Egypt. Poult. Sci. Vol. (39) (IV): (913-934) (2019) (1911-1056)

Egyptian Poultry Science Journal

http://www.epsj.journals.ekb.eg/

ISSN: 1110-5623 (Print) – 2090-0570 (Online)

EFFECTS OF LATE FEED RESTRICTION ON GROWTH PERFORMANCE AND INTESTINAL VILLI PARAMETERS OF BROILER CHICKS UNDER SUMMER CONDITIONS

H. M.M. Azouz, S.S. Gadelrab, H.M.EL-Komy

Anim. Prod. Res.ins., agric. Res. center, Giza, Egypt.

Corresponding author: H. M.M. Azouz Email: azouz-h2010@hotmail.com

Received: 16/11/2019 Accepted: 11 /12/2019

ABSTRACT: The aim of that study was to investigate the effects of late feed restriction at finisher stage or 12 hours feed withdrawal combined with feed restriction (FR) on growth performance, carcass traits, intestinal villi histo-morphometry and economic efficiency in chicks reared under summer conditions for 42 days were evaluated. A total number of 240 unsexed one day-old Ross 308 broiler chickens were randomly allocated to eight dietary treatments. Chickens fed *ad libitum* during starter and grower stage, after that two feeding regimes were applied during finisher stage (29 – 42 d); the first regime were providing feed *ad libitum*, 90 %, 80 % and 70 % of *ad libitum* feed for treatments T_1 (control), T_2, T_3 and T_4, respectively, the second compromised 12 hours feed withdrawal (fasting) associated with FR which T_5 (100 %), T_6 (90 %), T_7 (80 %) and T_8 (70 %). Live body weight did not differ significantly at 2 and 4 week of age or at final live body weight. LBW and BWG at 4 – 6 week of age of broilers subjected to 12 hours feed withdrawal comes before late feed restriction (100, 90, 80 and 70 %) were greater than the counterpart treatments. There were significant differences in feed intake and FCR during finisher period and the entire the experimental period between chicks given restricted diets and the control. Significant differences were recorded in the percentage of carcass, total edible parts and abdominal fat. An inverse relationship was seen between FR and abdominal fat deposition. There were no mortalities during experimental periods. Restricted fed groups scored highest villus and depth crypts and the lower production cost. It can be concluded that birds fed on restricted diets (70 %) and feed withdrawal 12 hours before feed restriction at finisher period gave the best FCR and less expensive in production.

Keyword: broiler, feed restriction ,growth performance, Carcass , villus and crypts.

INTRODUCTION

The high cost of feed in poultry production is well established. Generally, feed represents of 65-75% of cost of production. This high proportion is due to the type and quality of feed ingredients in the feed, several of which are foods utilized by man and therefore expensive.

Mark *et al.* (2002) stated that modern commercial broiler is the product of intensive selection over many generations for rapid growth and enhanced muscle mass. Selection for these economically important traits has been accompanied by an increase in voluntary feed intake, resulting in birds that do not adequately regulate feed intake to achieve energy balance. Thus, broiler chickens are prone to obesity resulting from hyperphagia when given free access to feed.

Increasing cost of feeding and early fat deposit are few of the problems of poultry farmers (Smith, 1990). It is generally assumed that when birds eat more, they have higher body weight at market age (Urdaneta-Rincon and Leeson, 2002). Feeding strategies in growing broiler chickens should be aimed at optimizing lean carcass tissue, feed conversion ratio and body weight gain (Gous and Cherry, 2004; and Teimouri *et al.,* 2005).

Feed restriction is a conventional strategy employed in modern broiler breeder industry to lessen fat accretion and avoid reproduction and health complications (Savory *et al.,* 1993) but not in modern broiler meat industry where feeding is *ad libitum*. However, *ad libitum* feeding has been implicated in health problems (Crouch, 2000; Saleh *et al.,* 2005; and Rezaei *et al.,* 2006). Feed restriction has been adopted to avoid rapid growth rate, which is associated with ascites, lameness, mortality, and poor reproductive results (Mench, 2002; and Tolkamp *et al.,* 2005). In addition, FR in the early stage is beneficial for improving the feed efficiency and decreasing the breeding cost (Zubair and Leeson, 1994).Nevertheless, negative effects of FR include chronic hunger (Savory *et al.,* 1993), boredom and feeding frustration (Savory and Kostal, 1993) increased aggression (Mench, 1998) ; over drinking (Hocking *et al.,* 1996) and the expression of these behaviors is positively correlated with the level of restriction imposed (Savory and Maros, 1993). Negative physiological effects include adrenal hypertrophy and persistent increase in corticosterone secretion after 24 h restriction or feed-off days (Mench, 1991) or increased susceptibility to *Staphylococcus aureus* after 48 h (Gross and Siegel, 1982).Nutrient restriction is usually employed to tackle problems that accompany early-life fast growth rate in broilers. Also, can be used to modify birds growth pattern by decreasing their maintenance requirements, which should improve feed efficiency (Urdaneta-Rincon and Leeson, 2002). Excessive fat deposition is one of the main problems faced by the broiler industry these days, since it does not only reduce carcass yield and feed efficiency but also causes rejection of the meat by consumers (Kessler *et al*., 2000) and causes difficulties in processing (Chambers, 1990). Recent reports on feed restriction during the growing period in broiler chickens indicate that restricting feed intake lowers body weight and carcass fat and improves feed efficiency (Al-Taleb, 2003).

Certainly, any feed restriction program will have to consider age effects. Mench (2002) indicated that the effects of feed restriction would be more severe in young birds due to high metabolic requirements resulting from rapid growth at this stage. Marks (1979) found that the main increase in growth rate manifests primarily in the first four weeks after hatching; and Ghazanfari *et al.* (2010) recommended full feeding of broiler breeder chicks for several weeks before any restriction program for adequate frame size, vigorous growth and uniform flock body weight. Leeson *et al.* (1992) studied the response of 35- to 49-day-old male broilers to either 10, 20, 30, 40, or 50% less of this diet to 49 days of age. There was a linear relationship between nutrient intake and body weight and weight gain. Also, Sahraei and Hadloo (2012) reported that during finisher periods from 36 to 45 day old, feed restriction in 10 % less than *ad libitum* has any adverse effect on broiler chickens performance and carcass traits, while at level 20 % carcass weight were lower than control birds ($p<0.01$).

Therefore, this study aimed at identifying the duration and level of restriction that will be bring the healthy carcass tissue, improved feed efficiency and cost benefits in broiler production. The expectation is to provide broiler meat producers with information that may enable flexibility in decision-making regarding feeding strategy in times of feed shortages or high cost of feed.

MATERIALS AND METHODS

The present study was carried out at the poultry production department of Al-Shaer Island Farm, Qanatr, Production Sector, and Ministry Of Agriculture, from 20 June to 31 July.

Birds and management:

Two hundred and forty, one-day old unsexed Ross 308 broiler chicks were wing- banded, weighted individually and sorted into similar body weights. Chicks were allocated to eight experimental groups; each group consists of three replicates (10 chicks/ replicate). All experimental chicks were brooded and raised in three tiers, wire floor battery cages in a closed broiler house, under the same managerial and hygienic conditions. The initial interior temperature was about 32 ^{o}C during the first week. The temperature values (36 - 40^{o}) and the relative humidity percentages (65 – 75 %) were daily recorded by using a thermo-hygrograph. The artificial light was provided for completing 24 lighting hours daily throw the experimental period, which lasted for 6 weeks. All chicks have undergone all the vaccinations recommended in the farm preventive program. Diets were weekly mixed. Feed and water *ad-libitum* during the starter and grower periods (1 – 14 d, and 15 – 28 d old). Feed restriction is done on the finisher period from 29 – 42 d old.

