Alternative Use Of Turmeric In Induce Molting On Performance Of Layers.

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ABSTRACT

The purpose of present research was to investigate the impact of various molting methods on performance and health of White leghorn layers. For this purpose, two experiments were conducted on floor system (FS) and cage system (CS). Five hundred and ten birds (68 weeks) were purchased and brought at experimental station. Birds were initially weighed and randomly divided into five treatments 50 in each treatment, each group was consisted on three replications. The first group served as control and was fed on layer diet, while the other treatments were provided low energy feed with turmeric (LEFT), withdrawal feed (WF), low energy feed with aluminum sulphate (LEFA) and low energy feed (LEF), respectively. The production performance, egg quality, hematology, intestinal morphology and economics of the experimental birds were recorded throughout the experimental period. Results obtained revealed that during induced molting period maximum body weight loss was recorded in WF, followed by LEFT, LEFA, LEF and CF groups in both systems. Higher body weight was observed in control and lower in feed restricted method during post molt stage. Feed intake was significantly higher in LEFT group than control diet. Significantly ($P<0.05$) higher egg production was recorded in LEFT group than LEF and CF treatment throughout the production period in cage and floor system. Better feed efficiency was noted in LEFT and poor in Control Feed treatment. Hen house and hen day egg production was significantly ($P<0.05$) higher in LEFT and lower in control group. Hatchability and fertility rate was also higher in LEFT treatment than control feed. Higher mortality rate was observed in feed restricted and lower in LEFT treatment in cage and floor housing system. Egg weight, shell thickness, shell weight and Haugh unit score were significantly ($P<0.05$) increased in turmeric treatment. Non-significant difference was observed among the groups for albumin weight, yolk weight, egg length, egg width and egg pH. Villus height was higher in control feed treatment during induced molting stage. However, intestinal morphology was significantly improved in LEFT group than other treatments and control group during post molting period. T3 and T4 hormone concentration was higher in full feed than other groups. Significantly higher values of T3 hormone was recorded in WF treatment and lower for control feed treatment during molting period. However, maximum T4 hormone level was recorded in WF treatment and lower for CF treatment, respectively at induce molting period. Economics of experimental birds showed that maximum net profit was earned from the LEFT and minimum from control feed treatment. It was concluded from present findings that molting with turmeric method showed better production performance than other treatment techniques.

Key words: Molting, Layer, Egg, Turmeric, Hormones. Economics.

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INTRODUCTION

The Layers are the most productive egg producers on entire the world. The innovative techniques had not been examined to improve energetic potential of hens. In Recent scenario, a hen may be produced annually 280 to 320 eggs (Soomro *et al*., 2015). Mostly Leghorn Hens preferred for commercial egg production due to low height, weight and produce the maximum egg production. Different growing techniques are practiced and organized as modern technologies of molting induction. Force molting is being practiced by the commercial egg industry. Molt Induction may result in loss of production for at least two weeks due to regression and complete rejuvenation of reproductive tracts influencing hormonal changes (Berry, 2003), maximum weight loss (30 to 35 percent) North and Bell, (2003). After a molt, the hen's production rate usually peaks slightly below the previous peak rate and improved egg quality (Hurwitz *et al*., 1998). While, growing age of fowls may accompany with decreases egg production (Cloete *et al*., 2004; 2006). Growing birds may consume more feed than the young birds (Mehta *et al*., 1986). While, Yasmeen *et al*., (2008) reported that there was no effect of oldness on feed consumption, however, feed proficiency was decreases. In molted birds Egg quality was improve with the proceedings age (El-Aggoury *et al*., 1989). The most important among these include manipulation of minerals including sodium, calcium, iodine and zinc, with fully or partially reduced dietary intakes. Several methods/ techniques have been used by researchers such as feed withdrawal, manipulation of feed and mineral supplementation. Minerals are the important for poultry and may use on vide range. Among them Alum is commonly used as mineral salts (potassium aluminum phosphate and ammonium aluminum sulphate). Due to its naturally occurring state, the substance has been used since more than 2,000 years; it has wide variety of applications (McGraw-Hill, 2002). Before the start of the 20th century, it was routinely pretend and used for pickling, canning, tanning leather, and baking. From then on, its use in food processing gradually decreased, due to its side effects and wellbeing concerned. Researcher/ Professionals of various fields in medicine and health care, still regularly used, to treat injuries and disease i.e. reduce swallowing of mucous membranes that result from inflammations of the nasal, gastrointestinal, and urinary passages and stop bleeding etc. (Britannica, 2017). Alum has an Astringent affect, can causes the contraction or shrinkage of tissues and that dry up secretions. Alum has an Astringent affect, can causes the contraction or shrinkage of tissues and that dry up secretions. It may be used in depilatory waxes used for the removal of body hair or applied to freshly waxed skin as a soothing agent (Kanlayavattanakul, and Lourith, 2011). One of the most common ingredient, which is widely used as flavoring agent in south Asian countries, is turmeric commonly called as Huldhe. In Turmeric (curcuma longa), the most active ingredient is Curcumin (diferuloylmethane), a natural polyphenol. It has been common and popular spice in Asian and middle-eastern cuisines since centuries (Chattopadhyay *et al.*, 2004). The Turmeric is extensity used and testified to perform numerous biological activities, like anti-oxidant, anti-inflammatory, (Gandhi *et al.*, 2011), anti-microbial (Araujo and Leon, 2001), anti-diabetic, anti-coagulant, and anti-ulcer (Lokova *et al.*, 2001). It is also being reported to enhance and improve nutrients digestibility, metabolism, and prevent biliary syndromes and anorexia in humans and farm animals (Al-Sultan and Gameel, 2004; Chattopadhyay *et al.*, 2004). Turmeric supplementation stimulates the secretion of bile acids through hepatic veins and activities of lipase, amylase and proteases, which have important roles in metabolism and thus boosted digestion (Platel and Srinivasan, 2000). Turmeric also improves and helps to recover the liver functions and decreases the serum triglycerides, LDL cholesterol and blood glucose levels (Seo *et al.*, 2008; Gandhi *et al.*, 2011). Therefore, this study has been designed to investigate the effectiveness of molting induction in hens. However, no such physical evidence is accessible concern the research on growth and egg production of white leghorn hens. Therefore, assessments the importance of leghorn fowls in our surroundings, the existing research was objected and planned to observe the pre-molting performance of different housing conditions/systems on leghorn layers as the hens will be subject to further objective on induced molting techniques.

