for hens exposed to force molting.

2.5-Molting procedures

It is well known that egg production decreases as the age of the laying hens increases. In order for a laying hen to enter a second or even a third production cycle, it is exposed to force molting in order to rejuvenate the laying hens reproductive tract and allow hens to produce higher quality eggs (Keshavars and Quimby , 2002).

The main purpose of molting is to cease egg production in order for the hens to enter a nonproductive state, which increasers egg production and egg quality post molt (Webster, 2003). Induction of molt after 12 months of egg production is commonly practiced by the commercial egg industry to expand productivity of hens for a second laying cycle, and to enhance albumen and shell quality, which normally decline by the end of the first laying cycle.

(FW) is the common procedure to induce molt and stimulates multiple egg-laying cycles in laying hens, (Koelkebeck , *et al* 2006 ., Holt , 1995) .Most feed withdrawal programs intend to reduce the photo – period from 16 to 8 hrs. (Brake, 1993). Feed removal causes hens to reach a target body weight loss (Brake and Carey , 1983).

Some researchers viewed feed withdrawal method as logical because wild birds exhibit similar behavior where they undergo a natural molt, (Webster, 2003). They lose as much as 25 – 30 % of their body weight while refusing to eat until the later stages of the molt, (Mrosovsky and Sherry , 1980).

However, recent concerns have been raised about the animal welfare during the feed withdrawal period, because it is thought to be harmful to hens (Webster, 2003, Park *et al*., 2004). A number of studies have been conducted in an attempt to evaluate methods other than feed removal .

High – zinc diets, (McCormick and Cunnigham, 1987). An experiment was conducted using 6168 Hyaline white hens, (79 wk of age) randomly assigned to two dietary treatments. The treatments included high dietary zinc (Zn) and feed withdrawal, (FW) methods. In the Zn method, hens were fed a layer ration containing 20,000 ppm of zinc as zinc oxide for 10 d and the light was reduced to 12 h/d. At day 11, hens were returned to the control layer ration and received 16 h of light/d. In FW method, feed deprivation was continued for 5 d, water was provided for ***ad lb*** intake and the photo period was reduced to 12 h/d. On day 6, hens were returned to the control layer ration and received 16 h of light/d. The hens subjected to ZN and FW method lost 5 and 20% of their initial body weight by 11 and 6 days of the experiment, respectively. The FW treatment resulted in total cessation of egg production within 7 d and the birds remained out of production until 16 d of the experiment. Hens subjected to Zn treatment ceased egg production by 8 day of the experiment and remained out of production until day 29. The mortality percentage throughout the entire experiment for Zn and FW were 0.057 and 0.032%, respectively which was significantly different. No differences were observed between feed removal treatment and non-fed removal treatment for post molt hen day production, egg weight, feed intake, feed efficiency and internal Zn of the eggs laid after Zn treatment. These results indicated that non fed removal method is as effective as feed removal method on post molt performances, although it caused significantly more mortality. Another study by El-Deck, and Al-Harthi, (2004) reported that, four hundred and eight broiler breeder hens from a commercial flock of Hubbard broiler breeders was utilized in this experiment. The flock was reared for 19 weeks after which it was transferred to production houses. Egg production was commenced at the 24th week of age and egg production reached 80.2%. Hens were randomly assigned to four force molting treatments, which were as follow: 1) feed and water restriction, 2) 20.000 ppm Zn as Zinc oxide addition to the layer diet "16% CP", 3) 30.000 ppm Zn as zinc oxide addition to the layer diet "16% CP", and 4) fasting. Results revealed that during the 1st experimental period, ZnO at 3%, fasting treatment were significantly, ($p < 0.05$) higher in body weight losses (21%). Furthermore, ZnO addition to layer feed reduce feed consumption significantly. No effects of treatment were observed regarding the digestive system parameters. In the 2nd period of the study, body weights decreased with the ZnO 2%, feed restricted, and ZnO 3% (8.9, 4.9 and 4.4%) respectively. However, body weight in the fasting group increase (14.5%). During the 3rd experimental period, body weight increased with all force molting treatments with the highest of the fasted group. No significant differences, ($p > 0.05$) were observed in the reproductive system parameters including ovary weight. However, oviduct weight of the ZnO 3% contributed the highest weight 3.53 g/1000 g body weight. Koelkebeck,*et al* (2006) investigated the alternative molting programs at the University of Nebraska revolved around the feeding of "nutrient-balanced" diets (1,250 kcal of ME /1b, 10 and 12.5% protein, 10.5% calcium, and 0.5% available phosphorus) with 0% added salt compared with a conventional feed withdrawal program (Scheideler *et al*, 2003). Their program also called for increasing the photoperiod to 16 or 24 h of light for 1 wk before the initiation of the molt treatments. In their research, the level of sodium did not affect (FI); however, cessation of lay and BW loss were not as complete as those hens molted by an 8- to 10-d fasting method. In addition, they found that fasted birds had better egg shell quality in the post molt production period. In the work conducted at North Carolina State University, 4molting techniques were compared that consisted of a no-molt group; a long fast (12 d followed by a full-fed diet, 16% protein, 2% calcium); a short fast (5 d followed by feeding a low protein/energy maintenance diet(10% protein, 1,650 kcal of MEn/kg). The results indicated that using a low protein, low energy molt diet without fasting provides good postmolt results and is feasible for the industry to use. Furthermore, the nonfasting method resulted in comparable egg production, egg income, and feed costs compared with the fasting methods. In the research at the University of California, 5 field tests using paired houses on 3 California commercial egg farms were conducted (Bell and Kuney,2004). Relative performance of flock molted by traditional feed removal methods was evaluated compared with flocks fed diets with low levels of sodium, calcium, and protein. In general, egg production and BW losses differed between the 2 molting methods during the first 4 wk of the test, but performance after that was similar. Mixed economic result were noted between the 2 methods used. In the work done at the University of Arkansas, the approach was to feed hens a molt diet containing supplemental iodinate thyroxin , (Hooge *et al*,2005). This work has shown promise and the authors have been granted a patent license agreement to continue doing the work. There approach at the University of Illinois has been to develop a non-withdrawal feeding program that is easy for the industry to implement, and that uses feed ingredients that are inexpensive and readily available. There hypothesis has been that an acceptable non withdrawal feeding program could be implemented by feeding a molt diet that is low in energy and protein and palatable to the birds. They have used non withdrawal molting diets composed of wheat middling, soybean hulls, corn gluten meal, and other ingredients by themselves and in combination with corn.

The results of these studies are inconsistent and were costly, and can cause negative behavior such as cannibalistic pecking (Webster , 2003 ; Biggs *et al* ., 2004).

Low calcium diets have also been used; however, ovaries and oviducts did not regress to a non-reproductive state and production did not cease completely and has been shown to cause osteoporosis and temporary paralysis, (Webster , 2003).

Cottonseed meals were investigated by, Davis, *et al*.,(2002) whether addition of ground ,delinted , whole cottonseed to hen's diet could promote molting . Hens voluntarily reduced intake of a feed containing 50 % finely ground , delinted , whole cotton seed diet to such an extent that the birds molted. The molt induced by feeding a ground cottonseed diet was determined to be equivalent in effectiveness to one produced by a complete feed withdrawal (Davis, *et al*, 2002). A subsequent review of the literature indicated that laying hens fed diets containing 15 or 20% ground cottonseed rapidly reduced voluntary feed intake with a subsequent decline in body weight and egg production, (Fitzsimmons *et al*, 1989).

Laying hens reject feed containing ground cottonseed meals. For optimum feed rejection, the cottonseed meals must be finely ground to prevent selective consumption of part of a mash diet. Laying hens fed a diet containing 50% cottonseed meals had decreased egg production rate and body weight loss rate equivalent to hens subjected complete feed withdrawal. Inclusion of finely ground cottonseed meals in feed is an effective means of inducing molt in laying hens, (Davis, et al. 2002).