Experimental Diets and Treatments:

A basal diet was formulated to meet the nutrient requirements according to the nutritional recommendation of Ross 308 strain, The starter diet was used from 0–14 d which contained 23 % crude protein and 3000 kcal ME/kg diet, followed by grower diet from 15- 28 d which contained 21.5 % crude protein and 3100 kcal ME/kg diet . The finisher diet was used from 29 d till the end of the study ,which contained 19.5 % crude protein and 3200 kcal ME/kg diet. The diets composition and its chemical analysis are shown in (Table 1).

Eight dietary treatments were made using basal diet:

1 – Basal diet 100% (control).
2 – Feed restriction 90 .
3 – Feed restriction 80 %.
4 – Feed restriction 70 %.

5 –control preceded by 12 hours feed withdrawal (WD).
6 – Feed restriction 90 % plus WD.
7 – Feed restriction 80 % with WD.
8 – Feed restriction 70 % further WD.

The average feed intake for the control was determined every three days, from which the value of the dietary restriction of the rest treatments is calculated every three days also.

Growth performance:

Birds' individual body weight (BW) and pen feed consumption were weekly written down. Also, mortality was daily observed. Body weight gains (BWG), average feed consumption (DFC) and feed conversion ratio (FCR) were scored and calculated.

Carcass criteria and intestinal histology:

At the end of the experiment at 42 days of age, three birds were chosen from each group to be near the average body weight, fasted for eight hours nearly. Selected birds were individually weighed and slaughtered to complete bleeding. Slaughtered birds were used to evaluate carcass characteristics, weight of each eviscerated carcass, edible parts like liver, heart and empty gizzard, were recorded. The abdominal fat was gently removed and weighed and calculated as percentage of live body weight. The dressing percentage was calculated, by dividing the carcass and giblets weights by the pre slaughter live body weight of birds. Also, part of the ileum has been taken 10 cm long for the histological examination of the intestine villus and crypts.

Economic efficiency percentage (EEf) and Performance index (PI):

The economic evaluation of the end product was based on the difference between growth rate and feeding cost. The economic efficiency traits were calculated according to North (1981) in relation to the price of local market at the exact time of the experiment.

Statistical analysis:

The data were statistically analyzed using General Linear Model (GLM) Procedure of SAS software version 9.1, 2005, as the following model:

$Yijk = u + Ti + Eijk$ Where $Yijk$ = Observed trait, u = the overall means, Ti = the effect of treatment, $Eijk$ = Random error. The differences between experimental groups were tested for significant by Duncan's multiple range test (Duncan, 1955) was used to detect the differences between means of different groups.

RESULTS AND DISCUSSION

Growth performance:

Live body weight and daily weight gain:

The effects of feeding arrangements on live body weight (LBW) and weight gain of experimental chicks are presented in table (2). There were no significant differences in LBW and BWG between treatments at starter, grower and finisher period or over the entire trail period (1 - 42 d).

Data summarized in table (2) show that chicks subjected to 12 h feed withdrawal (12 h wd, T_5) came before feeding *ad libitum* (T_1) and had higher live body weight (2003 g) and BWG at finisher period and total experiment which were 954 and 1963 g, respectively, the same trend was happened between T_2 (90 % FR) and T_6 (90 % FR + 12 h wd). Therefore, the greater the intensity of feed restriction, the less live body weight and weight gain in chicks. The reduction in growth performance as the severity of FR increases is a direct income of feed restriction.

In general, results confirm the superiority of groups undergo 12 h wd that came before feed restriction (100, 90, 80 and 70 %) in body weight gain at finisher stage (the restriction period) compare with groups received feed restriction only or the control.

The present results are in accordance with those obtained by Mohsen *et al.* (2016) who reported that feed-restricted birds were able to attain normal market body weight at d 42, the duration and severity of the FR used allowed birds to attain market body weight for age. The energy to support accelerated growth may come from a reduction in the overall maintenance energy needs (Yu and Robinson, 1992) or from a decrease in needs for basal metabolic rate as observed in feed-restricted birds (Zubair and Leeson, 1994). However, fast initial growth rate can lead to management problems, such as increased incidence of metabolic disorders.

Al-Aqil *et al.* (2009) noticed that FR had negligible effect on growth performance at a hot, humid tropical climate. However, the regimen alleviated bird stress. The hot, humid climate can have a damaging effect on performance and well-being of poultry (Daghir, 1995a).

Zulkifli *et al.* (1994 a, b, and 2000a) presented evidence that FR can enhance the ability of chickens to withstand high ambient temperatures than those fed *ad libitum* throughout the experiments. Zulkifli *et al.* (2004) reported that the early age feed restricted birds had better survivability rate than those fed *ad libitum* throughout.

Also, restricted birds sometimes exhibit a higher body weight than that of birds fed ad libitum (Plavnik and Hurwitz, 1990).

The present results are in not compatible with those obtained by Poliana *et al.* (2003) who confirmed that feeding program did not affect any of the performance parameters. It was not the same effect of restriction on birds performance found by Sugeta *et al*. (2002), but with lower body weight gain in relation to the ad libitum birds, perhaps due to the restriction severity (70% of the *ad libitum* feed intake).

Cristiane *et al.* (2014) showed that feed restriction affects chicken performance, leading to a decrease in the weight of the body and some organs. A decrease in body weight observed in chickens that were feed restricted during the starter and finisher periods (Duarte *et al*., 2011).

Omosebi *et al.* (2014) indicated that weight gain significantly ($p<0.05$) reduced as duration and level of feed restriction increased.

The body weight gain of broiler chickens could be inhibited by feed restriction (Washburn and Bondari, 1978).

Feed consumption and feed conversion ratio:

Data for values of feed consumption (FC) and feed conversion ratio (FCR) are summarized in table (2).

The highest feed consumption during the entire experimental period (3378 g) was recorded by broiler group fed on program12 hours wd plus 100 % of *ad libitum*, followed by the control. The lowest feed consumption was recorded for broiler groups received 70 % of *ad libitum* with or without 12 hours wd, respectively.

At the finisher and total periods and total periods, treatment subjected to restricted diets scored the best FCR compared with the control treatment.

Birds received FR plus 12 h wd recorded the best FCR compare other treatments and the control. Concerning the best FCR during the whole experimental period of growth was achievement for treatment in 70 % of FR plus 12 h wd sharing with treatment received 70 % FR, followed by treatment ingest 80 % of *ad libitum* together with treatment 80 % FR + 12 h wd, the control treatment recorded the lowest FCR along the whole experimental period of growth.

Results obtained in that study are consistent with those obtained by Mohsen *et al.* (2016) who found that average feed intake and FCR from d 1 to 21 were lowered significantly ($P < 0.05$) for birds with restricted feed compared with the control birds.

Quantitative FR improve feed conversion ratio (Deaton, 1995; and Lee and Lesson, 2001). Some studies showed that feed restriction for short periods during the early growth phases improved feed efficiency and reach a weight equal to that of birds fed *ad libitum* (Hornick et al., 2000; and Pinheiro *et al*., 2004).

Al-Aqil *et al.* (2009) reported that the early age feed restricted birds had better cumulative feed conversion ratios than those fed *ad libitum*, under the natural tropical environment.

Zulkifli *et al*. (2004) noted significant improvement in the FCR of birds subjected to early age fasting and raised under the hot, humid conditions.

Makinde (2012) observed that average daily feed intake were similar ($P>0.05$) for control and restricted group for one week but higher than restricted groups for two weeks. FR did not affect ($P>0.05$) efficiency of feed conversion ratio except for two weeks, the least feed efficient. . Furthermore, Ghazanfari *et al.* (2010) showed that chicks at the finishing stage eat more than they need to grow, turning excessive eating into precipitated fat.