Materials and Methods:

One thousand (1000) Hi-sex leghorn hens reared on two conditions i.e. Floor system (500 hens) and Cage system (500 hens) were subjected and brought to Sindh Poultry Vaccine Centre (SPVC), Animal Science Complex, Korangi, Karachi.

Farm Management

Before arrival of birds, shed was initially cleaned, washed, sanitized and finally the house was allowed for one day to dry. Prior to start of experiment, one week of time were set or count as adaptation periods. the house temperature (70^{o}F) and Humidity (65 percent) were maintained in each treatment. Floor space of 1.75 square feet per bird on deep litter system was provided for layers. Feed space of 2.6 inches per bird was given or 10 large tube feeders per 250 birds were provided. One tube feeder for shell grit was provided for every 250 pullets. The hens were provided feed and water *ad libitum*. Rice husk/ wooden dust were used as bedding material and were spread over the floor at 4-6-inch depth. Rice husk used as litter material and purchased from a local rice mill near Gadap, super highway Karachi and exposed to sunlight for 24 hours to entirely dry before insertion/placing in to shed and then spread at floor area up to 4-6-inch depth. Care was taken to sustain optimal humidity and temperature during research trail. To reduce production of lethal/ noxious gases in farm and turning of litter material on regular basis for at least 2-4 times, as practiced for moistening of litter material. Availability of light and ventilation during the experiment was ensured through regular monitoring during research. All the experimental units were maintained in specially remodelled, individual compartments. Each compartment was provided separate feeding and egg collection space for cage system. locally made cages equipped with isolated drinkers were used. These cages were placed in one of the well-ventilated layer houses.The poultry house,cages, and its equipment was cleaned & disinfected with disinfectant solution before placing the hens. The layer house was well-ventilated, reasonable warm in winter and remain cool in summer, and free from drafts. After the adaptation period, birds in all treatmentwere fed initially commercial layer ration (3 weeks) until they reach the age of experiment i.e. 71 weeks. Feed were given *ad Libitum* accordingto NRC (1994)standards and referencesthru by Summers and Leeson (2005).

OBSERVATIONS OF RESEARCH.

Weight gain and weight loss (g):

The experimental layers were weighed carefully by using a sophisticated electronic digital balance. While weight gain and weight loss were determined by using following formulae:

a. Weight gain = Final weight/ initial weight x 100

b. Weight loss = Initial weight/ current weight x 100

Production and egg quality:

a. Eggseparately collected fresh eggs of different housing systems were weighed on a digital balance and then noted the following parameters.

b. Egg and shell weight (g): Each egg was weighed for egg and shell weight on electronic digital balance in grams.

c. Egg shell thickness (mm): The egg shell thickness was measured by using Venire Caliper in millimetres (mm). The egg shell thickness was measured from the equator lines.

d. Egg Mass: Egg mass was Calculated on weekly basis by Following formula: Average egg mass (Per hen per day in grams) = percent of HDEP X Average egg weight in grams

e. Albumin height: Albumin height was recorded through Haugh unit as reported byHaugh (1937).

f. Yolk index: Yolk index was recorded through following formula: Yolk Index = height of yolk / width of yolk

g. Fertility and Hatchability: At the 102 weeks the male mature birds were facilitated for observing the hatchability and fertility of eggs before the termination of the experiment, for that birds were facilitate at the ratio of 1:10 birds for up-to one month’s in all treatment groups. The clean and fertile eggs were stored for seven days at the 4^0Croom temperature. Candling were performed at 3, 7, 11 and on 15 days. For that, the local made incubators (Fanjet) were used and standard protocol were fallowed.

Hormones:

Blood samples of two birds were taken from each replicate during molt and post molt production periods. Samples were stored for diagnostic analysis of T3 and T4 Hormone profile. Radioimmunoassay was performed in the Genesys, (LTI, laboratories Technologies Inc.) machine.

