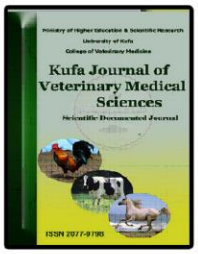
Kufa Journal for Veterinary Medical Sciences Vol.(6). No.(2) 2015

Kufa Journal for Veterinary Medical Sciences
vetmed@uoKufa.edu. iq



Effect of Quantitative Feed Restriction on Some Physiological Parameters of Japanese Quails

Saad Kleman Abd* Faiyz Sami Al-Khateeb**
Thaier Mohammad Abdulbaki**
*Dep. of Pharmacology and Toxicology College of Pharmacy University of Mosul Mosul, Iraq
**Dep. of Animal production College of Agriculture and Forestry University of Mosul Mosul, Iraq
E mail: saadkleman@yahoo.com

Abstract
The aim of this study to evaluate the effect of quantitative feed restriction on some physiological parameters of Japanese Quail. A total of 160 unsexed Japanese Quail aged 21 days were used for this study, divided randomly to four groups, each has four replicates as follows; control group (T1) feed *ad libitum*, treatment (T2), treatment (T3) and treatment (T4), 10%, 20% and 30% feed restriction of the control group value respectively for two weeks. On day 35 all the groups returned to the free feed *ad libitum* till the end of the treatment.
Variables measured includes; productive, hematological and biochemical parameters.
The results shows significant ($p\leq0.05$) effect of feed restriction as the body weight decreased in the 4^{th}, 5^{th} and 6^{th} week, on the other hand the weekly body weight increase, decreased significantly ($p\leq0.05$) in the 4^{th} week and increased significantly ($p\leq0.05$) in the 6^{th} week. The amount of feed taken in 4^{th}, 5^{th} decrease significantly ($p\leq0.05$) and increased significantly ($p\leq0.05$) at the 6^{th} week, but the feed conversion ratio increased significantly ($p\leq0.05$) in the 4^{th} week and decreased ($p\leq0.05$) in the 5^{th} and 6^{th} week, with significant ($p\leq0.05$) increase in the relative growth rate in the 5^{th} and 6^{th} week in T4 . Cholesterol increased while triglycerides decrease significantly ($p\leq0.05$). Hb and PCV decrease significantly ($p\leq0.05$) compared to the control. We can conclude from the results that quantitative feed restriction programs may have some economic benefits with some health hazard through rising cholesterol levels, decreasing Hb and PCV values according to the intensity of feed restriction regimen.
Key words: Quail, feed restriction, body weight, feed conversion ratio. hematology, biochemical.

تأثير التقنين الغذائي الكمي على بعض المعايير الفسلجية لطائر السمان الياباني

سعد كليمان عبد* فائز سامي الخطيب** ثائر محمد عبد الباقي**
* فرع الأدوية والسموم / كلية الصيدله / جامعة الموصل

** قسم الثروة الحيوانية / كلية الزراعه والغابات / جامعة الموصل

الخلاصة:

الهدف من هذه الدراسة هو لتقييم تأثير التقنين الغذائي الكمي على بعض المعايير الفسلجية لطيور السمان الياباني، استخدم 160 طير غير مجنس بعمر21 يوم وزعت عشوائيا الى أربعة معاملات كل معاملة 40 طيرا بواقع أربعة مكررات لكل معامل كل مكرر 10 طيور (مجموعة سيطرةT1 تغذية حره، مجموعة معاملة أولى T2، مجموعة معاملة ثانية T3 ومجموعة معاملة ثالثة T4 10%، 20%، 30% تقنين غذائي كمي من قيم السيطرة بالتعاقب ولمدة أسبوعين) بدء التقنين من عمر 21-35 يوم، أعيدت التغذية الحرة لكل المجاميع الى نهاية التجربة.