The use of feed ingredients with low nutritional value, insoluble plant fibers such as grape pomace (GP), or guar meal , dietary manipulation of certain minerals such as zinc , iodine , sodium , chloride , Ca , aluminum , and copper or the use of anti – ovulatory drugs , among other technics , that have resulted in satisfactory post molt performance, (Keshasarz and Quimby, 2002). An investigation by Mansoor *et al* (2007) was carried out to assess the possibility of using single dietary sources as alternatives to feed deprivation for the induction of molt in commercial laying hens. The study involved six dietary groups of 29 laying hens: un-molted dried tomato pomace, alfalfa meal, rice bran, cumin seed meal and feed withdrawal. The birds received the above diets during the molting period (11 days), and body weight loss and ovary weight regression were measured. Post-molt production parameters, (number of eggs produced per hen per day, egg weight, shell weight, yolk color) were measured for 12 weeks. Results showed that all dietary sources were as effective as feed withdrawal in causing ovary weight regression in birds. Post-molt eggs laid by hens molted by all dietary sources were of comparable quality to eggs from feed-deprived hens and superior to those from un-molted hens. As fibrous feed with low metabolisable energy and an appreciable amount of protein, dried tomato pomace and alfalfa meal may be fed to hens on an *ad lb* basis for effective molt induction while reducing the stress of severe starvation and retaining comparable egg quality and production.

Keshavars, (2003) reported that grape pomace diet plus thyroxin at different levels could support a similar post molt performance as the conventional method of continuous FW. They experimented to evaluate the effect of a number of molting techniques that appeared to be less stressful than the conventional feed withdrawal, (FW) method on post molt performance. Egg production traits, egg quality, and serum corticosterone, for the most part, were not different among various molting techniques.

The result indicated that use of, (GP) diet plus thyroxin could support a similar post molt performance as the conventional method of continuous FW. Nevertheless, because use of the, (GP) diet plus thyroxin supplies the hens continuously with some nutrients such as energy, protein, vitamins and minerals, etc., during induction of molt, this approach seems preferable due to ever-increasing public concern surrounding the hen welfare and the long duration of FW in a conventional FW technique.

Unfortunately, the physiological response did not indicate that the use of a GP diet plus thyroxin was less stressful than the conventional method of continuous FW. Thyroxin was used in some of treatments to accelerate the rate of BW loss and to reduce the period needed to reach 30 % BW, (Keshavarz , 2003).

In a recent report (Donalson *et al* ., 2005), different rations of alfalfa combined with layer ration were used to induce molt. These authors concluded that alfalfa mixed with layer ration appears to be viable alternatives to conventional feed withdrawal methods for the successful induction of molt and retention of post molt performance. These authors concluded that fibrous feeds with low metabolizable energy and appreciable amount of protein, may be fed to hens on an *ad lib* basis for effective molt induction while reducing the stress of severe starvation and retaining comparable egg quality and production. Due to food safety issues and animal welfare issue, this study involved feeding alfalfa mixed with layer ration at different ratios to hens to determine their ability to induce molt. The treatment ratios were 100% AA (A 100) and 90% alfalfa and 10% layer ration (A 90) and 70% alfalfa and 30% layer ration (A70). In addition a full fed (FF) non-molted control and a FW negative control were used. From these result, alfalfa or alfalfa mixed with layer ration appears to be viable alternatives to conventional FW methods for the successful induction of molt and retention of post molt performance.

Feed deprivation is commonly used by the poultry industry to induce molting and stimulate multiple egg-laying cycle. However, feed deprivation has been observed experimentally to increase susceptibility of poultry to Salmonella infections. Previous studies indicated that alfalfa was efficacious in reducing Salmonella, (McReynolds *et al*, 2006). Evaluation of physiological parameters showed the alfalfa treatment groups had reduction ($p < 0.05$) in weight loss, ovary weight, and feed consumption when compared with the full-fed standard commercial layer diet hens, and these results were comparable with the non-fed hens. A second experiment, all of the treatment groups had a reduction, ($p < 0.05$) in SE colonization of the ceca when compared with the controls. There were also similar physiological reduction in weight loss, ovary weight, and feed consumption when birds were fed the alfalfa diets. These data suggest that alfalfa can potentially be combined with layer ration to limit SE infection and still induce a molt comparable with feed withdrawal. Other by-products were used such as jojoba meal (Arnouts *et al* . , 1993 ; Vermaut *et al* ., 1997) wheat middling, (Seo *et al* ., 2001). They used non withdrawal molting diets composed of wheat middling, soybean hulls, corn gluten meal, and other ingredients by themselves and in combination with corn.

Chapter Three

3-Materials and Methods.

3.1-Rumen Content Preparation.

Bovine rumen content was collected from 5 carcasses of feed lot beef cattle that were slaughtered at the Municipality slaughter house of Nablus, shortly carcasses were eviscerated, wet rumen content was allowed to drain and then squeezed through 0.1 mm plastic sieve.

Collected material was then sun dried under shade for 12 days to ensure that end product was approximately 13% moisture.

Dried rumen content was then sealed in plastic bags and transported to a well-ventilated storage area in the experimental location at An-najah farm in Tulkarm. Dried rumen content was stored for 10 days before the beginning of the experiment. (Table 2) shows the chemical analysis (AOAC, 1995) at An-najah laboratories of the dried rumen content which was performed before the beginning of the experiment.

Table 2: Chemical analysis of rumen content as air dried

Test	Units	
Gross energy	Cal/100g	10.7
Fiber	%	45.3
Ash	%	11.9
Moisture	%	8.79
Protein	%	7.5

3.2-Alfalfa Preparation.

Alfalfa hay was secured from a local dealer. The hay was finely ground (0.5-1mm in length) using a commercial grinder and the final product was packaged in a plastic bags and transported to the experimental location at An-najah farm in Tulkerm where stored for 10 days before used. (Table 3) shows the chemical analysis, (AOAC, 1995) at An-najah laboratories of the alfalfa.

Table 3 : Chemical analysis of alfalfa as air dried

Test	Units	
Gross nergy	Cal/ loog	9.3
Fiber	%	49.2
Ash	%	10.3
Moisture	%	1.98
Protein	%	14.4

3.3-Experimental Design.

A 85 Hy-line hens over 60 weeks of age were obtained from a local commercial laying flock. Laying hens were placed individually in double – deck layer cages and allowed a 10 days acclimation period. During the acclimation period, hens were provided free access to water and a commercial layer diet that met or exceed the National Research Council recommendations for nutrients (NRC,1994) (Table 4). Also hens were exposed to 16h of light.

Table 4: Analysis of commercial layer ration,

Protein	Fat	Fiber	Moisture	Ash	Ca	P	Salt	Mn
18%	5%	5%	13%	12%	4%	0.55%	0.3%	80gm/ton

Palestine Poultry company.

Following the acclimation period that lasts 10 days, a total of 80 egg laying hens were individually divided at random to four dietary treatments groups, designated as follows: (1) full- feed hens (FF); (2) non- fed hens (feed- withdrawal group) (FW);(3) rumen- content- feed hens (RC); and (4) rumen content 50% mixed with 50% alfalfa meal feed hens (RCAA).

In treatment 1, hens continued to receive *ad lib* the commercial layer ration, while in treatments 3 and 4 hens received rumen content and a mixture of rumen content with alfalfa, respectively, through out the molt period.

In treatment 2, hens were exposed to conventional feed- withdrawal molt procedure.

3.4-Molt Procedure.

On day 0, hens in treatments 2,3, and 4, were exposed to natural day light instead of 16 hr. photo period light schedule.

Also at day 0, hens in treatment 2 were deprived of water and fed for 2 days and of feed alone for 8 more days, which sum up the fast period to 10 consecutive days.

Hens in treatment 3 had access to a meal made of dried rumen content (RC) while hens in treatment 4 had access to a meal of (RC) 50% with 50% (AA) meal. Hens in treatment 1 were full- fed with commercial layer ration and full access to water and were exposed to 16 hr. day light.

After the fast period, hens in treatment 2, 3, and 4 were given a pullet ration for 11 days, and then a commercial layer ration was introduced. At the same time light period was raised to 16 hr. hens were kept for 8wks thereafter.

Initial and final body weight were recorded individually before and after the molt (fast) 10-day period, and one hen from each treatment group was euthanized by cervical dislocation, and the heart, spleen, liver, and oviduct were excised then weighted and oviduct length was also measured.

Once production commenced, hen day production was recorded daily , and feed intake was recorded weekly by a sensible balance.

Egg, shell, albumin, yolk weights were measured for eggs produced during the last 3 days of every week throughout the experimental period.

3.5-Statistical Analysis.

Data for all variables measured or calculated were analyzed using the general Linear Models (GLM) procedures of SAS (2000), and least significant differences (LSD) test was applied for mean comparisons, differences at $p \leq 0.05$ were considered significant.

Chapter Four

4-Results

4.1-Body weight

The effect of force molting treatment on body weight in different post molt periods are shown in (table 5). Hens subjected to feed withdrawal (FW), rumen content (RC), or rumen content with alfalfa meal (RCAA) methods showed significantly greater, ($P< 0.05$) percentages of body weight loss, (32.7, 31.2, and 34, 3% respectively) than those in full feed (FF) method . Full feed hens exhibited the least amount of body weight loss (0.33 %) when compared will all other treatments of molted hens.