Intestine Villus Height:

The entire small intestinal tract was removed for morphological study. It was cut into 2cm for tissue sample of Small intestine. The tissue sample was preserved in 10 percent formaldehyde for 72 hours, and then processed for dehydration, clearing and embedded in wax. Villus height was measured from tip (with a lamina pro- pria) of villus to the base (villus-crupt junction), and villus width was measured at its middle part; while the crypt depth was measured from villus-crypt junction to the distal limit of the crypt. Eighteen Villi was counted from nine different sections (Duodenum, jejunum and ileum) in each segment of per bird, and the average was expressed as the mean of villus height and villus width for each hen (Rajput *et al.*, 2013). The tissue sections were examined on a Nikon phase contrast microscope coupled with a Microcomputer integrated digital imaging analysis system (Nikon Eclipse 80i, Nikon Co., Tokyo, Japan) and then segments were fixed in 10% formalin then processed:

Data analysis: The Recorded data was collected from all the systems and statistically analyzed for factorial designed and tabulated by using JPM Software of SAS, USA.

RESULTS AND DISCUSSION

Weight gain

Effect of pre, induce and post molting on live body weight of hi-sex white leghorn layer incontrol feed (CF), low energy feed with turmeric (LEFT),withdrawal feed (WF), low energy feed with aluminum sulfate (LEFA), low energy feed (LEF) groups of floor and cage system.

The results of pre-molting stage were not significant ($P>0.05$)in the floor and cage system while the results of induce molting were significantly ($P<0.05$) higher in CF group of floor and cage system. The results of post molting were also significantly ($P<0.05$) higher in CF group of floor and cage system respectively (Table-05).

Egg production

Effect of dietary feeding methods on the egg production during different production stages.Egg production of starting(76th week), peak (88th) and decline phase (100th) were significantly (P<0.05) higher in LEFT group of cage system (Table-08).

The maximum egg production was recorded in cage system for LEFT group. Interaction showed significant difference between the systems and treatments for egg production. In commercial laying hens, it is most commonly referred to as an induced molt because the hens are brought out of egg production simultaneously. This may be seen in weight loss and decline in egg production during the molt stage as well as an increase in feather quality during post molt under both induced-molting systems. That feather status greatly improved under the induced-molting regimes is important because feather loss during the molt and feather replacement post molt often lead to reduced parasitic load (Clayton, 1999) and thus may enhance the long-term health of the hens, indicating that some type of induced-molting regime promotes hen health and, therefore, well-being.

Hen Day Egg Production, Hen House Production, Fertility and Hatchability percentage

Results of hen day egg production (HDEP), hen house egg production (HHEP), fertility and hatchability were observed significant (P<0.05) in floor and cage system. HDEP, fertility and hatchability were observed significantly higher in group LEFT of floor system, while HHEP was higher in LEFT of cage system (Table-11).