أظهرت النتائج وجود تأثيراً معنويا ($p\leq0.05$) للتقنين الغذائي حيث إنخفض وزن الجسم معنويا ($p\leq0.05$) في الأسابيع; الرابع، الخامس والسادس في حين إنخفضت الزيادة الوزنية الأسبوعية معنويا ($p \leq 0.05$) في الأسبوع الرابع وأرتفعت معنويا ($p \leq 0.05$) في الأسبوع السادس. إنخفضت كمية الغذاء المتناولة في الأسابيع; الرابع والخامس وأرتفعت في الأسبوع السادس معنويا ($p\leq0.05$)

ولكن كفاءة التحويل الغذائي أرتفعت في الأسبوع الرابع وإنخفضت في الأسبوع الخامس والسادس معنويا ($p\leq0.05$) مع زيادة معنوية ($p\leq0.05$) في معدل النمو النسبي في الأسبوع الخامس والسادس لT4. وهذا مايفسر فائدة التقنين الغذائي الكمي بالنسبة لوزن الجسم وكفاءة التحويل الغذائي لتعويض النقص الحاصل. بينما أرتفع مستوى الكولسترول وانخفضت الشحوم الثلاثية معنويا p) ($0.05 \leq$ لمجموعة T4 مقارنة ب T1، من جهة أخرى كان هنالك إنخفاضا معنويا ($p\leq0.05$) لتركيز الهيموكلوبين وحجم خلايا الدم المرصوصة لمجموعة T4 مقارنة T1.

يمكن الأستنتاج من نتائج الدراسة الحالية أن برامج التقنين الغذائي الكمي قد يكون لها تأثيرات مفيدة أقتصاديا مع وجود بعض المخاطر الصحية عن طريق رفع مستوى الكولسترول ومن جهة أخرى خفض لتركيز الهيموكلوبين وحجم الخلايا المرصوصة أعتمادا على شدة التقنين الغذائي .

الكلمات الدالة: طير السمان، التقنين الغذائي، وزن الجسم، كفاءة التحويل الغذائي، معايير الدم، المعايير الكيموحيوية.

Introduction:

Feeding cost for poultry is usually considered the most expensive item, reducing feeding cost is the most important factor on profitability. Numerous attempts down on this aspect one of them feed restriction which are cheap, adequate and readily available for feeding livestock.

Quantities and qualitative feed restriction are procedures that can be used to influence the feeding plans of poultry to decrease metabolic rate and growth to some extent.

Food intake can influence most of physiological functions. It is known that deprivation of energy supply induces a delay in the development of some vital functions in mammals; puberty starts later, the reproductive age prolongs, deterioration of immunity and health is delayed (1) . Chang in these vital functions are induced and accompanied by endocrine changes (2).

In general, the potential of feed restriction programs as a managements tool, related to decreasing the incidence of metabolic disease, carcass fat deposition, reduce maintenance requirements and improvement of feed efficiency in broiler chickens production, also can be lead to economical saving in cost of feeding in broiler chicken production, thus may be usefulness for commercial broiler chicks production farms (3).

Food deprivation is a commonly used management strategy in broilers, aiming to prevent excessive weight gain during growth and thereby to solve some health-related problems (4), while also preventing precocious fat deposition (5).

Feed restriction also presents some economic benefits (6,7).

In broilers, feed deprivation is frequently used in an attempt to control fat deposition and to improve feed conversion (6, 8, 9).

Duration of feed restriction to broiler chickens has now become an important issue of animal welfare because feed restriction can act as a stressor on the animal, stresses that occur early in life, while many systems of the chicks are still developing, may have adverse effect on the broilers (10).

Hematological profiles is an important index of physiological state of the individual (11). Hematological tests were usually performed in domesticated birds and served as supplementary data obtained during various experimental procedures. The blood biochemical analysis is important in diagnosis and clinical monitoring of disease (12).

Although early restricted feeding in broilers has been shown to be beneficial in reducing metabolic disorders(13,14, 15). Feed restriction, depending on its severity, could also predispose broilers to stress and reduce productivity (15).

Yet, limited information is available on changes in blood metabolites changes in association with different feed restriction techniques (16).

This experiment had been done to compare the effects of three regimens of quantitative feed restriction imposed in different intensities on body weight (BW), weekly body weight increase, food conversion ratio (FCR), relative growth rate. Hemoglobin (Hb) concentration, packed cell volume (PCV), Red Blood Cells count (RBCs), mean cell volume (MCV), mean cell hemoglobin (MCH) and mean cell hemoglobin concentration (MCHC). Serum glucose, total cholesterol and total triglycerides, to those of *ad libitum* feed in Japanese Quail.