Omosebi *et al.* (2014) mentioned that feed: gain ratio was superior for birds subjected to higher level and longer period of feed restriction (40 % for 6 weeks) compared to the ones on *ad libitum*.

In addition, feed restriction in the early stage is beneficial for improving the feed efficiency and decreasing the breeding cost (Zubair and Leeson, 1994).

Lippens *et al*. (2000) and Urdaneta-Rincon and Leeson (2002) noted that FR reduced overall maintenance requirements because birds subjected to a period of FR tend to have smaller body weights before they reach market weight thus they require less for this purpose.

Mortality rate (MR):

It is worthy of note that broilers of all restricted feed groups and the control group which raised under summer condition had no mortalities throughout the experimental periods. This is especially noticeable in this research that all birds that entered the experiment reached to the stage of marketing.

Similar results were reported by Makinde (2012) who found that there was mortality throughout the duration of the experiment of feed restriction. Quantitative FR has been observed to reduce mortality and culling (Yu and Robinson, 1992).

Mohsen *et al.* (2016) reported that quantitative FR has been observed to reduce mortality and culling.

Al-Aqil *et al.* (2009) recorded that under the natural tropical hot, humid conditions, early age feed restricted birds had better survivability rate than those fed *ad libitum* throughout.

Some investigators have reported a reduction in mortality rate following feed restriction (Bowes *et al*., 1988; and Arce *et al*., 1992). This could provide the greatest economic incentive for implementing early feed restriction by allowing for more birds to be marketed from a flock.

However, those results are not agreement with those reports by Omosebi *et al.* (2014) who found that mortality was not significantly affected by the feed restriction program and did not follow a particular pattern so it cannot be established if it was caused by restriction.

Carcass characteristics:

The data on carcass yield and carcass parts weights as proportion to live body weight upon slaughtering are presented in Table **3**. There were significant differences in the percentage of hot carcass, total edible parts, nonedible parts and abdominal fat while no significant differences in the percentage of liver, gizzard, heard, giblets, breast and thighs were found between treatments. The broiler subjected to 90 % FR had significantly the heaviest hot carcass percentage followed by groups of the control and 90 % FR+wd respectively. Broiler group fed 70 % FR or 70 % FR+wd had attained close carcass yield.

Also, it was found that, broiler treatment fed on 90 % FR obtained highest total edible parts percentage redirect by the control treatment and broiler treatment ingested 90 % FR + wd which were 76.02 and 74.13 % respectively.

Birds group subjected to FR+wd showed that gizzard weight percentage were lower than of Birds group subjected to FR only or the control birds.

Broiler groups received 90 % or 70 % FR scored he higher percentage of heart which were 0.49 and 0.45 %, on the other hand, Broiler groups received 80 % FR and control diets scored the lower (0.36 and 0.35 %).

However, there are significant differences in the percentage of abdominal fat between the groups. There were an inverse relationship between fasting intensity (FR) and abdominal fat deposition, where the control group recorded the highest percentage of abdominal fat, after that the percentage was decreased. Also, fasting (withdrawal the feed) 12 hours before feed restriction has the same trend, whereas broiler group fed on 70 % FR+wd achieved the lower percentage of pad fat among all groups.

Similar results were reported by Makinde (2012) who found FR did not significantly affect (P>0.05) final body weight, carcass weight and breast yields.

Most notably, Plavnik and co-workers (Plavnik and Hurwitz, 1985; Plavnik et al., 1986; and McMurtry *et al*., 1988) obtained no reduction of final body weight in broiler chickens subjected to severe early feed restriction (70 %).

Mohsen *et al.* (2016) reported that the relative weights of gizzard and liver were not significantly affected.

Cristiane *et al*. (2014) showed that the gizzard was the least affected organ of feed-restricted birds in the finisher period, while the small intestine was the most affected. Hypertrophy of the gizzard was also observed in broilers that were 30% feed-restricted (Lazaro *et al*., 2004). According to Govaerts *et al*. (2000), birds that are feed-restricted can give priority to the development of supply organs, such as the proventriculus and gizzard, at the expense of the growth of demand tissues, such as the breast and thigh.

It is known that feed restriction affects chicken performance, leading to a decrease in some organs, such as those of the digestive tract (Camacho *et al*., 2004; and Wijtten *et al*., 2010). However, Washburn (1991) demonstrated that slowing the rate of passage of a diet resulting from decrease the digestive tract, increased nutrient retention. Thus, the reduction of gastrointestinal organs observed at finisher periods (Duarte *et al*., 2011).

Omosebi *et al*. (2014) seen that abdominal fat and crude fat content decreased with increasing duration and level of restriction. This study proves that abdominal fat is a perfect indicator to estimate meat fat content.

Abdominal fat was greatly reduced with severity of restriction. This might be due to fat mobilization for energy supply and abdominal fat might be mobilized more easily during a fasting period. A reduction in abdominal fat content with concomitant reduction in body weight were found by Plavnik and Hurwitz (1991) and Jones and Farrell (1992). Other investigators have reported reductions in abdominal fat due to early life feed restriction but a small reduction in final body weight (Lippens *et al*., 2000).

Plavnik and Hurwitz (1985, 1989) and Plavnik *et al*. (1986) reported a decrease in fat pad on restricted birds. The same effect of restriction on the amount of carcass fat was found by Sugeta *et al*. (2002).

Nevertheless, Beane *et al*. (1979) reported that feed efficiency was improved, but the amount of abdominal fat in restricted male broilers was significantly increased. Also, Fontana *et al*. (1992) reported a larger abdominal fat deposition in the carcass of restricted birds after refeeding. According to Pinchasov and Jensen (1989), fat pad is more directly influenced by nutrition than total carcass fat.

Villi measurements:

Results in Tables (4) indicate that birds subjected to feed restriction had significant effects on villi length, where bird groups fed on FR diets recorded the highest villus (mm) compared control group which were 599.9 and 416.1 mm respectively. Also, significant improvements were found on crypts depth. Broiler groups received FR diets were more deepness compared to the control group. Moreover, broiler groups of FR achieved significantly better villus length versus crypts depth.

The present results are in compatible with those obtained by Buwjoom *et al.* (2010) who described that epithelial cells on the intestinal villi are the main sites of digestion and absorption of ingested feeds during their moving distally. Histologically, the intestinal villus height, cell area, cell mitosis number were rapidly decreased by feed withdraw, but these light microscopic parameters increased to the intact control values after refeeding (Mekbungwan and Yamauchi, 2004; Yamauchi *et al*., 2006b).

As the increased villus length and width provide more surface area for nutrient absorption and thus improve nutrient digestibility (Onderci *et al*., 2006), greater intestinal villus height and numerous cell mitosis in the intestine are reported to be functionally activated (Langhout *et al*., 1999; Yasar and Forbes, 1999). However, physiologically, acute energy restriction of 10 days had no effect on nutrient absorption in the intestine, but chronic energy restriction of 27 days enhanced uptake of nutrients (Ronado *et al.*, 2001) in mice.

Laudadio *et al.* (2012) stated that reducing the dietary protein level to 20.5% resulted in a higher villus height and villus height to crypt depth ratio in the duodenum and ileum. Dietary protein is a crucial regulator of the development of the gastrointestinal tract.

Mohsen *et al.* (2016) have shown that wet feeding and FR reduced digesta viscosity and crypt cell proliferation and increased intestinal villus height, all factors that improve nutrient digestibility. Cristiane *et al.* (2014) have seen that it is imperative to know the physiological changes that underlie feed restriction to better understand animal nutrition and health. In particular, it is important to know which changes in the gastrointestinal tract are responsible for processing dietary nutrients necessary for self-maintenance and growth (Gilbert *et al*., 2008).