Table 5 : Effect of force molting method on body weight and body weight loss.

Treatment 1 / Variable	FF	FW	RC	RCAA
Initial body weight (g)	1551.50^{a}	1551.25^{a}	1537.20^{a}	1588.25^{a}
Final body weight (g)	1554.75^{a}	1034.90^{b}	1048.00^{b}	1036.00^{b}
Body weight difference (g)	3.25^{a}	516.35^{b}	489.20^{b}	552.25^{b}
Body weight difference %	0.33^{a}	32.66^{b}	31.17^{b}	34.33^{b}

a-b means within a row with no common superscripts differ significantly ($p< 0.05$)

1-FF = Full feed; FW = feed withdrawal; RC = rumen content feed

RCAA = 50 % rumen content and 50 % alfalfa feed.

4.2-Organ Weight

The effect of force molting treatments on some selected visceral organs in term of weights or percentages of body weight are shown in (tables 6 and 7). It can be seen that organ weights loss occurs simultaneously with body weights at the end of the fasting period.

Generally un- molted control (FF) had higher ($p< 0.05$) organ weights either in grams or as percentages of body weights (table 6 and 7) compared to all other molting treatments. Effect of fasting or feeding rumen content and rumen content mixed with alfalfa was obvious on oviduct weight due to the rejuvenation process, (fasting in this case).

Table 6 :Effect of FF, FW, RC, RCAA force molting methods on post molt organ weights

Treatment 1 / **Variable**	**FF**	**FW**	**RC**	**RCAA**
Heart (gm)	7.15^{a}	5.00^{b}	3.65^{b}	4.35^{b}
Liver (gm)	35.05^{a}	16.50^{b}	15.65^{b}	15.35^{b}
Gizzard (gm)	25.05^{a}	15.05^{b}	29.00^{a}	19.90^{ab}
Spleen (gm)	1.45^{a}	1.00^{ab}	0.95^{b}	1.05^{ab}
Oviduct (gm)	59.50^{a}	13.15^{b}	16.60^{b}	14.45^{b}
Length of oviduct (cm)	70.5	28.5	39	40.5

a-b means within a row with no common superscripts differ significantly ($p< 0.05$).

1-FF = Full feed; FW = feed withdrawal; RC = rumen content feed

RCAA = 50 % rumen content and 50 % alfalfa feed.

Table 7 : Effect of FF , FW , RC and RCAA force molting methods on post molt organ weights (as % of body weight)

Variable \ Treatment 1	FF	FW	RC	RCAA
Heart	0.48^{ab}	0.50^{a}	0.36^{c}	0.41^{bc}
Liver	2.37^{a}	1.66^{b}	1.53^{b}	1.46^{b}
Gizzard	1.70^{a}	1.52^{b}	2.80^{b}	1.87^{b}
Spleen	0.10^{a}	0.10^{b}	0.09^{a}	1.10^{a}
Oviduct	0.040^{a}	0.013^{b}	0.016^{b}	0.014^{b}

a-c means within a row with no common superscripts differ significantly ($p< 0.05$).

1-FF = Full feed ; FW = feed withdrawal ; RC = rumen content feed

RCAA = 50 % rumen content and 50 % alfalfa feed .

4.3-Feed Intake and Feed Conversion Ratio

Feed intake was divided into two periods: First , feed Intake during the 10 – days fasting, (molt) period were, 105, 10 and 10 gm. for FF, RC, and RCAA hens respectively. However, FW hens had not received any feed, it can be seen that full feed hens had the highest feed intake. Second, feed intake during post molt period (56 days)

Table 8 shows feed intake and conversion ratio (gm. feed / gm. egg) for hens subjected to the different molt methods . No significant differences were noticed for hens in terms of intake or feed efficiency in all treatments in the post molt experimental period.

Table 8: Effect of force molting methods on post molt feed intake and feed conversion ratio

Variable \ Treatment 1	FF	FW	RC	RCAA
Average feed intake (g / day)	111.85[a]	108.22[a]	106.27[a]	105.07[a]
Feed conversion ratio (g/g)	1.60[a]	1.59[a]	1.52[a]	1.46[a]

a- means within a row with common superscripts not significantly ($p< 0.05$).

1-FF = Full feed ; FW = feed withdrawal ; RC = rumen content feed

RCAA = 50 % rumen content and 50 % alfalfa feed .

4.4-Egg production parameters

The effect of molt treatments on post molt egg production parameters are shown in(tables 9, and 10). Generally FF hens had significantly lower ($p< 0.05$) hen – day egg production when compared with all other treatments after post molt 8 wk, (table 9) figure 1and 2. RCAA hens had numerically higher egg production than FW or RC hens. Similar trends were noticed with respect to egg weight and egg out put differences were in favor of RC AA hens with respect to egg out put

Table 9 : Effect of FF, FW, RC and RCAA molt methods on post molt egg production parameters (8 wks)

Treatment 1 / Variable	FF	FW	RC	RCAA
Number of eggs (per 8 wks)/hen	252.00^{b}	412.50^{a}	415.50^{a}	453.50^{a}
Number of eggs (per wk)/hen	3.50^{b}	5.73^{a}	5.40^{a}	6.30^{a}
Average Egg weight (g)	69.74^{a}	68.18^{a}	69.76^{a}	71.86^{a}
Hen day egg production %	50.00^{b}	81.85^{a}	82.44^{a}	89.96^{a}
Average egg output	1.75^{b}	2.81^{ab}	2.91^{ab}	3.26^{a}

a-b means within a row with no common superscripts differ significantly ($p< 0.05$)

1-FF = Full feed ; FW = feed withdrawal ; RC = rumen content feed

RCAA = 50 % rumen content and 50 % alfalfa .

Treatment differences were not identifical ($P>0.05$).