Basically, egg production is determined by the rate of ovulation and developing follicles in the ovary, and laying period; Ovulation rate of follicles are determined by deposition of the yolk components into the development follicle, and it depend on the liver function in which most of the components are synthesized. There is an indication that liver function decreases with an increase in age and with an advance in egg production. On the other hands, active ingredient of turmeric modulates and speeds up the process of repair or regeneration of liver cells (Rahardja *et al.* 2015). The physiological responses of hens (weight loss, feather molting, and cessation of egg laying) during traditional molting are used as indicators of molt effectiveness. These responses are considered as important factors for improving the post-molt performance. According to Swanson and Bell, (1974), the post molt egg production should be 70- 75%. North and Bell (1990) reported that molt induction increased the egg production in the post molt period. Similarly, scientists have reported increased egg production in the post molt period (Yousaf, 2004; Yousaf and Ahmad, 2006; Koelkebeck and Anderson, 2007). Peak of post molt egg production in feed withdrawal method is 82% (Hassanabadi, and Kermanshahi, 2007). The peak production of a hen during the second cycle after being molted at 65 weeks is 75 to 85 %, which is equivalent to that of hens in a 40- 50 weeks old flock (Bell, 2003). In our study the birds induced to molt by different methods showed significant ($P<0.05$) improvement in the egg production as compared to the control. Higher egg production was recorded in the hens fed low energy turmeric supplemented feed, which was slightly better than other treatment methods. This might be due to the fact that Turmeric powder supplementation in laying quail improved liver function, which is particularly attributed with total number of liver cell per weight of tissue, and therefore the total capacity of the liver tissue to synthesize the substrates for yolk deposition (Saraswati *et al.*, 2013); These results were supported by increasing vitellogenin synthesis by the liver cells as a precursor for egg yolk deposition in the developing follicle, secreted into the blood. It could be attributed with increasing processes folliculogenesis and ovogenesis then resulted in increasing amount of the developing follicles in the ovary, which reflected in increasing egg production performance. The decreased cholesterol content in the egg produced by old laying hen fed dietary turmeric powder, in part, might be due to the increased number of developing follicles. With the greater number of developing follicles, cholesterol and fat as the main component of the yolk will be distributed to a greater number of growing follicles, so that the content of cholesterol and fat in each egg will be lower (Rahardja *et al.*, 2015). However, hen-day egg production during post-molt period was not significantly different among the treated groups. It is well known that egg production decreases as the age of the laying hen increases. In commercial laying hens, molting is induced to cause cessation of egg production and to extend the productive life of the hen. The productive egg-laying life of hens can be extended from 80 to 110 weeks or even 140 weeks, through the use of induced molting (Bell, 2003). Induced molting leads to the involution of reproductive tract, which is proportional to the loss of body weight and the rebuilding of the reproductive tract which lead to the removal of fat accumulation and therefore increased tissue efficiency. Bar *et al.* (2001) reported that egg production of the molted Lohmann hens was higher than that of the non-molted laying hens at the ages of 54, 57, and 60 weeks. Moore and Holt (2006) reported that induced molting rejuvenates the reproductive tract and stimulates hens at the end of a laying cycle to enter a new cycle of egg production. However, a complete and sustained regression of the oviduct along with a 25 to 30% loss of Body Weight is required to optimize second cycle egg production. Faitarone *et al.* (2008) observed higher productivity following a treatment of 3 days of fasting and then *ad libitum* feeding which may be explained by the use of feed after fasting, allowing rapid body weight recovery, better development of the reproductive tract, and faster return of egg production. The increase of egg production after force molting mainly due to the rest-period which resulted in recycling and rejuvenating of the molted hens for another season of egg production (El-Gendi *et al.*, 2009). Hassanabadi and Kermanshahi (2007) reported that hens in feed withdrawal method and Zn group, laid eggs at the almost same rate during the peak of post-molt production. Their result could be due to the fact that hens in Zn group stayed out of production for a longer period of time (21 day) than hens in Feed Withdrawal group (9 day). Additionally, the non-fasting molting programs have not proven to reduce stress and improve laying hen well-being compared to feed withdrawal (Biggs *et al.*, 2004). Alodan and Mashaly, (1999) recommended that hens improve their egg production due the rejuvenation of the productive organs and overall body weight loss after the molting period. Biggs *et al.*(2003) reported post molt egg production was significantly higher for 10 day feed withdrawal and wheat middling diets compared to the 4 day feed withdrawal and corn diets. The results show that the traditional feed withdrawal method is more effective at inducing molt than the LEFT, LEFA, LEF and control diets. These differences may be related to the length of rest or ovarian/oviduct regression obtained during the molt period. This result is similar to the results of Onbaşılar *et al.* (2007) who reported that post-molt egg production was not significantly different among groups molted by feed withdrawal, Zn and whole grain-barley diet methods in comparison of control. Similar results were obtained by Park *et al.* (2004) who found that there were no significant differences among groups molted by feed withdrawal, Zn acetate and Zn propionate in terms of post-molt egg production. However, Alodan and Mashaly (1999) reported that egg production was significantly affected by the molting program (Zn, CAL, and on-again, off-again), and the Zn group had significantly (P<0.05) lower egg production than the CAL and ON OFF treatments. A significant increase in egg weight, shell thickness and Haugh unit was recorded in all molted birds. The birds molted by feeding low energy turmeric supplemented diet showed maximum increase in the egg weight (Table 11). The increase in egg weight may be due to efficient utilization of feed by the birds. In general, egg size is larger during the second cycle than during the first cycle (North and Bell 1990). Previous studies reported that egg weight in post-molt period was not significantly affected by molting treatments in laying hens (Biggs *et al.,* 2004, Petek and Alpay 2008). Petek and Alpay (2008) illustrated that post-molt mean egg weight in the molting groups was much higher than in non-molt control hens. Faitarone *et al.* (2008) studied the effect of molting on egg weight and egg mass. They reported that egg weight in treatment of 3 days of fasting and restricted feeding was higher as compared to treatments of 3 days of fasting and *ad libitum* feeding and treatment of 1 day of fasting and restricted feeding. Hassanabadi and Kermanshahi (2007) indicated that egg weight at the peak of post-molting production was not significantly different between the molted hens. Biggs *et al.