The small intestine, especially crypts and villi of the absorptive epithelium, plays a significant role in the final phase of nutrient digestion and assimilation (Wang and Peng, 2008). Intestinal development can be assessed through measurements of the crypt, a region in which new intestinal cells are formed, as well as villus height and surface area, to determine the area available for digestion and absorption (Swatson *et al*., 2002; and Franco *et al*., 2006).

According to Yamauchi (2002), the morphological changes of the intestinal villi in broilers are dependent on the presence of digested nutrients in the small intestinal lumen. Maneewan and Yamauchi (2003) suggesting that protein is the most important factor in histological recovery after feed withdrawal.

The feed-restriction of chickens at 6 weeks of age caused an increase in the jejunal villus height, which was regarded as an adaptive strategy to maximize nutrient uptake once feeding (Thompson and Applegate, 2006). Yamauchi and Tarachai (2000) showed a rapid recovery of villus height through increased epithelial cell area and cell mitosis after 1 d of refeeding in chickens.

A decrease in metabolic rate could lead to a reduction in the energy required to maintain gastrointestinal turnover. In fact, feed restriction affects intestinal villus height, cell area, cell proliferation, and mitosis rate (Shamoto and Yamauchi, 2000).

Omosebi *et al.* (2014) found that restricted chicks had heavier digestive tract. Chickens with heavier relative digestive tract weight had slower gastro-intestinal clearance than those with lighter digestive tract. A slower clearance of feed from the intestinal tract allows the nutrients (i.e. minerals) greater exposure to the absorptive cells and consequently influences the efficiency of nutrient utilization.

Economic evaluation:

The results of using FR or FR+wd programs at finisher period during summer conditions are presented in Table (5). Broiler groups tolerate 70 % FR + wd and 70 % FR achieved higher net revenue, economic efficiency, relative REE % and PI. Birds group fed on 80 % FR + wd comes second in the standings, followed by birds groups of 90 % FR + wd.

Generally, it is clear that restriction fed groups were superior in the net revenue per bird compared to the control group. On the other side, FR + wd achieved the supreme in economic evaluation measurements compared with their counterparts of FR only or the control.

It is clearly that, FR + wd attained maximum profitability by decreasing cost of production and increase profit. All feed restriction with or without 12 hours withdrawal groups 100 %, 90 %, 80 % and 70 % exceeded the economic efficiency compared the control group.

Similar results were reported by Omosebi *et al.* (2014) who observed that as level and duration of feed restriction increased, feed cost/ kg reduced.

Urdaneta-Rincon and Leeson (2002) postulated that reduction in maintenance feed requirements provide a promising method of reducing feed cost of broiler chickens.

However, those results are not agreement with those reports by Makinde (2012) who reported that the highest revenue derived from full-fed birds because they had the highest final body weights, followed by birds restricted for 1 week and then for 2 weeks. Full-fed birds recorded the highest value of economic efficiency (Profit/total feed cost x 100) followed by birds restricted for 1 week, because final live weight of restricted birds were significantly less than ($P<0.05$) unrestricted except birds mildly restricted.

These results suggest that the duration and timing of feed restriction can reduce cost in broiler meat production without seriously affecting performance or economics of production depending on the restriction program applied.

General conclusion:

In conclusion, finally from the obtained results in this study, the most suitable feeding program during summer environment was feeding restriction plus twelve hours feed withdrawal at finisher stage because : first thing, it was excellent economic efficiency than other feed restriction programs and the control. The next, using program was associated with good BWG, FCR and no mortalities through the entire experimental period, better meat quality and lower abdominal fat. Then, also save the intestinal health and achieve a good and high villus and depth crypts. All of these are reflected on the health of the bird and improve the efficiency utilization of feed. The diet therefore produced lean meat at reduced cost which can be of advantage to the producer and beneficial to the consumer.

broiler, feed restriction ,growth performance, Carcass , villus and crypts.

Table (1): Ingredients and calculated chemical analysis of the basal diet.

Ingredients %	Starter (1-14d)	Grower (15-28d)	finisher (29-42d)
Yellow corn	53.26	56.10	60.77
Soy bean meal	34.6	30.30	24.85
(44 % CP)			
Corn gluten meal	5.25	5.66	5.64
(62 % CP)			
Vegetable oil	2.57	3.80	4.60
Limestone	1.13	1.45	1.41
Dicalcium	2.08	1.63	1.65
Phosphate			
Vit.& Min.	0.3	0.3	0.3
premix*	0.3	0.3	0.3
Salt (NaCl)	0.23	0.18	0.16
DL-Methionine	0.28	0.28	0.32
Lysine			
Calculated analysis			
Crude protein	23.00	21.50	19.50
(CP%)	3000	3100	3200
ME (Kcal/kg)	1	0.99	0.97
% Calcium	0.5	0.45	0.44
Av. phosphorous%	0.6	0.58	0.53
DL-Methionine	1.4	1.30	1.18
Lysine			

*Each 3 kg of Vit and Min in Premix contain: 12000000IU Vit A, 2000000 IU Vit D3 10000mg Vit E,2000mg Vit K, 1000mg Vit.B1, 5000mg Vit B2, 2000mg Vit B6, 10mg Vit B12, 30000mg Niacin, 10000 mg pantothenic acid, 50mg Biotin, 3000mg Folic acid, 250000 mg choline, 50000mg Zn, 6000mg Mn, 30000mg Fe, 40000mg Cu, 300mg I , 100mg Se and 100mg Co.

Table (2): Growth performance of broiler chickens as affected by dietary treatments.

Items	Feed Restriction (FR)				12 h fasting + FR				Sig.
	100 %	90 %	80 %	70 %	100 %	90 %	80 %	70 %	
Live body weight (LBW) (g) :									
1 day	40.8 ±0.03	40.7 ±0.02	40.3 ±0.05	40.4 ±0.04	40.2 ±0.03	40.2 ±0.03	40.5 ±0.04	40.3 ±0.02	NS
2 week	375 ±3.48	383 ±4.56	384 ±5.6	383 ±4.36	378 ±4.61	381 ±6.31	378 ±6.13	382 ±2.79	NS
4 week	1046 ±15.63	1054 ±10.89	1052 ±14.87	1057 ±13.32	1045 ±11.49	1051 ±9.50	1045 ±8.76	1049 ±6.68	NS
6 week	1980 ±19.61	1985 ±34.15	1952 ±22.06	1927 ±20.15	2003 ±20.57	1995 ±27.74	1961 ±25.13	1929 ±13.90	NS
Body weight gain (BWG) (g / bird) :									
1 d – 2 week	335 ±4.09	343 ±4.56	344 ±5.61	343 ±4.35	338 ±4.60	341 ±6.33	338 ±6.13	342 ±2.79	NS
2 – 4 week	671 ±16.12	671 ±10.46	668 ±14.43	674 ±13.99	667 ±10.43	670 ±9.90	667 ±12.14	667 ±6.46	NS
4 – 6 week	934 ±25.58	931 ±34.08	900 ±26.1	870 ±23.82	957 ±24.55	944 ±29.38	916 ±25.47	880 ±15.29	NS
1 – 6 week	1940 ±19.61	1945 ±34.14	1912 ±22.1	1887 ±20.15	1963 ±20.55	1955 ±27.74	1921 ±25.13	1889 ±13.90	NS
Feed consumption (g / bird) :									
1 d – 2 week	436^{h} ±1.51	440^{f} ±1.46	451^{c} ±1.21	449^{d} ±1.87	437^{g} ±1.29	453^{a} ±1.87	452^{b} ±1.13	442^{e} ±1.61	*
2 – 4 week	1134^{c} ±3.81	1147^{b} ±1.57	1136^{c} ±4.87	1159^{a} ±2.66	1141^{c} ±1.57	1139^{c} ±1.15	1136^{c} ±1.30	1147^{b} ± 1.40	*
4 – 6 week	1800^{a} ±0.30	1620^{b} ±0.23	1440^{c} ±0.23	1260^{d} ±0.38	1800^{a} ±0.23	1620^{b} ±0.23	1440^{c} ±0.23	1260^{d} ±0.38	*
1 – 6 week	3370^{a} ±6.74	3207^{b} ±6.31	3027^{c} ±7.24	2868^{d} ±7.51	3378^{a} ±6.32	3212^{b} ±6.09	3028^{c} ±6.04	2849^{d} ±4.38	*
Feed conversion (g feed / g gain) :									
1 d – 2 week	1.30 ±0.02	1.28 ±0.02	1.31 ±0.02	1.31 ±0.02	1.29 ±0.02	1.33 ±0.03	1.34 ±0.02	1.29 ± 0.02	NS
2 – 4 week	1.69 ±0.04	1.71 ±0.03	1.70 ±0.04	1.72 ±0.03	1.71 ±0.02	1.70 ±0.03	1.70 ±0.03	1.72 ± 0.02	NS
4 – 6 week	1.93^{a} ±0.04	1.74^{b} ±0.07	1.60^{c} ±0.05	1.45^{d} ±0.04	1.88^{a} ±0.04	1.71^{b} ±0.07	1.57^{c} ±0.05	1.43^{d} ± 0.03	*
1 – 6 week	1.74^{a} ±0.01	1.65^{c} ±0.03	1.58^{e} ±0.02	1.52^{f} ±0.02	1.72^{b} ±0.02	1.63^{d} ±0.03	1.57^{e} ±0.02	1.51^{f} ± 0.03	*