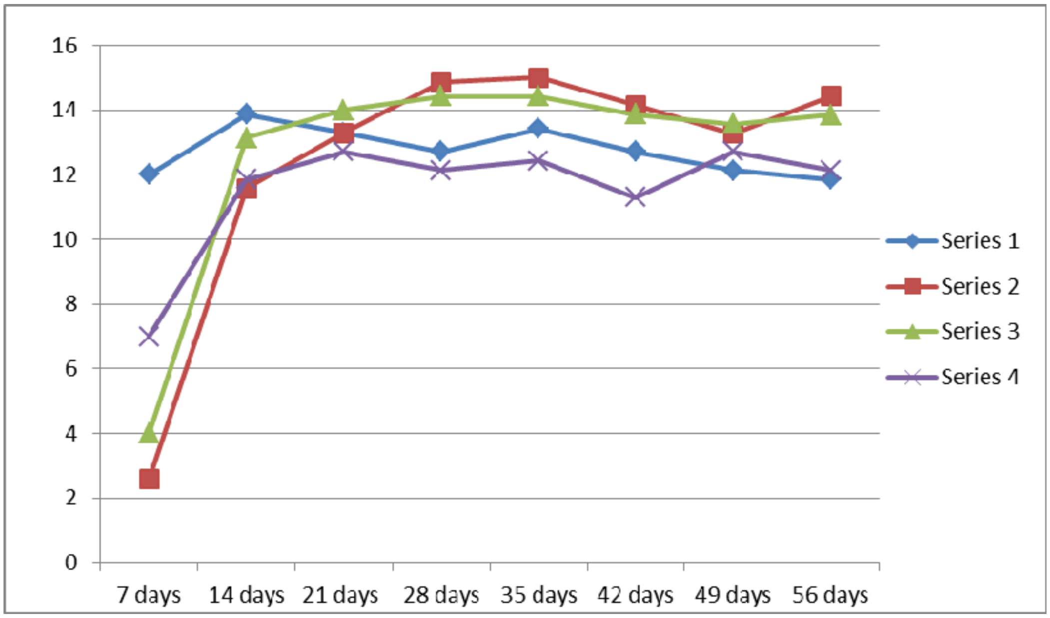

Figure 1: The average of egg production

Series 1: FF

Series 2: FW

Series 3: RC

Series 4: RCAA

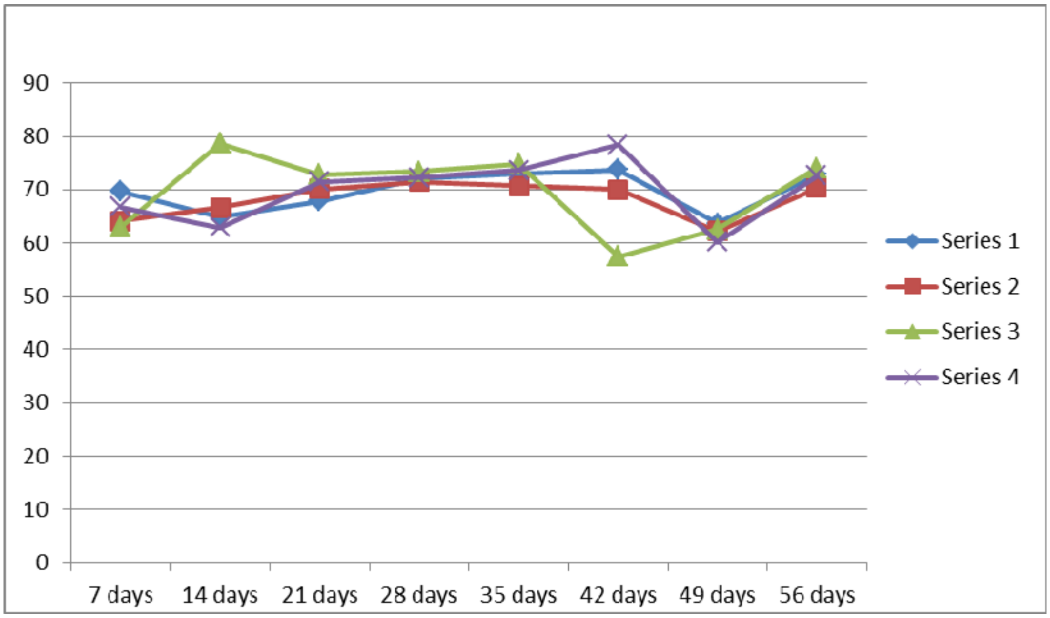

Figure 2: Average egg weight

Series 1: FF

Series 2: FW

Series 3: RC

Series 4: RCAA

4.5- External and internal egg quality

Table (10) and figures 3,4,and 5 showed that there are no significant differences among the fourth treatments, reverend to shell, albumin, and yolk, in gram or percentage but numerically were in favor FF.

Table 10 : Effect of FF, FW , RC and RCAA molt methods on post molt egg quality (8 wks.)

Treatment1 / Variable	FF	FW	RC	RCAA
Average Shell weight (g)	9.51[a]	8.83[a]	8.56[a]	9.49[a]
Shell percentage %	13.64[a]	12.95[a]	12.27[a]	13.21[a]
Average Albumen weight (g)	43.41[a]	41.14[a]	43.16[a]	43.22[a]
Albumen percentage %	62.24[a]	60.33[a]	61.86[a]	60.15[a]
Average Yolk weight (g)	16.76[a]	16.69[a]	16.56[a]	16.76[a]
Yolk percentage %	24.06[a]	24.48[a]	23.76[a]	23.35[a]

a- means within a row with common superscripts not significantly

($p< 0.05$)

1-FF = Full feed; FW = feed withdrawal; RC = rumen content feed

RCAA = 50 % rumen content and 50 % alfalfa feed.

Treatment differences were not identical ($P>0.05$).