* (2003) reported the effects of molt on egg weight. The hens on a 10 day feed withdrawal had significantly lighter post-molt eggs compared to the hens treated with a 4 day feed withdrawal or low-energy corn diet. Contradictory to our findings, Alodan and Mashaly (1999) found that different induced molting programs (Zn, Ca, and restricted feed) had no effect on egg weight. Contradictory finding regarding molting methods have been reported might be due to different layer breeds or housing conditions. The egg mass was significantly lower for the hens fed the corn diet and the 4 day feed withdrawal compared to both the 10 day feed withdrawal and the hens fed the low energy wheat middling diet, due to lower egg production levels. Egg shell thickness, an indication of shell quality, has shown to be similar between different types of molt induction regimens. Mazzuco and Hester, (2005). Although egg shell quality was lower in feed withdrawal birds during the molting period, which is likely related to the severe restriction in calcium intake for these birds (Al-Batshan *et al.*, 1994). While, shell quality was higher in turmeric supplemented birds due to better utilization of feed. The molt induction significantly improved shell thickness which enabled the hens to produce more number of eggs with better shells by rejuvenating the reproductive system (Wilson *et al.*, 1979). According to Heryanto *et al.*, (1997) it was suggested that during forced rest to the old glandular cells with new ones that are derived from the mucosal epithelium and un-involute glandular cells. Such rejuvenation of shell gland tissue may lead the improvement of calcium binding protein- D28 K induction which in turn is correlated with the increase in egg shell thickness. Induced molting cause improvement in the specific gravity, shell thickness, shell percent and smoothness of shell in layers and broiler breeders (Roland and Bushong, 1979; Roland and Brake, 1982). Calcium deposition into egg shells is important from an economic perspective for commercial laying hens, during the post-molt period, shell thickness was improved for feed withdrawal birds as compared other group. This may be related to a faster cessation of egg lay, and thus more time for calcium repletion of bones. The shell gland has an important function in egg production, specifically plumping (addition of water to the egg), shell formation and oviposition. The surface epithelial lining of the shell gland has a role in calcium secretion (Solomon *et al.*, 1975). Garlich and Parkhurust (1982) reported that the incidence of poor shell eggs was markedly reduced when oyster shell was available to the hens during the feed withdrawal period. Other studies have shown that shell quality post molt did not differ between fasted and nonfasted molting systems. An induction of molt of 63-wk-old hens by feed deprivation for 2 week or 30% Body weight loss caused duodenal Ca uptake to increase after molt with a concurrent increase in percent shell and eggshell thickness (Al-Batshan *et al.*, 1994). The presence of supplemental calcium during fasting also reduced the rate of decline in shell weight, percent shell and breaking strength during the first 3 days of initial fasting period. Zimmerman *et al.* (1987) reported that shell weight of eggs is improved only after molting. Faitarone *et al.* (2008) found that feed restriction during post-fasting period did not significantly affect egg production or eggshell quality. Faitarone *et al.*, (2008) observed higher productivity in days of fasting and *ad libitum* feeding compared to full feeding may be explained using feed after fasting, allowing rapid body weight recovery, better development of the reproductive tract, and faster return of egg production. The results obtained by Berry and Brake, (1991) demonstrated that induced molting, whether by fast or chemical supplemented methods, significantly increased the amount of calcium binding protein–D28K present in the egg shell gland and duodenum of aging hens. They added that egg shell quality, as measured by egg shell density and weight on the 10th egg, paralleled the increase in shell gland and duodenal calbindin. Haugh unit of albumen increases with the induced molting (Attia, *et al.*, 1994). The improvement of Haugh unit after molting may be due to rejuvenation of laying hen reproductive organs, as well as in broiler breeders (Khan *et al.*, 2011). The effect of molting to cause higher Haugh score unit of eggs has reflected by the formation of more intense thick while clearly indicates that the magnum portion of such hens became highly active and secrete more protein for consolidation of thick white. This is in conformation with the results of Zimmermann *et al.* (1987) and Bougon *et al.* (1989) who reported improved albumen quality in molted birds. These results are in agreement with those obtained by Park *et al.* (2004) who found that there were no significant differences for egg quality traits among feed withdrawal, Zn acetate and Zn propionate molt treatments. Onbaşılar *et al*. (2007) also reported that egg quality traits were not significantly different among chemically molted hens. Egg quality is also affected by molt with post-molt egg quality improving compared to pre-molt levels. No significant differences among treatments was recorded for egg fertility and hatchability. Similar results were found by Abd El-Kader (1997) who reported that the different treatments of force molting resulted in non-significant values of fertility and hatchability percentages and had significantly different values when compared to the control. Reddy *et al.* (2008) found that no significant difference in fertility due to different force molting methods in broiler breeder hens. Also, Ibrahim (1998) found that all force molting treatments had significantly improved hatchability percentages, but feed withdrawal treatment recorded the better hatchability percentage. Fattouh (2001) found that hatchability of Muscovy duck eggs was improved 3.2 and 5.1% by force molting either through fasting or Zinc treatments than the control. Owings and Sell (1980) reported higher hatchability for eggs laid by restricted fed turkey hens. Venkata *et al.,* (2008) showed that the mean values of fertility during the last periods of experiment were 87.76, 89.76 and 88.04% for control, Zinc oxide and feed withdrawal groups, respectively in Cornish. Gerry (1979) observed no improvement in fertility and over control birds when broiler males and female's parents were force molting using several methods. The post-molt feed intake of the molted hens was higher than that of the non-molted hens. This may be due to the higher rate of egg production and rapid increase in bodyweight in the hens of the molted groups. From the observation, it was evident that the control layers continued to lay eggs at a similar production level. The results of the present study confirm earlier findings (Hurwitz, *et al.*, 1998) that induced molting results in increased egg production and improved shell quality and decreased egg breakage, mortality, and culling. Egg production ceases during molt and can increase dramatically following molt. Biggs *et al.* (2003) suggested the difference in production may be from effects of novelty or palatability causing the hens to consume less, which lowered egg production.