a,b and c --- Means within the same row with the different superscripts are significantly different (P<0.05).

Table (3): Carcass characteristics of broiler chicks as affected by dietary treatments.

Items	Feed restriction				12 h fasting + FR				Sig.
	100 %	**90 %**	**80 %**	**70 %**	**100 %**	**90 %**	**80 %**	**70 %**	
LBW	1980 ±19.61	1985 ±34.15	1952 ±22.06	1927 ±20.15	2003 ±20.57	1995 ±27.74	1961 ±25.13	1929 ±13.90	NS
Carcass %	71.60^{ab} ± 1.44	72.99^{a} ± 1.04	67.65^{bc} ± 0.74	64.92^{c} ± 0.56	67.16^{bc} ± 0.68	69.53^{bc} ± 1.60	65.98^{c} ± 2.61	64.98^{c} ± 1.93	**
Edible parts %	76.02^{ab} ± 1.55	77.64^{a} ± 1.19	72.47^{bcd} ± 0.73	69.89^{cd} ± 0.20	71.63^{bcd} ± 0.94	74.13^{abc} ± 1.40	70.33^{cd} ± 2.52	69.34^{d} ± 1.64	**
Non edible parts %	23.98^{c} ± 1.55	22.36^{c} ± 1.19	27.53^{ab} ± 0.73	30.11^{a} ± 0.20	28.37^{ab} ± 0.94	25.87^{b} ± 1.40	29.67^{a} ± 2.52	30.66^{a} ± 1.64	*
Giblets %	4.43 ± 0.30	4.65 0.43	4.81 ± 0.24	4.97 ± 0.19	4.48 ± 0.34	4.59 ± 0.24	4.34 ± 0.36	4.36 ± 0.40	NS
Liver %	2.04 ± 0.04	2.14 ± 0.12	2.13 ± 0.05	2.25 ± 0.31	2.18 ± 0.06	2.18 ± 0.23	2.05 ± 0.30	1.96 ± 0.19	NS
Gizzard %	2.04 ± 0.16	2.02 ± 0.20	2.32 ± 0.10	2.27 ± 0.09	1.90 ± 0.24	2.01 ± 0.21	1.93 ± 0.14	1.97 ± 0.10	NS
Heart %	0.35 ± 0.02	0.49 ± 0.02	0.36 ± 0.02	0.45 ± 0.01	0.40 ± 0.08	0.40 ± 0.05	0.36 ± 0.01	0.43 ± 0.04	NS
Abdominal fat %	1.70^{a} ± 0.08	1.26^{b} ± 0.01	1.10^{bc} ± 0.02	0.85^{c} ± 0.09	1.32^{b} ± 0.16	1.09^{bc} ± 0.01	0.91^{c} ± 0.11	0.83^{c} ± 0.10	**
Breast %	37.79 ± 0.71	37.89 ± 0.16	36.59 ± 1.56	35.79 ± 1.86	36.72 ± 1.22	36.76 ± 1.60	35.86 ± 1.73	33.46 ± 1.40	NS
Thigh %	33.63 ± 1.24	30.63 ± 0.53	29.82 ± 0.98	30.62 ± 0.08	30.54 ± 0.65	32.82 ± 0.30	31.30 ± 1.49	31.35 ± 0.68	NS

a,b and c --- Means within the same row with the different superscripts are significantly different ($P<0.05$).

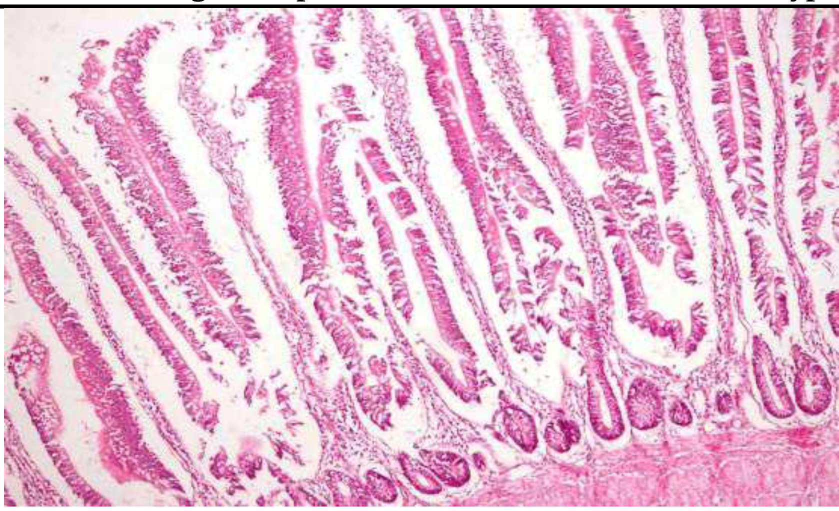
Table (4): Villus height and crypts depth of broiler chicks as affected by dietary arrangements.

Items	Control treatment	Feed Restriction	Sig.
Villus height (mm)	416.1 [b]± 13.9	599.9 [a]± 17.36	**
Crypts depth (mm)	59.56 [b]± 3.26	81.44 [a]± 4.58	**
Villi / Crypt	6.99 [b]± 0.24	7.37 [a]± 0.18	**

Table (5): Economic Efficiency as affected by dietary treatments.

Items	Feed restriction				12 h fasting + FR			
	100 %	**90 %**	**80 %**	**70 %**	**100 %**	**90 %**	**80 %**	**70 %**
LBW	1.980	1.985	1.952	1.927	2.003	1.995	1.961	1.929
T. revenue /chick (LE)	43.56	43.67	42.95	42.40	44.10	43.89	43.14	42.44
T. feed intake /chick (kg)	3.370	3.207	3.027	2.868	3.378	3.212	3.028	2.849
T. feed cost /chick (LE)	18.13	17.27	16.29	15.48	18.18	17.31	16.32	15.37
Fixed cost /chick (LE)	18	18	18	18	18	18	18	18
total cost /chick (LE)	36.13	35.27	34.29	33.48	36.18	35.31	34.32	33.37
Net revenue /chick (LE)	7.43	8.40	8.66	8.92	7.92	8.58	8.82	9.07
Economic effici. (EEF)	20.56	23.82	25.26	26.64	21.90	24.30	25.70	27.18
Relative REE %	100	115.86	122.86	129.56	106.52	118.19	125.00	132.2
Performance index. PI	113.79	120.30	123.54	126.78	116.45	122.39	124.9	127.74

Relative Economic Efficiency = Economic Efficiency of treatment other than the control / Economic Efficiency of the control group.