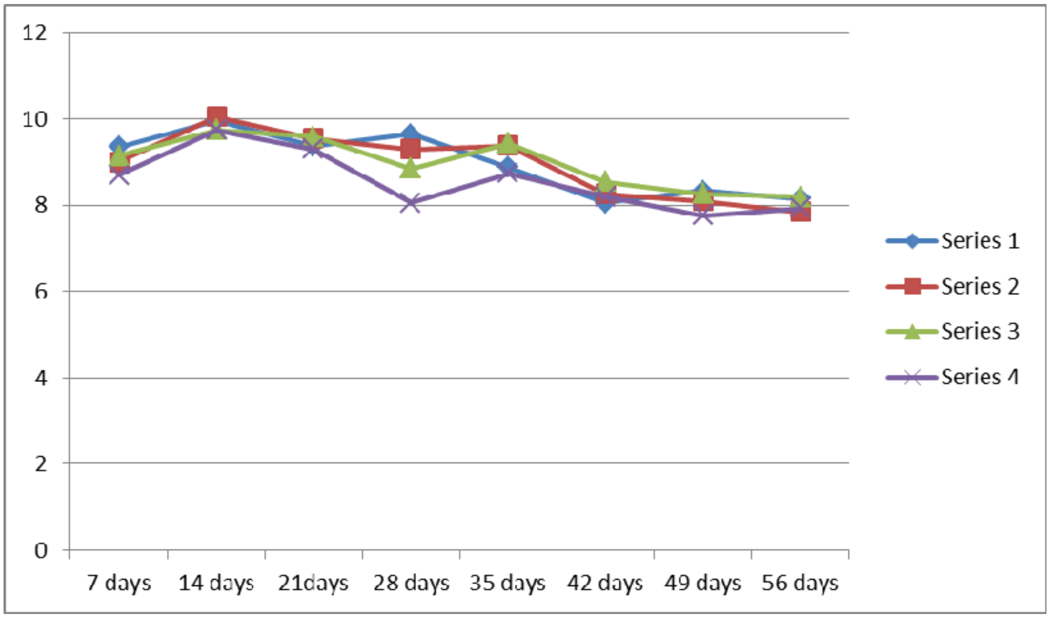

Figure 3: Average shell weight

Series 1: FF

Series 2: FW

Series 3: RC

Series 4: RCAA

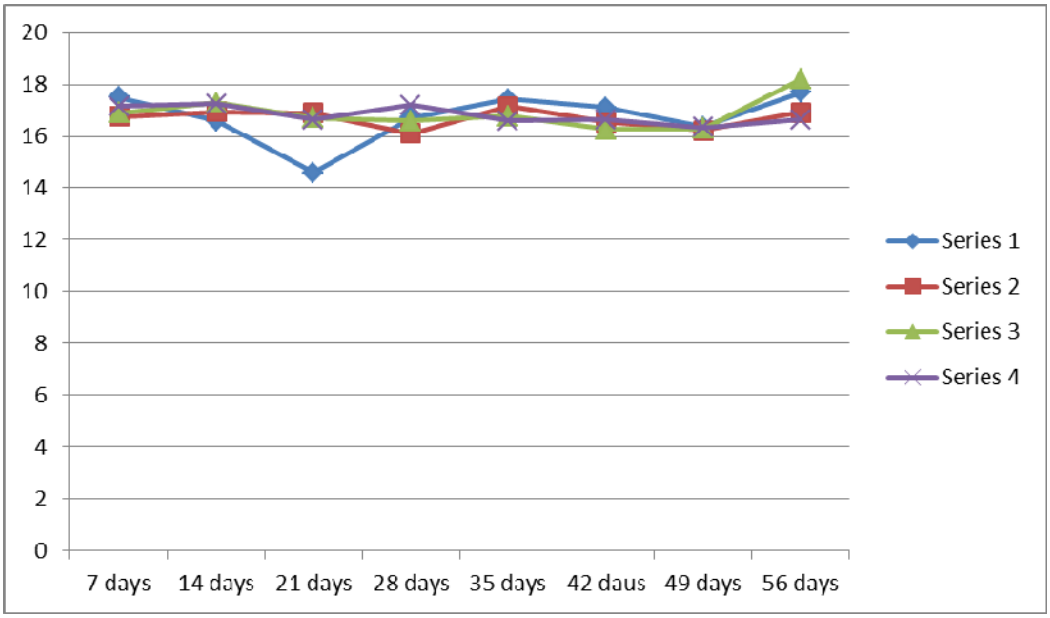

Figure 4: Average yolk weight

Series 1: FF

Series 2: FW

Series 3: RC

Series 4: RCAA

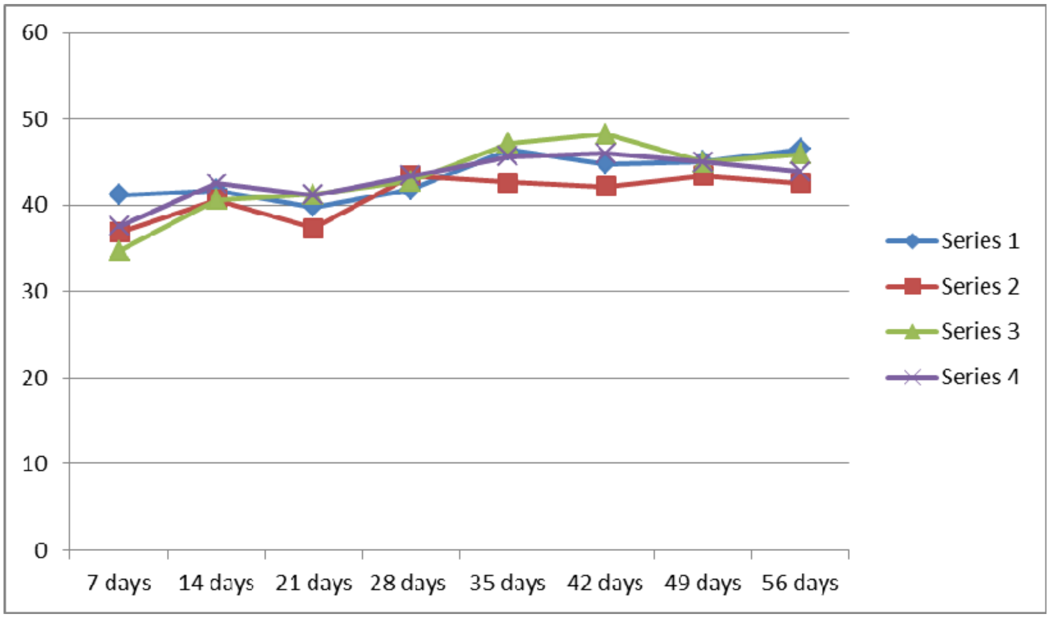

Figure 5: Average albumin weigh

Series 1: FF

Series 2: FW

Series 3: RC

Series 4: RCAA

Chapter Five

5-Discussion

5.1-Body weight.

Hens fed diets RC, RCAA and FW showed significantly greater,($P< 0.05$) percentages of body weight loss (31.17 ,34.33 and 32.66 % respectively) than those fed the layer ration, (FF) which in fact gained 0.33 % body weight . FF hens gained slightly instead of losing weight when compared with all treatments of molted hens (table 5).

Post molt performance has been shown to be directly dependent on body weight loss. Baker et al. (1983) reported that a 25-30 % body weight loss is necessary to optimize post molt performance. Our results are in agreement with the above mentioned findings. The weight exhibited by FW hens could be explained by the reduced photoperiod and nutrient deprivation. However, the weight loss exhibited by RC and RC AA hens could be explained by the reduced photoperiod. Photoperiod and nutrient deprivation have similar modes of action on the hypothalamic pituitary axis causing an inhibition of reproductive hormones and thus subsequent ovary regression and weight loss,(Andrews *et al* ., 1987 a; Berry, 2003).

Hens fed rumen content or rumen content mixed with alfalfa lost, similar to FW hens , body weight could be due to a decreased feed intake , which could be attributed to several factors including a higher percentage of alfalfa in the both diets . Pervious research, (Salvin *etal*., 1985) suggested that alfalfa has a very long transit time in the gastrointestinal tract of birds due to its high fiber content. This may explain the lower feed intake of hens fed RCAA. The same can be said concerning those hens fed RC, Since rumen content is expected to contain considerable proportions of bulk feed. Further evaluations are needed to completely understand the physiological and metabolic effects of rumen content and alfalfa as an alternative molting diets .

5.2-Organ weight.

Our results (table 6) are in agreement with previous works, (Berry and Brake, 1985; Brake, 1993; Donalson *et al*., 2005) . Berry and Brake (1985) Suggested that 25 % of the body weight loss was attributed to decreases in liver and reproductive organ weights, in that organs weight loss occurs simultaneously with body weight loss that occurs during molting. Body weight and organ weight losses were evident in FW, RC, and RC AA hens in our investigation. Berry and Brake, (1985) suggested that liver weight loss indicates a loss of liver energy stores such as glycogen and lipids.

These authors suggested also that regression of the ovary caused a decrease in synthesis of lipids and phospholipids which are metabolized in the liver under the control of ovarian steroids. This is evident in our study since liver weight of FF hens did not decrease and thus continued to metabolize egg components.

In general, the body weight and organs weights reductions in the present study are comparable with the recommended weight loss during molting. An exception to this generalization in the reduction in weights associated with molting for hens in RC hens.

5.3-Feed Intake :

Feed intake did not change over the 10 – day molt period .However, RC and RCAA hens exhibited the least feed intake (10gm and 10gm) respectively. This reduction in feed intake could have been due to several factors , including appetite low palatability of alfalfa by hens or decreased feeding stimulation with reduced day light hours, (Sen *et al* ., 1998 ; Andrews *et al* ., 1987 b). Sibbald , (1979) suggested that the slow passage rate of alfalfa may influence feed intake by giving hens a feeling of satiety and thus causing them to refrain from eating .Ued *et al* . (2002) suggested that decreased feed consumption for RC and RCAA hens due to delayed emptying of the crop, No significant differences were observed among any treatment during the 8 wk experimental period after the molt. This trend suggested that feed intake of all hens return to normal regard- less of the molt method.

5.4-Egg production parameters

North and Bell (1990) reported that the sooner hens enter the rest period and cease production, there quicker they will return to production, and reach their peak production, which occurs within a month of molting period. The peak production of a hen during the second cycle after being molted at 65 wks. is 75 to 85 % ,which is equivalent to that of hens in a 40-50 wks. old flock (Bell, 2003) .Due to the above reported information , our post molt duration of production lasted for 56– day when the experiment was terminated .

Hens in FW, RC and RCAA peak Production was attained at approximately four wks after molt . Hens in Fw , RC , and RCAA hen – day egg production was 81.85 ,82.44 , and 89.96, respectively. Whereas FF hens continued to lay less egg (50%) this is due to hens getting older.

RC and RCAA diets proved to be comparable with FW treatment for post molt egg production. It is well known that the goal of an acceptable molting program is to increase post molt egg production and quality . Alodan and Mashaly, (1999) recommended that hens improve their egg production due the rejuvenation of the productive organs and over all body weight loss after the molting period.

5.5-External and Internal Egg Quality

External and internal egg quality were examined in our study to determine if RC or RCAA would influence post molt quality of eggs . Egg weight, and shell , albumin and yolk weight (tables 9,10) were not influenced by molt treatment. This Finding did not agree with results reported by Donalson et al ., (2005) in which egg weights from hens molted by FW were higher compared to those given alfalfa . In our study, external and internal qualities were numerically in favor of FW hens. It would appear that RCAA treatment represented a viable alternative to FW. Maintaining both external and internal qualities indicates more eggs are saleable which increases profits for farmer.

Chapter six

6-Conclusions and recommendations

6.1-Conclusions

The use of dried rumen content or rumen content mixed with alfalfa proved to be effective in molt induction, increases post – molt egg production and post – molt egg quality as equally as conventional FW programs.

Rumen content and alfalfa are readily viable and need slight processing before used to induce molt in laying hens. Both feed stuffs appear to be viable alternatives to FW molting methods and yield comparable results .More research is required to investigate different combinations of rumen content and alfalfa for better molt induction and post –molt performance.

6.2- Recommendations

* RC or RCAA can be used as alternative method to FW to induced molt

* Using RC or RCAA have no effect on visceral organs

*Egg production and egg weight do not influenced by using RC or RCAA compared with FW

*Egg parameters (shell, albumin and yolk weight) did not affected by the method of molt.

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Appendixes

Appendix 1

The SAS System

The GLM Procedure

Dependent Variable: average egg number

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	8.79873750	2.93291250	14.88	0.012
Error	4	0.78855000	0.19713750		
Corrected Total	7	9.58728750			

R-Square	Coeff Var	Root MSE	avgegs Mean
0.917750	8.491546	0.444002	5.228750

Source	DF	Type I SS	Mean Square	F Value	Pr > F
treatment	3	8.79873750	2.93291250	14.88	0.0123

Source	DF	Type III SS	Mean Square	F Value	Pr > F
treatment	3	8.79873750	2.93291250	14.88	0.0123

Appendix 2

The SAS System

The GLM Procedure

t Tests (LSD) for average egg number

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.197138
Critical Value of t	2.77645
Least Significant Difference	1.2327

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	6.2950	2	3rcaa
A			
A	5.7250	2	2fw
A			
A	5.3950	2	4rc
B	3.5000	2	1ff

Appendix 3

The SAS System

The GLM Procedure

Dependent Variable: average egg weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	13.81303750	4.60434583	2.33	0.2157
Error	4	7.90195000	1.97548750		
Corrected Total	7	21.71498750			

R-Square	Coeff Var	Root MSE	avgegwt Mean

0.636106	2.011154	1.405520	69.88625

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	13.81303750	4.60434583	2.33	0.2157

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	13.81303750	4.60434583	2.33	0.2157