Materials and methods:

A total of 160 unsexed Japanese Quail aged 21day were utilized for this study. The birds were housed in cages of the farms of College of Agriculture and Forestry - University of Mosul, under controlled environmental conditions. The birds given growing ratio according to national research council (N. R. C.), Table (1). Divided randomly to four groups, each has four replicates of 10 birds per replicate as follows; control group (T1) feed *ad libitum*, while the other groups, treatment 2 (T2), treatment 3 (T3) and treatment 4 (T4) where 10%, 20% and 30% quantitative feed restriction of (T1) values respectively. On day 35 all the groups retrained to the free *ad libitum* feed till the end of the treatment.

Variables measured includes; body weight, weekly body weight increase, weekly feed intake, feed conversion ratio and relative growth rate, hematological and biochemical parameters.

At the end of the experiment blood samples were obtained from each group. Divided into two portions; one kept in container contain EDTA for the estimation of Hb, PCV, RBCs count, MCV, MCH and MCHC. Determination of blood parameters were carried out according to procedures described by (17). The other portion of the blood prepared for the separation of the serum by centrifugation (3000 rpm, for 10 min at room temperature) serum was collected and stored in eppendorf tubes at -20^{o}C, until biochemical parameters assayed. Serum samples were analyzed for glucose, total cholesterol, and triglycerides by enzymatic diagnostic kits (18). Glucose determined after enzymatic oxidation in presence of glucose oxidase using kits from Randox.

Cholesterol determination according to the enzymatic end point method by using kits from Randox. Triglycerides determination according to the colorimetric method using kits from Randox, following the same steps as described by manufactures (Randox laboratories limited, United Kingdom).

Table (1): Composition of Quails growing diets.

Ration	growing
Maize (%)	62
Soybean meal, 44% CP (%)	22
Concentrate1 (%)	10
Wheat bran (%)	—
Limestone (%)	5.7
Sodium chloride (%)	0.3
Calculated nutrient content	
Metabolizable energy (kcal/kg)	2,809
Crude protein (%)	20.2
Metabolizable energy (kcal/kg)	2,809
Crude fiber (%)	3.06
Crude fat (%)	3.15
Linolic acid(%)	1.45
Calcium(%)	2.95
Available phosphorus(%)	0.46

Analysis of variance (ANOVA) through General Linear Model procedure of SPSS (10.0) software considering replicates as experimental units, and the values were expressed as means ± standard error. Duncan's multiple range test was used to test the significance of difference between means by considering the differences significant at ($P \leq 0.05$) (19).

Results and discussion:

There are a significant decrease ($P \leq 0.05$) in BW for T4, T3 and T2 compared to T1 at the end of the 4^{th},5^{th} and 6^{th} week of age, Table (2) the decrease was greater in T3 and T4 compared to the other groups.

For weekly body weight increase there are a significant decrease ($P \leq 0.05$) for T4 compared to T1, T2, T3 and for T2 and T3 compared to T1 and T4 at the end of the 4^{th} week of age, on the other hand there are a significant increase ($P \leq 0.05$) in T4 compared to T1, T2, T3 and for T2, T3 compared to T1 and T4 on the 5^{th} and 6^{th} week of age, Table (2).

For the weekly feed intake there are significant decrease ($P \leq 0.05$) in T4, T3, T2 compared to T1 at the end of the 4^{th},5^{th} week of age and increased significantly ($p \leq 0.05$) at the 6^{th} week especially for T3, Table (2).

For the FCR there are a significant increase (P≤0.05) for T4, T3 and T2 compared to T1 at the end of the 4th week of age, and a significant decrease (P≤0.05) for T4, T3 compared to T1 at the end of the 5th week of age, Table (2).

There were a significant (p≤0.05) increase in the relative growth rate in the 5th and 6th week in T4 compared to T1 and the other groups, Table (2).

Table (2): The effect of quantitative feed restriction on body weight (g), weekly body weight increase (g/week), weekly feed intake, feed conversion ratio and relative growth ratio for Japanese Quail.