Egg Quality

Effect of dietary treatments on egg weight, shell weight, egg length, shell thickness and Haugh unit was significant(P<0.05) in cage and floor system, while egg mass, albumin weight, yolk weight, egg width, yolk index, egg pH was not significant (P>0.05).Egg weight, shell weight, egg length, shell thicknesswas observed higher in LEFT group of cage system, while Haugh unit was observed higher in LEFT group of floor system (Table-14).

Tri-iodothyronine (T3) and Thyroxin (T4) Hormone Concentration:

Serum Tri-iodothyronine(T3) and Thyroxin (T4) concentration was measured during pre, induce and post molt periods for the birds kept on floor system and cage system. The results of T3 were significant (P<0.05) for pre, induce and post molting periods. The results of T4 were significant (P<0.05) for pre and post molting period while not significant (P>0.05) for induce molting period. The concentration of T3 for pre, induce and post molting period was higher in the CF group of cage system while concentration of T4 for pre and post molting period was higher in NF of cage system (Table-17).

Davis et al. (2000) reported that plasma T3 and T4 concentration varied regarding the age and egg production cycle of the hens. Williamson *et al.* (1985) indicated that T3 is the major biologically active product of the thyroid and it is actually the main thyroid hormone related to the changes in the metabolic rate. Hassan (1996) observed that T3 hormone levels were consistently lower throughout the molting until the lowest level in the rested hens than the control. Levels of T3 in rested hens were decreased during the starvation period from 4-7 days followed by an increase over the pre-molt level after the resumption of feeding from 7-25 days then declined slightly until peak. Brake *et al.* (1979) stated that T3 levels did not differ significantly from initial levels during the starvation period but were increased significantly upon the resumption of feeding. They declared that the increase in T3 144 corresponded in time with the initiation of feather loss and a decrease in ovary weight also preceded increase in T3 after day 11 occurred concomitantly with the initiation of feather loss. This loss of insulation may have initiated a thermoregulatory response. El-Damarawwy (2003) revealed that plasma T3 and T4 were not significantly affected due to the fasting regimen applied. However, inhibition of induction of ovulation during the cessation of egg laying or at the beginning of the second production year, are all concerned with interactions of the same hormones upon the hypothalamo-hypophyseal-ovarian axis. According to Brake *et al.* (1979) they reported that T3 was the primary mediator of thyroid action during the period of feather loss. They reported also that plasma T4 initially decreased upon removal of feed, but increased above control levels by the sixth day of feed withdrawal. T3 levels remained relatively constant throughout the feed withdrawal period. The initial decrease in T4 may represent decreased output of T4 from the thyroid or an increased peripheral metabolism of the hormone associated with fasting in the sexually mature hen. The initial decrease in T4 was followed by an increase in T4, and this was found to be coincident with a loss of ovarian weight and presumably function. Davis *et al.* (2000) claimed that an increase in circulating T4 may be probably an important physiological factor for the initiation of molting because exogenous T4 administration has been observed to cause molting in laying chickens. In addition, the post-molt period is a time of regrowth and regeneration of the reproductive tract and feather. Thus, elevated T4 may be related to the metabolic effects that are required for regrowth and regeneration. Ryoko *et al.* (2004) reported that the peak of the plasma 145 concentrations of T4 coincide with the molt. They suggested that T4 is more important for feather growth and molting. Their study showed that the changes in plasma concentrations of both T4 and T3 correlated with molting but the absolute values of T4 were higher than those of T3. Although the exact role of the thyroid hormone still remains unsolved in molting, a rapid increase of T4 may be responsible for the start of molting as a trigger and maintenance of molting.

Intestinal Morphology:

Effect of various methods of molting on Intestine Villi height on floor and cage system. The result revealed that villi height was significant ($P>0.05$) in pre, induce and post molting phase. The villi height of pre-molting was significantly higher in LEFT group of floor system. The villi height of induce molting phase was significantly higher in CF of floor system. The villi height of post molting phase was higher in LEFA of floor system.

Conclusions: Constructed conclusions of this research, reviewed that the productivity performance were enhanced in floor system fowls throughout the research with improved health and welfare instead of cage system. Better egg production, body weight and dressing fractions were recorded in cage system.

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Table No. 01: FORMULATION OF EXPERIMENTAL RATION:

S.No	Feed Ingredient	Average gram per kg
1	Bone Meal	0.0123
2	Lime Stone	0.1245
3	Rapeseed Meal	0.0200
4	Canola / M	0.1253
5	A.P.C	0.0300
6	Corn	0.075
7	C.C feed	0.0300
8	Guar Meal	0.0300
9	Soyaben Meal	5400.00
10	Rice Polish	0.1662
11	Rice	4.3655
12	Molasses	0.0200
13	Soda bi Carb	0.0012
14	Salt	0.005
15	Lysine Sulphate	0.0035
16	D. L. M.	0.475
17	Jawari	0.001
18	Fish Meal	5.000
19	Coconut Cake	0.0705
20	Sunflower Meal	15
22	Wheat	8.35
23	Cottonseed Meal	0.003
24	Cotton . Gluten 60%	0.500
25	L. Lysine	0.6
26	Crude Protein (CP)	14%
27	Moisture	9.122
28	Energy (ME)	2485 kcal/g
29	Crude Fiber (CF)	6.6
30	Ash	15.609
31	Ether extract	3.6437

Table-2: Interaction of various methods of molting on different systems on live body weight of Hi-sex white leghorn layers (g/b)