Appendix 4
The SAS System
The GLM Procedure

t Tests (LSD) for average egg weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	1.975487
Critical Value of t	2.77645
Least Significant Difference	3.9024

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	71.875	2	3rcaa
A			
A	69.755	2	4rc
A			
A	69.735	2	1ff
A			
A	68.180	2	2fw

Appendix 5
The SAS System
The GLM Procedure

Dependent Variable: feed intake

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	52.6434375	17.5478125	0.40	0.7590
Error	4	173.9086500	43.4771625		
Corrected Total	7	226.5520875			

R-Square	Coeff Var	Root MSE	fi Mean
0.232368	6.113718	6.593721	107.8513

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	52.64343750	17.54781250	0.40	0.7590

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	52.64343750	17.54781250	0.40	0.7590

Appendix 6
The SAS System
The GLM Procedure

t Tests (LSD) for feed intake

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	43.47716
Critical Value of t	2.77645
Least Significant Difference	18.307

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt

A	111.845	2	1ff
A			
A	108.220	2	2fw
A			
A	106.270	2	4rc
A			
A	105.070	2	3rcaa

Appendix 7
The SAS System
The GLM Procedure
Dependent Variable: shell weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.37763750	0.45921250	2.88	0.1669
Error	4	0.63875000	0.15968750		
Corrected Total	7	2.01638750			

R-Square	Coeff Var	Root MSE	shellw Me
0.683221	4.394328	0.399609	9.093750

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	1.37763750	0.45921250	2.88	0.1669

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	1.37763750	0.45921250	2.88	0.1669

Appendix 8
The SAS System
The GLM Procedure
t Tests (LSD) for shell weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.159688
Critical Value of t	2.77645
Least Significant Difference	1.1095

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	9.5100	2	1ff
A			
A	9.4850	2	3rcaa
A			
A	8.8250	2	2fw
A			
A	8.5550	2	4rc

Appendix 9
The SAS System

The GLM Procedure

Dependent Variable: albumin weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	6.83953750	2.27984583	2.99	0.1589
Error	4	3.05215000	0.76303750		
Corrected Total	7	9.89168750			

R-Square	Coeff Var	Root MSE	albmnwt Mean
0.691443	2.044338	0.873520	42.72875

Source	DF	Type I SS	Mean Square	F Value	Pr > F

trt	3	6.83953750	2.27984583	2.99	0.1589
Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	6.83953750	2.27984583	2.99	0.1589

Appendix 10
The SAS System
The GLM Procedure
t Tests (LSD) for albumin weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.763038
Critical Value of t	2.77645
Least Significant Difference	2.4253

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	43.4050	2	1ff
A			
A	43.2150	2	3rcaa
A			
A	43.1600	2	4rc
A			
A	41.1350	2	2fw

Appendix 11
The SAS System
The GLM Procedure

Dependent Variable: yolk weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.06190000	0.02063333	0.28	0.8363
Error	4	0.29190000	0.07297500		
Corrected Total	7	0.35380000			

R-Square	Coeff Var	Root MSE	yokwt Mean
0.174958	1.617598	0.270139	16.70000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	0.06190000	0.02063333	0.28	0.8363

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	0.06190000	0.02063333	0.28	0.8363

Appendix 12
The SAS System

The GLM Procedure

t Tests (LSD) for yolk weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.072975
Critical Value of t	2.77645
Least Significant Difference	0.75

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	16.7750	2	1ff

A			
A	16.7750	2	3rcaa
A			
A	16.6900	2	2fw
A			
A	16.5600	2	4rc

Appendix 13

The SAS System

The GLM Procedure

Dependent Variable: all eggs number

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	48114.37500	16038.12500	4.98	0.0774
Error	4	12869.50000	3217.37500		
Corrected Total	7	60983.87500			

R-Square	Coeff Var	Root MSE	allegs Mean
0.788969	14.79541	56.72191	383.3750

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	48114.37500	16038.12500	4.98	0.0774

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	48114.37500	16038.12500	4.98	0.0774

Appendix 14

The SAS System

The GLM Procedure

t Tests (LSD) for all eggs number

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	3217.375
Critical Value of t	2.77645
Least Significant Difference	157.49

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	453.50	2	3rcaa
A			
A	415.50	2	4rc
A			
A	412.50	2	2fw
B	252.00	2	1ff

Appendix 15

The SAS System

The GLM Procedure

Dependent Variable: percentage egg production

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	2316.176918	772.058973	5.15	0.0735
Error	4	599.128414	149.782103		
Corrected Total	7	2915.305332			

R-Square	Coeff Var	Root MSE	prcntegprod Mean
0.794489	15.56221	12.23855	78.64273

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	2316.176918	772.058973	5.15	0.0735

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	2316.176918	772.058973	5.15	0.0735

Appendix 16

The SAS System

The GLM Procedure

t Tests (LSD) for percentage eggs production

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05

Error Degrees of Freedom	4
Error Mean Square	149.7821
Critical Value of t	2.77645
Least Significant Difference	33.98

Means with the same letter are not significantly different.

t Grouping		Mean	N	trt
	A	92.75	2	4rc
	A			
	A	89.98	2	3rcaa
	A			
B	A	81.85	2	2fw
B				
B		50.00	2	1ff

Appendix 17
The SAS System
The GLM Procedure

Dependent Variable: percentage hen day egg production

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1894.147416	631.382472	4.98	0.0774
Error	4	506.641314	126.660328		
Corrected Total	7	2400.788730			

R-Square	Coeff Var	Root MSE	prcnthdeg Mean
0.788969	14.79541	11.25435	76.06647

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	1894.147416	631.382472	4.98	0.0774

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	1894.147416	631.382472	4.98	0.0774

Appendix 18
The SAS System
The GLM Procedure
t Tests (LSD) for percentage hen day egg production

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	126.6603
Critical Value of t	2.77645
Least Significant Difference	31.247

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	89.98	2	3rcaa
A			
A	82.44	2	4rc
A			
A	81.85	2	2fw
B	50.00	2	1ff

Appendix 19
The SAS System
The GLM Procedure

Dependent Variable: egg output

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	19240385640	6413461880	5.19	0.0729
Error	4	4946500481	1236625120		
Corrected Total	7	24186886122			

R-Square	Coeff Var	Root MSE	egoutput Mean
0.795488	15.01042	35165.68	234275.1

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	19240385640	6413461880	5.19	0.0729

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	19240385640	6413461880	5.19	0.0729

Appendix 20
The SAS System
The GLM Procedure
t Tests (LSD) for egg output

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	1.2366E9
Critical Value of t	2.77645
Least Significant Difference	97636

Means with the same letter are not significantly different.

t Grouping		Mean	N	trt
	A	293204	2	3rcaa
	A			
B	A	253039	2	2fw
B	A			
B	A	232693	2	4rc
B				
B		158164	2	1ff

Appendix 21

The SAS System

The GLM Procedure

Dependent Variable: average egg output

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	250930176.1	83643392.0	4.60	0.0874
Error	4	72791282.1	18197820.5		
Corrected Total	7	323721458.2			

R-Square	Coeff Var	Root MSE	avgoutput Mean
0.775142	15.89465	4265.890	26838.53

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	250930176.1	83643392.0	4.60	0.0874

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	250930176.1	83643392.0	4.60	0.0874

Appendix 22

The SAS System

The GLM Procedure

t Tests (LSD) for average egg output

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	18197821
Critical Value of t	2.77645
Least Significant Difference	11844

Means with the same letter are not significantly different.

t Grouping		Mean	N	trt
	A	32578	2	3rcaa
	A			
B	A	29087	2	4rc
B	A			
B	A	28115	2	2fw
B				
B		17574	2	1ff

Appendix 23

The SAS System

The GLM Procedure

Dependent Variable: percentage shell weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.96734905	0.65578302	1.19	0.4181
Error	4	2.19561269	0.54890317		
Corrected Total	7	4.16296173			

R-Square	Coeff Var	Root MSE	prcntshelwt Mean
0.472584	5.691971	0.740880	13.01623

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	1.96734905	0.65578302	1.19	0.4181

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	1.96734905	0.65578302	1.19	0.4181

Appendix 24
The SAS System
The GLM Procedure
t Tests (LSD) for percentage shell weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.548903
Critical Value of t	2.77645
Least Significant Difference	2.057

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	13.6373	2	1ff
A			
A	13.2111	2	3rcaa
A			
A	12.9453	2	2fw
A			
A	12.2713	2	4rc

Appendix 25
The SAS System
The GLM Procedure

Dependent Variable: percentage albumin weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	6.80234366	2.26744789	1.53	0.3358
Error	4	5.91408439	1.47852110		
Corrected Total	7	12.71642806			