Body Weight(g)				
Age/weeks	T1(M±SE)	T2(M±SE)	T3(M±SE)	T4(M±SE)
3	107.0±0.3 a	106.8±0.5 a	106.8±0.3 a	106.5±0.2 a
4	139.9±3.9 a	128.3±1.4 ab	124.9±1.0 ab	118.0±2.0 b
5	167.2±3.9 a	152.1±1.9ab	149.6±4.6 b	146.2±4.6 b
6	187.8±6.8 a	175.6±0.6 b	176.5±3.7 b	177.1±4.4 b
Weekly Body Weight Increase(g/week)				
4	32.9±3.8a	21.4±1.8ab	18.1±0.8ab	11.5±1.8 b
5	27.3±4.2 a	23.8±1.2 a	24.7±3.7 a	28.2±4.7 a
6	20.6±3.0 b	23.6±2.3 ab	26.9±1.5 ab	30.9±1.5 a
Weekly Feed Intake(g)				
4	126.0±2.5 a	113.4±1.9ab	100.8±0.9ab	88.2±1.2 b
5	160.4±6.4 a	144.3±2.1 b	128.3±3.1abc	112.3±1.9 c
6	189.9±6.9 b	204.0±5.4ab	226.2±4.5 a	214.8±13.5ab
Feed Conversion Ratio				
4	3.9±0.4b	5.5±0.4ab	5.4±0.2ab	7.0±1.6 a
5	6.0±0.9a	6.2±0.4a	4.7±0.3b	4.8±0.7b
6	9.4±1.5 a	8.4±1.0 a	8.9±0.8 a	7.1±0.7 a
Relative Growth Rate				
4	16.1±0.09a	11.8±0.13b	10.2±0.34b	6.7±0.03c
5	11.5±0.08b	11±0.12b	11.6±0.16b	13.7±0.14a
6	7.6±0.06b	9.4±0.03b	10.7±0.17b	12.4±0.78a

M±SE, The different letters shows significant (p ≤0.05) differences between the columns.

Our results for BW confirms with the results of (20, 6) who shows that in restricted Quail BW were significantly lower than *ad libitum* controls during restriction two weeks after restriction ended, however, BW were no longer different. However, (6) shown that feed intake following feed restriction from 21 to 35 days was significantly reduced, also FCR of feed restriction 7- 21day group are consistent with those of (21). Those results confirms with our results.

Several researches has shown that chickens subjected to feed restriction for short periods during the early growth phase show improvement of feed efficiency and reach normal weight to that chickens feed *ad libitum* at market weight (22, 23, 24).

Compensatory growth after a feed restriction period, associated with increased feed intake and digestive

adaptation allows the broilers chickens to demonstrate better food conversion efficiency and meat yield

when submitted to an early age food restriction (16). Young birds, in their post natal growth period, may reduce their growth and metabolism when facing a food shortage (25). FCR was better in birds under feed restriction 7-21days as compared to the control group ($p \leq 0.05$) (6).

Body data can be useful aids to diagnosis of diseases in birds, moreover and managing abnormalities due to diseases change blood parameters (26, 27).

Our result shows that there are no significant changes in glucose values except for T4 where there is a non significant increase in glucose levels, Table (3). These results in agreement with (16) whose results show no statistical changes for glucose concentrations between feed restricted groups and controls. Further, non significant changes in glucose blood levels in response to feed restriction have also been previously reported by (28, 29, 8).

Table (3): The effect of quantitative feed restriction on glucose, cholesterol and triglycerides for Japanese Quail.

	T1(M±SE)	**T2**(M±SE)	**T3**(M±SE)	**T4**(M±SE)
Glucose(mg/dl)	193.5±27.3 a	191.8±24.2 a	196.8±17.4a	197.8±19.1 a
Cholesterol(mg/dl)	166±21.9 b	165.2±12.9b	166.5±16.6b	169.2±12.9 a
Triglycerides(mg/dl)	98.2±15.5 a	97.5±3.9 a	95.2±10.4 b	95.3±11.0 b

M±SE, The different letters shows significant ($p \leq 0.05$) differences between the columns.

In fact, it would be expected that early after starting feed restriction glucose blood levels would decrease, in association to fasting. Changes in some blood parameters, such as glucose and other metabolites, are expected following diet restrictions in particular when they are extended in time (16).

Changes in the blood metabolites profiles, as well as in the results, may vary with the sort of feed restriction regimen, the diet composition, the duration of food deprivation, the deepen of the induced restriction and with the moment of the rearing period when food restriction is imposed (6, 28, 8).

The higher levels of serum glucose in restricted-fed birds may be due to better FCR, nutrient absorption and glucose synthesis via gluconeogenesis (6).