Phase	System										P Value			
	Floor					Cage					SE	system	treatment	interaction
	CF	LEFT	WF	LEFA	LEF	CF	LEFT	WF	LEFA	LEF				
Pre-molting	1952.67	1954.00	1953.33	1955.33	1951.67	1952.32	1951.21	1952.00	1951.37	1951.83	2.501	0.4093	0.9795	0.9993
Induced-molt	1850.00^{a}	1514.04^{c}	1407.23^{b}	1536.17^{d}	1632.67^{e}	1847.67^{a}	1521.00^{d}	1452.67^{g}	1554.23^{d}	1629.86^{e}	1.776	0.021	0.001	0.001
Post-molt	2038.60^{b}	1973.80^{j}	1951.39^{i}	1941.87^{f}	1928.40^{g}	2093.37^{a}	2036.33^{b}	1939.63^{h}	2017.67^{d}	1998.30^{e}	1.202	0.026	0.015	0.018

abc with different super script showed significant ($P<0.05$) difference. CF = Control Feed, LEFT = Low energy Feed with Turmeric, WF = withdrawal Feed, LEFA = Low energy Feed with Aluminum sulphate, LEF = Low energy Feed.

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Table–3: Effect of various methods of molting on Egg production of different housing systems of Hi-sex white leghorn layers.

Phase / Variables	SYSTEM										P Value			
	Floor					Cage					SE	System	Treatment	Interaction
	CF	LEFT	NF	LEFA	LEF	CF	LEFT	NF	LEFA	LEF				
Start (76th)	16.90^{d}	22.00^{c}	12.20^{f}	12.06^{f}	10.90^{g}	8.10^{h}	28.70^{a}	13.60^{e}	24.77^{b}	11.10^{g}	0.158	0.017	0.0001	0.001
Peak (88th week)	54.40^{f}	88.63^{c}	87.00^{d}	82.70^{c}	55.46^{f}	58.10^{e}	90.30^{a}	88.60^{c}	84.00^{b}	82.80^{d}	0.363	0.034	0.001	0.019
Decline (100th week)	45.60^{g}	71.40^{b}	68.60^{d}	66.80^{c}	50.20^{f}	39.40^{i}	69.97^{a}	66.37^{e}	63.50^{d}	42.80^{h}	0.388	0.026	0.014	0.042

abc with different super script showed significant ($P<0.05$) difference. CF = Control Feed, LEFT = Low energy Feed with Turmeric, WF = withdrawal Feed, LEFA = Low energy Feed with Aluminum sulphate, LEF = Low energy Feed.

Table-4: Effect of various methods of molting on Hen Day Egg Percentage (HDEP), Hen House Production (HHEP) fertility and hatchability percentage of Hi-sex white leghorn layers on floor and cage system

Variables	SYSTEM										P Value			
	Floor					Cage					SE	System	Treatment	Interaction
	CF	LEFT	NF	LEFA	LEF	CF	LEFT	NF	LEFA	LEF				
HDEP (%)	55.37^{h}	82.50^{a}	72.10^{e}	77.3^{d}	68.80^{f}	52.87^{i}	81.40^{b}	68.94^{g}	79.10^{c}	67.20^{g}	0.290	0.036	0.001	0.050
HHEP (%)	50.89^{i}	77.54^{b}	70.23^{e}	73.3^{c}	67^{f}	49.7^{j}	78.02^{a}	66.98^{h}	72.50^{d}	61.60^{g}	0.148	0.018	0.014	0.003
Fertility (%)	84^{d}	92^{a}	88^{bc}	89^{ab}	86^{cd}	80^{d}	92^{a}	88^{bc}	88^{bc}	84^{d}	1.060	0.247	0.029	0.062
Hatchability (%)	80^{c}	90^{a}	83^{bc}	88^{a}	82^{bc}	78^{c}	90^{a}	84^{b}	84^{b}	81^{c}	0.806	0.132	0.028	0.085

abc with different super script showed significant (P<0.05) difference. CF = Control Feed, LEFT = Low energy Feed with Turmeric, WF = withdrawal Feed, LEFA = Low energy Feed with Aluminum sulphate, LEF = Low energy Feed.

Table– 5: Effect of various methods molting on Egg quality of Hi-Sex White Leghorn Layer.