R-Square	Coeff Var	Root MSE	prctalbmnwt Mean
0.534926	1.988483	1.215945	61.14936

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	6.80234366	2.26744789	1.53	0.3358

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	6.80234366	2.26744789	1.53	0.3358

Appendix 26
The SAS System
The GLM Procedure
t Tests (LSD)for percentage albumin weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	1.478521
Critical Value of t	2.77645
Least Significant Difference	3.376

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	62.243	2	1ff
A			
A	61.878	2	4rc
A			
A	60.328	2	2fw
A			
A	60.149	2	3rcaa

Appendix 27
The SAS System
The GLM Procedure

Dependent Variable: percentage yolk weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.37466365	0.45822122	0.71	0.5937
Error	4	2.57368353	0.64342088		
Corrected Total	7	3.94834718			

R-Square	Coeff Var	Root MSE	prcntyokwt Mean
0.348162	3.354666	0.802135	23.91103

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	1.37466365	0.45822122	0.71	0.5937

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	1.37466365	0.45822122	0.71	0.5937

Appendix 28

The SAS System

The GLM Procedure

t Tests (LSD) for percentage yolk weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.643421
Critical Value of t	2.77645
Least Significant Difference	2.2271

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	24.4827	2	2fw
A			
A	24.0553	2	1ff
A			
A	23.7572	2	4rc
A			
A	23.3489	2	3rcaa

Appendix 29

The SAS System

The GLM Procedure

Dependent Variable: feed conversion ratio

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.02513874	0.00837958	0.88	0.5223
Error	4	0.03803192	0.00950798		
Corrected Total	7	0.06317066			

R-Square	Coeff Var	Root MSE	fcr Mean
0.397950	6.313888	0.097509	1.544355

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	0.02513874	0.00837958	0.88	0.5223

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	0.02513874	0.00837958	0.88	0.5223

Appendix 30

The SAS System

The GLM Procedure

t Tests (LSD) for feed conversion ratio

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.009508
Critical Value of t	2.77645
Least Significant Difference	0.2707

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	1.60383	2	1ff
A			
A	1.58728	2	2fw
A			
A	1.52435	2	4rc
A			
A	1.46196	2	3rcaa

Appendix 31
The SAS System
The GLM Procedure

Dependent Variable: initial body weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	28638.100	9546.033	0.35	0.7890
Error	76	2070971.700	27249.628		
Corrected Total	79	2099609.800			

R-Square	Coeff Var	Root MSE	initialbwt Mea
0.013640	10.60175	165.0746	1557.050

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	28638.10000	9546.03333	0.35	0.7890

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	28638.10000	9546.03333	0.35	0.7890

Appendix 32
The SAS System
The GLM Procedure
t Tests (LSD) for initial body weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	76
Error Mean Square	27249.63
Critical Value of t	1.99167
Least Significant Difference	103.97

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	1588.25	20	3rcaa
A			
A	1551.50	20	1ff
A			
A	1551.25	20	2fw
A			
A	1537.20	20	4rc

Appendix 33
The SAS System
The GLM Procedure

Dependent Variable: final body weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	3982289.838	1327429.946	92.59	<.0001
Error	76	1089549.550	14336.178		
Corrected Total	79	5071839.388			

R-Square	Coeff Var	Root MSE	finalbwt Mean
0.785177	10.24756	119.7338	1168.413

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	3982289.838	1327429.946	92.59	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	3982289.838	1327429.946	92.59	<.0001

Appendix 34
The SAS System
The GLM Procedure
t Tests (LSD) for final body weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	76
Error Mean Square	14336.18
Critical Value of t	1.99167
Least Significant Difference	75.411

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	1554.75	20	1ff
B	1048.00	20	4rc
B			
B	1036.00	20	3rcaa
B			
B	1034.90	20	2fw

Appendix 35
The SAS System
The GLM Procedure

Dependent Variable: body weight difference

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	4135363.238	1378454.413	51.53	<.0001
Error	76	2032925.250	26749.016		
Corrected Total	79	6168288.488			

R-Square	Coeff Var	Root MSE	bwdif Mean
0.670423	-42.08324	163.5513	-388.6375

Source	DF	Type I SS	Mean Square	F Value	Pr >
trt	3	4135363.238	1378454.413	51.53	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	4135363.238	1378454.413	51.53	<.0001

Appendix 36
The SAS System
The GLM Procedure
t Tests (LSD)for body weight difference

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	76
Error Mean Square	26749.02
Critical Value of t	1.99167
Least Significant Difference	103.01

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	3.25	20	1ff
B	-489.20	20	4rc
B			
B	-516.35	20	2fw
B			
B	-552.25	20	3rcaa

Appendix 37
The SAS System
The GLM Procedure

Dependent Variable: percentage body weight difference

Source	DF	Sum of Squares	Mean Square	F Value	Pr >
Model	3	16480.49404	5493.49801	82.12	<.0001
Error	76	5083.87610	66.89311		
Corrected Total	79	21564.37014			

R-Square	Coeff Var	Root MSE	prcntbwdif Mean
0.764246	-33.43836	8.178821	-24.45940

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	16480.49404	5493.49801	82.12	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F

```
trt                         3     16480.49404      5493.49801      82.12    <.0001
```

Appendix 38

The SAS System

The GLM Procedure

t Tests (LSD) for percentage body weight difference

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

```
                              Alpha                              0.05
                              Error Degrees of Freedom             76
                              Error Mean Square              66.89311
                              Critical Value of t             1.99167
                              Least Significant Difference   5.1512
                   Means with the same letter are not significantly different.
                        t Grouping         Mean      N    trt
                                 A        0.325     20    1ff
                                 B      -31.165     20    4rc
                                 B
                                 B      -32.663     20    2fw
                                 B
                                 B      -34.334     20    3rcaa
```

Appendix 39

The SAS System

The GLM Procedure

```
Dependent Variable: heart weight
                                         Sum of
Source                      DF          Squares     Mean Square    F Value    Pr > F
Model                        3     13.72375000      4.57458333      10.08    0.0246
Error                        4      1.81500000      0.45375000
Corrected Total              7     15.53875000
R-Square     Coeff Var      Root MSE    heartwt Mean
0.883195      13.37190      0.673610        5.037500
Source                      DF       Type I SS     Mean Square    F Value    Pr > F
trt                          3     13.72375000      4.57458333      10.08    0.0246
Source                      DF     Type III SS     Mean Square    F Value    Pr > F
trt                          3     13.72375000      4.57458333      10.08    0.0246
```

Appendix 40

The SAS System

The GLM Procedure

t Tests (LSD) for heart weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

```
                              Alpha                              0.05
                              Error Degrees of Freedom              4
                              Error Mean Square               0.45375
                              Critical Value of t             2.77645
                              Least Significant Difference   1.8702

                   Means with the same letter are not significantly different.
                        t Grouping         Mean      N    trt
                                 A       7.1500      2    1ff
                                 B       5.0000      2    2fw
                                 B
                                 B       4.3500      2    3rcaa
                                 B
                                 B       3.6500      2    4rc
```

Appendix 41

The SAS System

The GLM Procedure

```
Dependent Variable: liver weight
                                         Sum of
Source                      DF          Squares     Mean Square    F Value    Pr > F
Model                        3     555.3437500     185.1145833     111.94    0.0003
Error                        4       6.6150000       1.6537500
Corrected Total              7     561.9587500
R-Square     Coeff Var      Root MSE    liverwt Mean
0.988229      6.231288      1.285982        20.63750
Source                      DF       Type I SS     Mean Square    F Value    Pr > F
```

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	555.3437500	185.1145833	111.94	0.0003

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	555.3437500	185.1145833	111.94	0.0003

Appendix 42
The SAS System
The GLM Procedure
t Tests (LSD) for liver weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	1.65375
Critical Value of t	2.77645
Least Significant Difference	3.5705

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	35.050	2	1ff
B	16.500	2	2fw
B			
B	15.650	2	4rc
B			
B	15.350	2	3rcaa

Appendix 43
The SAS System
The GLM Procedure

Dependent Variable: gizzard weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	221.5300000	73.8433333	5.77	0.0618
Error	4	51.2100000	12.8025000		
Corrected Total	7	272.7400000			

R-Square	Coeff Var	Root MSE	gizrdwt Mean
0.812239	16.08116	3.578058	22.25000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	221.5300000	73.8433333	5.77	0.0618

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	221.5300000	73.8433333	5.77	0.0618