For the cholesterol concentration the results shows significant increase in T4 and a significant decrease ($P \leq 0.05$) in triglycerides levels in T3 and T4 compared to T1, with agree to (16) results who found a sticking increases in total cholesterol for the mild feed deprivation groups, which parallels a slight decrease in triglycerides levels in blood suggesting that birds are more susceptible to protein catabolism during fasting. (30) who indicated that meal-fed or starved chickens have been shown to have higher plasma cholesterol than control birds. On the other hand birds submitted to severe feed restriction for 2 weeks showed the highest triglycerides,

suggestive of an increased protein catabolism and increased lipid availability for fat deposition (16).

Table (4): The effect of quantitative feed restriction on Hb, PCV and RBCs count, MCV,MCH and MCHC for Japanese Quail.

	T1(M±SE)	**T2**(M±SE)	**T3**(M±SE)	**T4**(M±SE)
Hb (g/dl)	14.6±1.0 a	14.3±0.8a	14.3±0.4a	13.3±0.5 b
PCV %	39.8±4.3a	38.2±4.6a	38.8±1.9a	37.8±4.3b
RBCs x10^6	4.3±0.9 a	4.0±0.1a	4.1±0.2 a	3.9±0.3 a
MCV(fl)	94.3±10.5a	94.7±8.7a	94.6±4.6 a	96.1±8.8 a
MCH (pg)	34.8±4.9 a	35.4±1.3 a	34.7±1.4 a	33.7±1.1 a
MCHC (g/dl)	36.8±1.4 a	37.6±2.5 a	36.8±2.3 a	35.3±3.1 a

M±SE, The different letters shows significant ($p \leq 0.05$) differences between the columns.

Hematological parameters can act as indicators for the state of birds health (31, 32). Hb concentration, PCV decreased significantly ($p \leq 0.05$) in T4 compared to T1 and the other groups. For MCV, MCH, MCHC there are no significant changes, but the MCH, MCHC decreased in T4 which may contribute to the decreased values of Hb and PCV in the same group. This result in agreements with the results of (6) who found significant decrease in hematocrit value as compared to full-fed broilers. And with (33) whose results shows that mean RBC, Hb and MCHC generally decreased as the severity of early skip a day feed withdrawal increased (34).

The decrease in Hb, PCV and RBCs is a normal event as there are several factors including diet contents (35), feed restriction (36, 37) and fasting (2) affect the blood profiles of healthy birds. We suggest from our result that moderate to severe feed restriction may affect Hb formation in Quails and this will affect PCV.

Conclusion:

For concluding, data gathered in the present study showed that quantitative feed restriction starting by day 21-35 of age, followed by *ad libitum* was associated with changes in body weight, weekly body weight, weekly feed intake, feed conversion ratio and relative weight gain for Japanese Quail, which in conclusion the use of such feed regimen programs have an economical values for the farmers, on the other hand it have some bad effect on cholesterol, Hb and PCV. So special attention should be taken by the poultry industries when applying such feed regimen programs.

Introduction:

Feeding cost for poultry is usually considered the most expensive item, reducing feeding cost is the most important factor on profitability. Numerous attempts down on this aspect one of them feed restriction which are cheap, adequate and readily available for feeding livestock.

Quantities and qualitative feed restriction are procedures that can be used to influence the feeding plans of poultry to decrease metabolic rate and growth to some extent.

Food intake can influence most of physiological functions. It is known that deprivation of energy supply induces a delay in the development of some vital functions in mammals; puberty starts later, the reproductive age prolongs, deterioration of immunity and health is delayed (1) . Chang in these vital functions are induced and accompanied by endocrine changes (2).

In general, the potential of feed restriction programs as a managements tool, related to decreasing the incidence of metabolic disease, carcass fat deposition, reduce maintenance requirements and improvement of feed efficiency in broiler chickens production, also can be lead to economical saving in cost of feeding in broiler chicken production, thus may be usefulness for commercial broiler chicks production farms (3).

Food deprivation is a commonly used management strategy in broilers, aiming to prevent excessive weight gain during growth and thereby to solve some health-related problems (4), while also preventing precocious fat deposition (5). Feed restriction also presents some economic benefits (6,7).

In broilers, feed deprivation is frequently used in an attempt to control fat deposition and to improve feed conversion (6, 8, 9).

Duration of feed restriction to broiler chickens has now become an important issue of animal welfare because feed restriction can act as a stressor on the animal, stresses that occur early in life, while many systems of the chicks are still developing, may have adverse effect on the broilers (10).