Item	Phases										p value			
	FLOOR					CAGE					SE	System	Treatment	Interaction
	CF	LEFT	NF	LEFA	LEF	CF	LEFT	NF	LEFA	LEF				
Egg weight	55.08^{d}	58.84^{ab}	56.21^{b}	56.9^{bc}	56.02^{c}	57.08^{b}	60.02^{a}	58.04^{ab}	57.44^{ab}	57.87^{ab}	1.200	0.0248	0.0154	0.037
Egg mass	49.10	48.60	47.80	49.20	48.70	47.99	50.08	48.45	49.38	49.95	1.190	0.1139	0.3190	0.410
Shell weight	7.44^{e}	7.57^{c}	7.47^{d}	7.54^{bcd}	7.49^{cd}	7.79^{b}	8.06^{a}	7.86^{ab}	8.01^{a}	7.93^{ab}	0.075	0.015	0.001	0.028
Albumin weight	33.22	33.07	32.83	33.37	33.04	33.17	34.02	33.02	33.72	34.50	0.751	0.0934	0.3620	0.455
Yolk weight	15.61	15.63	15.58	15.61	15.59	15.57	15.68	15.53	15.63	15.59	0.124	0.3746	0.0084	0.411
Egg length	5.37^{b}	5.41^{ab}	5.34^{bc}	5.39^{ab}	5.38^{ab}	5.40^{ab}	5.43^{a}	5.38^{ab}	5.33^{c}	5.35^{bc}	0.120	0.033	0.075	0.048
Egg width	4.03	4.07	4.10	4.0	4.02	4.03	4.09	4.13	4.05	4.06	0.024	0.2202	0.082	0.068
Shell thickness	0.10^{d}	0.18^{a}	0.13^{bc}	0.16^{ab}	0.12^{c}	0.14^{b}	0.17^{ab}	0.12^{c}	0.15^{ab}	0.14^{b}	0.011	0.0465	0.013	0.035
Yolk index	0.14	0.18	0.15	0.17	0.15	0.16	0.17	0.13	0.19	0.15	0.108	0.0890	0.082	0.097
Haugh unit	51.16^{c}	57.77^{a}	49.25^{cd}	54.73^{b}	52.58^{bc}	48.24	52.51^{bc}	47.28^{d}	51.33^{bc}	49.57^{cd}	1.290	0.048	0.010	0.031
Egg pH	7.60	7.70	7.60	7.70	7.80	7.60	7.80	7.60	7.70	7.70	0.577	0.2554	0.1219	0.251

abc with different super script showed significant ($P<0.05$) difference. CF = Control Feed, LEFT = Low energy Feed with Turmeric, WF = withdrawal Feed, LEFA = Low energy Feed with Aluminum sulphate, LEF = Low energy Feed

Table–6:Effect of various methods of molting on T3 and T4 of Hi-sex white leghorn layers.

Parameters	Phases										p value			
	FLOOR					CAGE					SE	system	treatment	interaction
	CF	LEFT	NF	LEFA	LEF	CF	LEFT	NF	LEFA	LEF				
Pre- molting	202.33^{bc}	178.50^{cd}	216.50^{ab}	214.67^{ab}	201.83^{bc}	242.00^{a}	158.00^{d}	180.50^{cd}	185.50^{bcd}	190.17^{bcd}	11.887	0.1313	0.0014	0.0206
Induced molting	278.17^{a}	262.17^{abc}	265.00^{ab}	250.83^{bc}	247.17^{c}	268.83^{a}	267.00^{ab}	250.67^{bc}	263.00^{abc}	267.83^{ab}	6.127	0.4733	0.0412	0.0339
Post molting	202.00^{bc}	202.00^{cd}	202.00^{ab}	215.67^{ab}	203.17^{bc}	243.50^{a}	159.17^{d}	181.50^{cd}	186.50^{bcd}	191.33^{bcd}	11.998	0.1739	0.0013	0.0199

Parameters	Phases										p value			
	FLOOR					CAGE					SE	system	treatment	interaction
	CF	LEFT	NF	LEFA	LEF	CF	LEFT	NF	LEFA	LEF				
Pre-molting	0.70^{a}	0.82^{b}	0.69^{b}	0.73^{ab}	0.85^{ab}	0.78^{ab}	1.03^{a}	0.85^{ab}	0.85^{ab}	0.79^{ab}	0.1094	0.1456	0.5305	0.8015
Induced molting	1.05	0.93	0.89	0.85	0.85	1.01	1.04	1.04	0.97	0.97	0.0931	0.4027	0.5032	0.8695
Post molting	0.69^{b}	0.83^{a}	0.83^{b}	0.70^{b}	0.81^{ab}	0.77^{ab}	0.77^{b}	0.77^{ab}	0.84^{ab}	0.80^{ab}	0.1118	0.1198	0.4551	0.8919

Table–7:Effect of various methods of molting on Intestine Villi height (um) in Hi-sex white leghorn layers.

Parameters	Phases										p value			
	FLOOR					CAGE					SE	system	treatment	interaction
	CF	LEFT	NF	LEFA	LEF	CF	LEFT	NF	LEFA	LEF				
Pre- molting	1613.33[c]	1683.33[a]	1631.67[c]	1618.33[c]	1633.33[c]	1641.67[bc]	1676.67[ab]	1676.67[ab]	1608.33[c]	1616.67[c]	13.427	0.3574	0.0005	0.1285
Induced molting	1671.67[a]	830.00[d]	733.33[e]	930.00[c]	1233.33[b]	1661.67[a]	820.00[d]	720.00[e]	930.00[c]	1203.33[b]	11.055	0.0851	<.0001	0.7456
Post molting	1713.33[cd]	1783.33[b]	1798.33[ab]	1818.33[a]	1733.33[c]	1708.33[d]	1776.67[b]	1776.67[b]	1808.33[a]	1716.67[cd]	7.976	0.0274	<.0001	0.8157

abc with different super script showed significant (P<0.05) difference. CF = Control Feed, LEFT = Low energy Feed with Turmeric, WF = withdrawal Feed, LEFA = Low energy Feed with Aluminum sulphate, LEF = Low energy Feed.