Appendix 44
The SAS System
The GLM Procedure
t Tests (LSD) for gizzard weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	12.8025
Critical Value of t	2.77645
Least Significant Difference	9.9343

Means with the same letter are not significantly different.

t Grouping		Mean	N	trt
	A	29.000	2	4rc
	A			
	A	25.050	2	1ff
	A			
B	A	19.900	2	3rcaa
B				
B		15.050	2	2fw

Appendix 45
The SAS System

The GLM Procedure

Dependent Variable: oviduct weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	3018.225000	1006.075000	137.40	0.0002
Error	4	29.290000	7.322500		
Corrected Total	7	3047.515000			

R-Square	Coeff Var	Root MSE	oviductwt Mean		
0.990389	10.43785	2.706012	25.92500		

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	3018.225000	1006.075000	137.40	0.0002

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	3018.225000	1006.075000	137.40	0.0002

Appendix 46

The SAS System

The GLM Procedure

t Tests (LSD) for gizzard weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	12.8025
Critical Value of t	2.77645
Least Significant Difference	9.9343

Means with the same letter are not significantly different.

t Grouping		Mean	N	trt
	A	29.000	2	4rc
	A			
	A	25.050	2	1ff
	A			
B	A	19.900	2	3rcaa
B				
B		15.050	2	2fw

Appendix 47

The SAS System

The GLM Procedure

Dependent Variable: oviduct length

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1956.375000	652.125000	226.83	<.0001
Error	4	11.500000	2.875000		
Corrected Total	7	1967.875000			

R-Square	Coeff Var	Root MSE	oviductlngth Mean
0.994156	3.799625	1.695582	44.62500

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	1956.375000	652.125000	226.83	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	1956.375000	652.125000	226.83	<.0001

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The SAS System

The GLM Procedure

t Tests (LSD) for oviduct length

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	2.875
Critical Value of t	2.77645
Least Significant Difference	4.7077

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	70.500	2	1ff
B	40.500	2	3rcaa
B			
B	39.000	2	4rc
C	28.500	2	2fw

Appendix 49

The SAS System

The GLM Procedure

Dependent Variable: spleen weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.31375000	0.10458333	3.64	0.1221
Error	4	0.11500000	0.02875000		
Corrected Total	7	0.42875000			

R-Square	Coeff Var	Root MSE	spleenwt Mean
0.731778	15.24119	0.169558	1.112500

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	0.31375000	0.10458333	3.64	0.1221

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	0.31375000	0.10458333	3.64	0.1221

Appendix 50
The SAS System
The GLM Procedure
t Tests (LSD) for spleen weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.02875
Critical Value of t	2.77645
Least Significant Difference	0.4708

Means with the same letter are not significantly different.

t Grouping		Mean	N	trt
	A	1.4500	2	1ff
	A			
B	A	1.0500	2	3rcaa
B	A			
B	A	1.0000	2	2fw
B				
B		0.9500	2	4rc

Appendix 51
The SAS System
The GLM Procedure

Dependent Variable: percentage heart weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.02683449	0.00894483	9.80	0.0258
Error	4	0.00365229	0.00091307		
Corrected Total	7	0.03048678			

R-Square	Coeff Var	Root MSE	prcntheartwt Mean
0.880201	6.897770	0.030217	0.438071

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	0.02683449	0.00894483	9.80	0.0258

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	0.02683449	0.00894483	9.80	0.0258

Appendix 52
The SAS System
The GLM Procedure
t Tests (LSD) for percentage heart weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.000913
Critical Value of t	2.77645
Least Significant Difference	0.0839

Means with the same letter are not significantly different.

t Grouping		Mean	N	trt
	A	0.50350	2	2fw
	A			
B	A	0.48015	2	1ff
B				
B	C	0.41247	2	3rcaa
	C			
	C	0.35616	2	4rc

Appendix 53
The SAS System

The GLM Procedure

Dependent Variable: percentage liver weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.05176518	0.35058839	18.28	0.0085
Error	4	0.07671507	0.01917877		
Corrected Total	7	1.12848025			

R-Square	Coeff Var	Root MSE	prcntliverwt Mean
0.932019	7.891291	0.138487	1.754940

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	1.05176518	0.35058839	18.28	0.0085

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	1.05176518	0.35058839	18.28	0.0085

Appendix 54

The SAS System

The GLM Procedure

t Tests (LSD) for percentage liver weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.019179
Critical Value of t	2.77645
Least Significant Difference	0.3845

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	2.3699	2	1ff
B	1.6618	2	2fw
B			
B	1.5322	2	4rc
B			
B	1.4559	2	3rcaa

Appendix 55

The SAS System

The GLM Procedure

Dependent Variable: percentage gizzard weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	1.95346370	0.65115457	12.45	0.0170
Error	4	0.20915008	0.05228752		
Corrected Total	7	2.16261377			

R-Square	Coeff Var	Root MSE	prcntgizrdwt Mean
0.903288	11.57119	0.228665	1.976154

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	1.95346370	0.65115457	12.45	0.0170

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	1.95346370	0.65115457	12.45	0.0170

Appendix 56

The SAS System

The GLM Procedure

t Tests (LSD) for percentage gizzard weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.052288
Critical Value of t	2.77645
Least Significant Difference	0.6349

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	2.8016	2	4rc
B	1.8864	2	3rcaa
B			
B	1.6996	2	1ff
B			
B	1.5170	2	2fw

Appendix 57
The SAS System
The GLM Procedure

Dependent Variable: percentage spleen weight

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	0.00006289	0.00002096	0.10	0.9568
Error	4	0.00085135	0.00021284		
Corrected Total	7	0.00091424			

R-Square	Coeff Var	Root MSE	prcntspleenwt Mean
0.068787	14.92311	0.014589	0.097761

Source	DF	Type I SS	Mean Square	F Value	Pr > F
trt	3	0.00006289	0.00002096	0.10	0.9568

Source	DF	Type III SS	Mean Square	F Value	Pr > F
trt	3	0.00006289	0.00002096	0.10	0.9568

Appendix 58
The SAS System
The GLM Procedure
t Tests (LSD) for percentage spleen weight

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	4
Error Mean Square	0.000213
Critical Value of t	2.77645
Least Significant Difference	0.0405

Means with the same letter are not significantly different.

t Grouping	Mean	N	trt
A	0.10084	2	2fw
A			
A	0.09934	2	3rcaa
A			
A	0.09751	2	1ff
A			
A	0.09336	2	4rc

جامعة النجاح الوطنية

كلية الدراسات العليا

تأثير نمط القلش على أداء دجاج البيض

إعداد

حكم أحمد مصطفى البسط

إشراف

د. معن سمارة

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

2011

تأثير نمط القلش على أداء دجاج البيض

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الملخص

تستخدم طريقة التجويع (التصويم) لإحداث القلش في دجاج البيض في المزارع حول العالم . وحديثا بدأ تذمر (خاصة جمعيات الرفق بالحيوان) من أن حرمان الدجاج من غذائه يضر بصحة الحيوان وإنتاجه ويعد ممارسة لا إنسانية .

جاءت هذه الدراسة للبحث في إمكانية استخدام مخلفات زراعية مثل محتويات الكرش لوحدها أو بخليط مع دريس الفصة. تم استخدام 85 من دجاج البيض من سلالة هاي لاين أكملت 60 أسبوعا من عمرها. وتم استخدام لإنجاز هذه الدراسة أربع معاملات على النحو التالي :

في المعاملة الأولى استمرت الطيور في تناول عليقتها كالمعتاد (FF) وفي الثانية أخضعت الطيور للتصويم كما هو متبع في التجارب (FW) أما طيور المجموعة الثالثة فقدم لها محتويات كرش مجففة (RC) وقدم للمجموعة الرابعة من الطيور خليط من محتويات الكرش المجففة ودريس الفصة مناصفتا (RCAA) .

تبين ان الطيور التي حرمت او أعطيت محتويات كرش مجففة أو خليط من محتويات الكرش المجففة مع دريس الفصة، قد فقدت 32.66 , 31.17 , 34.33 % من وزنها على التوالي, في حين أن طيور المعاملة الأولى لم تفقد من وزنها وجاء مفاجئا هو أن أداء الطيور ما بعد القلش لم يختلف بين المعاملات FW, RC, RCAA في حين أن الإنتاج انخفض بشكل ملحوظ لطيور المعاملة الأولى (FF). يستدل من نتائج هذه التجربة أنه يمكن استعمال محتويات كرش مجففه لوحدها او مخلوطة مع دريس الفصة لإجراء عملية القلش الصناعي لدجاج البيض التجاري.