Fig(1): Histological section of Intestine from Feed Restriction, showing histological normal intestinal villi (H&E, 100X).

Fig(2): Histological section of Intestine of from Control treatment, showing intense inflammatory cells infiltration in lamina propria associated with interstitial edema. (H&E, 100X).

REFERENCES

Al-Aqil, A.; Zulkifli, I.; Sazili, A. Q.; Omar1, A. R. and Rajion, M. A. 2009. The Effects of the Hot, Humid Tropical Climate and Early Age Feed Restriction on Stress and Fear Responses, and Performance in Broiler Chickens. Asian-Aust. J. Anim. Sci. Vol. 22, No. 11 : 1581 – 1586.

Al-Taleb, S.S. 2003. Effect of an early feed restriction productive performance and carcass quality. Online J Biol Sci, 36: 607-611.

Arce, J.; Berger, M. and Coello, C. L. 1992. Control of ascites syndrome by feed restriction techniques. J Appl Poultry Res, 1: 1-5.

Atteh, J. O. 2003. Romancing the chicken. 68th Inaugural Lecture. Library and Communications Committee, University of Ilorin. Uni Ilorin Press, Ilorin, Nigeria, pp 32.

Beane, W. L.; Cherry J. A. and Weaver Jr. W. D. 1979. Intermittent light and restricted feeding of broiler chickens. Poultry Sci, 58: 567-571.

Bowes, V. A.; Julian, R. J.; Leeson, S. and Stirtzinger, T. 1988. The effect of feed restriction on feed efficiency and incidence of sudden death syndrome in broiler chickens. Poultry Sci, 67: 1102-1104.

Buwjoom, T.; Yamauchi, K.; Erikawa, T. and Goto, H. 2010. Histological intestinal alterations in chickens fed low protein diet. J. of Animal Physiology and Animal Nutrition. 94: 354–361.

Camacho, M.A.; Suدrez, M. E.; Herrera, J. G.; Cuca, J. M. and Garc-Bojalil, C. M. 2004. Effect of age of feed restriction and microelement supplementation to control ascites on production and carcass characteristics of broilers. Poultry Science, 83: 526-532.

Chambers, J. R. 1990. Genetics of growth and meat production in chickens. In: Poultry breeding and genetics. Crawford, R.D. (Ed.). Elsevier Science Publishers B.V. Amsterdam. Netherlands. pp: 599-643.

Cristiane, R. A. Duarte, Maria L. M. Vicentini-Paulino and Daniela F. Pinheiro 2014. Digestive Enzymatic Responses of Chickens Feed-restricted and Refed as Affected by Age. J. Poult. Sci., 51: 289-296.

Crouch, A. N.2000. The effects of physical feed restriction on body composition and reproductive performance of commercial large white turkey breeder hens and its subsequent economic impact. PhD thesis. North Carolina State University. U.S.A.

Daghir, N. J. 1995. Nutrient requirements of poultry at high temperatures. In: Poultry production in hot climates (Ed. N. J. Daghir), CAB International, Wallingford, UK. pp. 101-124.

Deaton, J. W.1995. The effect of early feed restriction on broiler performance. Poult. Sci; 74:1280e6.

Duarte, C. R. A.; Vicentini-Paulino, M. L. M.; Buratini, Jr. J.; Castilho , A. C. S. and Pinheiro, D. F. 2011. Messenger ribonucleic acid abundance of intestinal enzymes and transporters in feed-restricted and refed chickens at different ages. Poultry Science, 90: 863-868.

Duncan, D. B. 1955. The multiple ranges and multiple F Test. Biometrics.11: 1-42.

FONTANA, E. A.; WEAVER, W. D.; DENBOW, D. M.; WATKINS, B. A.

1992. Effect of early feed restriction on growth, feed: gain ration and mortality in broiler chickens. Poultry Science, Champaign, v. 71, p. 1296-1305.

Franco, J. R. G.; Murakami, A. E.; Natali, M. R. M.; Garcia, E. R. M. and Furlan, A. C. 2006. Influence of delayed placement and dietary lysine levels on small intestine morphometrics and performance of broilers. Braz. J. Poult. Sci. 8:233–241.

Freeman, B. M.; Manning, A. C. C. and Flack, L. H.1980. Short-term stressor effects of food withdrawal on the immature fowl. *Comp. Biochem. and Phys.*; 67 (A): 569-571.

Ghazanfari, S.; Kermanshahi, H.; Nassiry, M. R.; Golian, A.; Moussavi, A. R. H. and Salehi. A. 2010. Effect of feed restriction and different energy and protein levels of the diet on growth performance and growth hormone in broiler chickens. *J. Biol. Sciences*; 10: 25-30.

Gilbert, E. R.; Wong, E. A. and Webb, Jr. K. E. (2008). Peptide absorption and utilization: Implications for animal nutrition and health. Journal of Animal Science, 86: 2135-2155.

Gous, R.M. and Cherry, P.2004. Effects of body weight at, and lighting regimen and growth curve to, 20 weeks on laying performance in broiler breeders. Brit Poultry Sci, 45: 445-452.

Govaerts, T.; Room, G.; Buyse, J.; Lippens, M.; De Groote, G. and Decuypere, E. 2000. Early and temporary quantitative food restriction of broiler chickens. 2. Effects on allometric growth and growth hormone secretion. British Poultry Science, 41: 355-362.

Gross, W. B.; and Siegel, P. B. 1982. Socialization as a factor to resistance to infection, feed efficiency, and response to antigen in chickens. *Am. J. of Vet. Res.* 1982; 43: 20010-20012.

Hocking, P.M.; Maxwell, M. H. and Mitchell, M. A. 1996. Relationships between the degree of food restriction and welfare indices in broiler breeder females. *Br. Poult. Sci.*; 37: 263-278.

Hornick, J.L.; Van Eenaeme, C.; Gerard, O.; Dufrasne, I.; Istasse, L.; 2000. Mechanisms of reduced and compensatory growth. Domest Anim Endocrinol;19:121e32.

Iyayi, E. O. and Tewe, O. O. 1998.TSP, urea and creatine levels as indices of quality of cassava diets for pigs. Trop Vet, 16: 57-67.

Jones, G. P. D. and Farrell, D. J. 1992. Early-life food restriction of chicken. Methods of application, amino acid supplementation and the age at which restriction should commence. Brit Poultry Sci, 33: 579-587.

Kessler, A. M.; Snizek Jr., P. N. and Brugalli, I. 2000. Manipulação da quantidade de gordura na carcaça de frangos. Anais da Conferência APINCO de Ciência e Tecnologia Avícolas. APINCO. Campinas, SP. Brazil. pp. 107- 133.

Langhout, D. J.; Schutte, J. B.; Van, L. P.; Wiebenga, J.; Tamiminga, S. 1999. Effect of dietary high and low methylated citrus pectin on the activity of the ileal microflora and morphology of the small intestinal wall of broiler chick. British Poultry Science 40, 340–347.

Laudadio, V.; Passantino, L.; Perillo, A.; Lopresti, G.; Passantino, A.; Khan, R. U. and Tufarelli, V. 2012. Productive performance and histological features of intestinal mucosa of broiler chickens fed different dietary protein levels. Poultry Science, 91: 265-270.

Lazaro, R.; Latorre, M. A.; Medel. P.; Gracia, M. and Mateos, G. G. 2004. Feeding regimen and enzyme supplementation to rye-based diets for broilers. Poultry Science, 83: 152-160.

Lee, K. H. and Lesson, S. 2001. Performance of broilers fed limited quantities of feed or nutrients during seven to fourteen days of age. Poult Sci;80:446e54.

Leeson, S.; J. D. Summers and L. J. Caston 1992. Response of broilers to feed restriction or diet dilution in the finisher period. Poult Sci.;71(12):2056-64.

Lippens, M.; Room, G.; DeGroote, G. and Decuypere, E. 2000. Early and temporary quantitative food restriction of broiler chickens. Effects on performance characteristics, mortality and meat quality. Brit Poultry Sci, 41: 343-354.

Makinde, O. A. 2012. Influence of timing and duration of feed restriction on growth and economic performance of finisher broiler chickens. African J. of Food, Agri., Nut. and deve. V: 12 , N: 7. P: 6977-6986.

Maneewan, B. and Yamauchi, K. 2003. Effects of semi-purified pellet on the chicken intestinal villus histology. Jpn. Poult. Sci. 40: 254-266.

Mark, P. Richards; Stephen, M. Poch; Craig, N. Coon; Robert, W. Rosebrough; Christopher, M. Ashwell and John, P. McMurtry 2002. Feed Restriction Significantly Alters Lipogenic Gene Expression in Broiler Breeder Chickens. American Society for Nutritional Sciences.

Marks, H. L. 1979. Growth rate and feed intake of selected and non-selected broilers. *Growth*; 43: 80-90.

McGoven, R. H.; Feddes, J.J.; Robinson, F. E. and Handson, J. A. 1999. Growth performance, carcass characteristics and the incidence of ascites in broilers in response to feed restriction and litter oiling. *Poult. Sci.*; 78: 522-528.

McMURTRY, J. P.; PLAVNIK, I.; ROSEBROUGH, R. W.; STEELE, N. C. and PROUDMAN, J. A. 1988. Effect of early feed restriction in male broiler chicks on plasma metabolic hormones during feed restriction and accelerated growth. Comparative Biochemistry and Physiology A, New York, v. 91, p. 67-70.

Mekbungwan, A.; and Yamauchi, K. 2004. Growth performance and histological intestinal alterations in piglets fed dietary raw and heated pigeon pea seed meal. Histology and Histopathology 19, 381–389.

Mench, J. A. 1991. Research note: Feed restriction in broiler breeders causes a persistent elevation in corticosterone secretion that is modulated by dietary tryptophan. *Poult. Sci.*; **70:** 2547-2550.

Mench, J. A. 1998. The development of aggressive behavior in male broiler chicks: a comparison with laying-type males and the effects of feed restriction. *Applied Anim. Behav. Sci.*; 21: 233-242.

Mench, J.A. (2002). Broiler breeders: Feed restriction and welfare. World Poultry Sci J, 58: 20-29.

Mohsen, A.; Movahedeh, L. and Zohreh, M. 2016. Effects of wet feeding and early feed restriction on blood parameters and growth performance of broiler chickens. Animal Nutrition, 2: 168-172.

North, M.O. 1981. Commercial Chicken Production Manual, 2nd Ed. AVI Publishing Company Inc, USA.

Omosebi, D. J.; Adeyemi, O. A.; Sogunle, M. O.; Idowu, O. M. O. and Njoku, C.P. 2014. Effects of duration and level of feed restriction on performance and meat quality of broiler chickens. Arch. Zootec. 63 (244): 611-621. 2014.

Onderci, M.; Sahin, N.; Sahin, K.; Cikim, G.; Aydı`n, A.; Ozercan, I. and Aydı`n, S. 2006. Efficacy of supplementation of a-amylase-producing bacterial culture on the performance, nutrient use and gut morphology of broiler chickens fed a corn-based diet. Poultry Science 85, 505–510.

Pinchasov, Y. and Jensen, L. S. 1989. Comparison of physical and chemical means of feed restriction in broiler chicks. Poultry Sci, 68: 61-69.

Pinheiro, D. F.; Cruz, V. C.; Sartori, J. R. and Vicetini-Paulino, M. L. 2004. Effect of early feed restriction and enzyme supplementation on digestive enzyme activities in broilers. Poult Sci;83:1544e50.

PLAVNIK, I. and HURWITZ, S. 1985.The performance of broiler chicks during and following a severe feed restriction at an early age. Poultry Science, Champaign, v. 64, p. 348-355.

Plavnik, I. and Hurwitz, S. 1989. Effect of dietary protein, energy and feed pelleting on the response of chicks to early feed restriction. Poult Sci;68:1118e25.

PLAVNIK, I. and HURWITZ, S. 1990. Performance of broiler chickens and turkey poults subjected to feed restriction or to feeding of low-protein or low- sodium diets at an early age. Poultry Science, Champaign, v. 69, p. 945-952.

Plavnik, I. and Hurwitz, S. 1991. Response of broiler chickens and turkey poults to food restriction of varied severity during early life. British Poultry Science 32, 343–352.

PLAVNIK, I.; McMURTRY, J. P. and ROSEBROUGH, R. W. 1986. Effect of early feed restriction in broilers – I: growth performance and carcass composition. Growth, Lakeland, v. 50, p. 68-76.

Poliana, F. G.; Erika N. G., Jesus A. F.; Maria I. T. F.; Renato L. F. and Marcos M. 2003. Performance and hormonal profile in broiler chickens fed with different energy levels during post restriction period. Pesq. agropec. bras., Brasília, v. 38, n. 6, p. 697-702.

Rezaei, M.; Teimouri, A.; Pourreza, J.; Syyahzadeh, H. and Waldroup, P.W. 2006. Effect of diet dilution in the starter period on performance and carcass characteristics of broiler chicks. J Central Europ Agric, 7: 63-70.

Robinson, F.E.; Classen, H.L.; Hanson, J.A. and Onderka, D.K. 1999. Growth performance, feed efficiency and the incidence of skeletal and metabolic disease in full-fed and feed-restricted broiler and roaster chickens. J Appl Poultry Res,1: 33-41.

Ronado, P. F.; Qing-Xue, C. and Shyam, P.2001. Chronic but not acute energy restriction increases intestinal nutrient transport in mice. Journal Nutrition 131, 779–786.

Saleh, E .A.; Watkins, S. E.; Waldroup, A. L. and Waldroup, P. W. 2005. Effects of early feed restriction of live performance and carcass composition of male broilers grown for further processing. Poultry Sci Ass, 14: 87-93.

Savory, C. J.; Maros, K. and Rutter, S. M.1993. Assessment of hunger in growing broiler breeders in relation to a commercial restricted feeding programme. *Anim. Welfare*; **2:** 131-152.

Savory, C. J. and Kostal, L. 1993. Behavioural responses to reserpine treatment in restricted-fed broiler breeder fowls. Med. Sci. Res.; 21: 351-352.

Savory, C. J. and Maros, K. 1993. Influence of degree of food restriction, age and time of day on behaviour of broiler breeder chickens. *Behav. Processes*; 29:179-190.

Sahraei, M. and M. H. M. Hadloo 2012. Effect of Physical Feed Restriction in Finisher Period on Carcass Traits and Broiler Chickens Performance. Global Veterinaria, 9 (2): 201-204,

Shamoto, K. and Yamauchim K. 2000. Recovery responses of chick intestinal villus morphology to different refeeding procedures. Poultry Science, 79: 718- 723.

Smith, A. J. 1990. Poultry tropical agriculturist series. Macmillan. Ibadan. pp. 138- 147.

SUGETA, S. M.; GIACHETTO, P. F.; MALHEIROS, E. B.; MACARI, M. and FURLAN, R. L.2002,Efeito da restrição alimentar quantitativa sobre o ganho compensatório e composição da carcaça de frangos. Pesquisa Agropecuária Brasileira, Brasília, v. 37, n. 7, p. 903-908, jul.

Swatson, H. K.; Gous, R.; Iji, P. A. and Zarrinkalam. R. 2002. Effect of dietary protein level, amino acid balance, and feeding level on growth, gastrointestinal tract, and mucosal structure of the small intestine in broiler chickens. Anim. Res. 51:501–515.

Teimouri, A.; Razaei, J.; Pourreza, J.; Sayyazadeh, H. and Waldroup, P.W. 2005. Effect of diet dilution in starter period on performance and carcass characteristics of broiler chicks. Int J Poultry Sci, 4: 1006-1011.

Thompson, K. L. and Applegate, T. J. 2006. Feed withdrawal alters small intestinal morphology and mucus of broilers. Poultry Science, 85: 1535- 1540.

Tolkamp, B.J.; Sandilands, V. and Kyriazakis, I. 2005. Effects of qualitative feed restriction during rearing on the performance of broiler breeders during rearing and lay. Poultry Sci, 84: 1286-1293.

Urdaneta-Rincon, M. and Leeson, S. 2002. Quantitative and qualitative feed restriction on growth characteristics of male broiler chickens. Poultry Science, 81: 679-688.

Wang, J. X. and Peng, K. M. 2008. Developmental morphology of the small intestine of African ostrich chicks. Poult. Sci. 87:2629–2635.

Washburn, K. W. 1991. Efficiency of feed utilization and rate of feed passage through the digestive system. Poult Sci;70:447e52.

Washburn, K.W. and Bondari, K. 1978. Effects of timing and duration of restricted feeding on compensatory growth in broilers. Poultry Sci, 57: 1013- 1021.

Wijtten, P. J.; Hangoor, E.; Sparla, J. K. and Verstegen, M. W. 2010. Dietary amino acid levels and feed restriction affect small intestinal development, mortality, and weight gain of male broilers. Poultry Science, 89: 1424-1439.

Yamauchi, K. 2002. Review on chicken intestinal villus histological alterations related with intestinal function. Jpn. Poult. Sci. 39:229–242.

Yamauchi, K. and Tarachai, P. 2000. Changes in intestinal villi, cell area and intracellular autophagic vacuoles related to intestinal function in chickens. British Poultry Science, 41: 416-423. 2000.

Yamauchi, K.; Samanya, M.; Seki, K.; Ijiri, N. and Thongwittata, N. 2006. Influence of dietary sesame meal level on histological alterations of the intestinal mucosa and growth performance of chickens. The Journal of Applied Poultry Research 15, 266–273.

Yasar, S. and Forbes, J. M. 1999. Performance and gastro-intestinal response of broiler chicks fed on cereal grain-based foods soaked in water. British Poultry Science 40, 65–67.

Yegani, M. and Korver, D. R. (2008). Factors affecting intestinal health in poultry. Poultry Science, 87: 2052-2063.

Yu, M. and Robinson, F. E. 1992. The application of short-term feed restriction to broiler chicken production: a review. J Appl Poult Res;1:147e53.

Zubair, A.K. and Leeson, S. 1994. Effect of early feed restriction and realimentation on metabolic heat production and changes in digestive organs in broiler chickens. Poult Sci;73: 529e38.

Zulkifli, I.; Che Norma, M. T.; Israf, D. A. and Omar, A. R. 2000. The effect of early age feed restriction on subsequent response to high environmental temperatures in female broiler chickens. Poult. Sci. 79:1401-1407.

Zulkifli, I.; Dunnington, E. A.; Gross, W. B. and Siegel, P. B1994.a. Food restriction early or later in life and its effect on adaptability, disease resistance, and immunocomptence of heat-stressed dwarf and nondwarf chickens. Br. Poult. Sci. 35:203-213.

Zulkifli, I.; Dunnington, E. A.; Gross, W. B. and Siegel, P. B. 1994.b. Inhibition of adrenal steroidogenesis, food restriction and acclimation to high ambient temperatures in chickens. Br. Poult. Sci. 35:417-426.

Zulkifli, I.; Norbaiyah, B. and Siti, N. A. 2004. Growth performance, mortality and immune response of two commercial broiler strains subjected to early age feed restriction and heat conditioning under hot, humid tropical environment. Arch. Geflügelk. 68:253-258.

العربي الملخص

تأثير التحديد الغذائي خلال موسم الصيف على الأداء الأنتاجي وصحة و سلامة الخملات لكتاكيت اللحم

هشام محمود محمد عزوز ، صابر صبحي جادالرب ، حمدي محمد أحمد الكومي
معهد بحوث الإنتاج الحيواني مركز البحوث الزراعية الدقي الجيزة مصر.

أجريت هذه التجربة لدراسة تأثير تحديد كمية العلف المقدمة للطائر في مرحلة الناهي أو تصويم الطائر لمدة ١٢ ساعة قبل أجراء التحديد الكمي للعلف علي قياسات الأداء الأنتاجي و مواصفات الذبيحة و شكل و سلامة الخملات و الكفاءة الأقتصادية لكتاكيت التسمين الروص(٣٠٨) من عمر يوم حتي ٤٢ يوم في ظل ظروف الصيف . تم أستخدام عدد ٢٤٠ كتكوت تسمين روص غير مجنس عمر يوم. وزعت عشوائيا إلي ثمانية معاملات تجريبية. تم تغذية الكتاكيت علي المقررات الغذائية الموصي بها بكتالوج السلالة حتي الشبع خلال مرحلتي البادئ و النامي ، أما في مرحلة الناهي فتم تنفيذ التحديد الغذائي كالأتي ، النظام الأول التغذية حتي الشبع و ٩٠ % و ٨٠ % و ٧٠ % من العلف المأكول حتي الشبع و ذلك للمعاملات الأولي (الكنترول) و الثانية و الثالثة و الرابعة علي الترتيب . أما النظام الثاني هو التصويم لمدة ١٢ ساعة (سحب العلف) قبل أجراء التحديد الغذائي وهو كالتالي بنسبة ١٠٠ % و ٩٠ % و ٨٠ % و٧٠ % من العلف حتي الشبع و ذلك للمعاملات الخامسة و السادسة و السابعة و الثامنة. تم تسجيل وزن الجسم و كمية العلف المستهلك عند عمر صفر ، ١٤، ٢١، ٢٨، ٤٢يوم من العمر. توجد فروق غير معنوية بين معاملات التحديد الغذائي و التغذية حتي الشبع في الوزن الحي للكتاكيت في عمر٢ ، ٤أسبوع و عمر الناهي ككل . وزن الجسم و الزيادة في الوزن للكتاكيت التي تم تصويمها لمدة ١٢ ساعة قبل التحديد الغذائي في مرحلة الناهي كانت أكبر من المعاملات الأخري. توجد هناك فروق معنوية في كمية العلف المستهلك و معدل التحويل الغذائي خلال فترة الناهي و خلال فترة التجربة ككل بين معاملات التحديد الغذائي و الكنترول . هناك فروق معنوية بين المعاملات تم تسجيلها كنسبة مئوية لوزن الذبيحة و الأجزاء الكلية المأكولة و دهن البطن . و قد وجد علاقة عكسية بين النسبة المئوية لدهن الذبيحة و درجة شدة التصويم . و لا توجد حالات نفوق خلال فترة التجربة كلها . وجود تحسن في طول الخملات و شكلها و سلامتها في معاملات التحديد الغذائي مقارنة بالكنترول . كذلك تميزت معاملات التحديد الغذائي بأنخفاض تكلفة الإنتاج.

بصفة عامة يمكن أن نستنتج أن معاملات التحديد الغذائي (٧٠%) و التي تم تصويمها لمدة ١٢ ساعة قبل التحديد الغذائي في مرحلة الناهي أعطت أفضل معامل تحويل غذائي و أقل تكلفة في الأنتاج.