Hematological profiles is an important index of physiological state of the individual (11). Hematological tests were usually performed in domesticated birds and served as supplementary data obtained during various experimental procedures. The blood biochemical analysis is important in diagnosis and clinical monitoring of disease (12).

Although early restricted feeding in broilers has been shown to be beneficial in reducing metabolic disorders(13,14, 15). Feed restriction, depending on its severity, could also predispose broilers to stress and reduce productivity (15).

Yet, limited information is available on changes in blood metabolites changes in association with different feed restriction techniques (16).

This experiment had been done to compare the effects of three regimens of quantitative feed restriction

imposed in different intensities on body weight (BW), weekly body weight increase, food conversion ratio (FCR), relative growth rate. Hemoglobin (Hb) concentration, packed cell volume (PCV), Red Blood Cells count (RBCs), mean cell volume (MCV), mean cell hemoglobin (MCH) and mean cell hemoglobin concentration (MCHC). Serum glucose, total cholesterol and total triglycerides, to those of *ad libitum* feed in Japanese Quail.

Materials and methods:

A total of 160 unsexed Japanese Quail aged 21day were utilized for this study. The birds were housed in cages of the farms of College of Agriculture and Forestry - University of Mosul, under controlled environmental conditions. The birds given growing ratio according to national research council (N. R. C.), Table (1). Divided randomly to four groups, each has four replicates of 10 birds per replicate as follows; control group (T1) feed *ad libitum*, while the other groups, treatment 2 (T2), treatment 3 (T3) and treatment 4 (T4) where 10%, 20% and 30% quantitative feed restriction of (T1) values respectively. On day 35 all the groups retrained to the free *ad libitum* feed till the end of the treatment.

Variables measured includes; body weight, weekly body weight increase, weekly feed intake, feed conversion ratio and relative growth rate, hematological and biochemical parameters.

At the end of the experiment blood samples were obtained from each group. Divided into two portions; one kept in container contain EDTA for the estimation of Hb, PCV, RBCs count, MCV, MCH and MCHC. Determination of blood parameters were carried out according to procedures described by (17). The other portion of the blood prepared for the separation of the serum by centrifugation (3000 rpm, for 10 min at room temperature) serum was collected and stored in eppendorf tubes at -20^{o}C, until biochemical parameters assayed. Serum samples were analyzed for glucose, total cholesterol, and triglycerides by enzymatic diagnostic kits (18).

Glucose determined after enzymatic oxidation in presence of glucose oxidase using kits from Randox. Cholesterol determination according to the enzymatic end point method by using kits from Randox. Triglycerides determination according to the colorimetric method using kits from Randox, following the same steps as described by manufactures (Randox laboratories limited, United Kingdom).

Table (1): Composition of Quails growing diets.

Ration	growing
Maize (%)	62
Soybean meal, 44% CP (%)	22

Concentrate1 (%)	10
Wheat bran (%)	—
Limestone (%)	5.7
Sodium chloride (%)	0.3
Calculated nutrient content	
Metabolizable energy (kcal/kg)	2,809
Crude protein (%)	20.2
Metabolizable energy (kcal/kg)	2,809
Crude fiber (%)	3.06
Crude fat (%)	3.15
Linolic acid(%)	1.45
Calcium(%)	2.95
Available phosphorus(%)	0.46

Analysis of variance (ANOVA) through General Linear Model procedure of SPSS (10.0) software considering replicates as experimental units, and the values were expressed as means ± standard error. Duncan's multiple range test was used to test the significance of difference between means by considering the differences significant at ($P \leq 0.05$) (19).

Results and discussion:

There are a significant decrease ($P \leq 0.05$) in BW for T4, T3 and T2 compared to T1 at the end of the 4^{th},5^{th} and 6^{th} week of age, Table (2) the decrease was greater in T3 and T4 compared to the other groups.

For weekly body weight increase there are a significant decrease ($P \leq 0.05$) for T4 compared to T1, T2, T3 and for T2 and T3 compared to T1 and T4 at the end of the 4^{th} week of age, on the other hand there are a significant increase ($P \leq 0.05$) in T4 compared to T1, T2, T3 and for T2, T3 compared to T1 and T4 on the 5^{th} and 6^{th} week of age, Table (2).

For the weekly feed intake there are significant decrease ($P \leq 0.05$) in T4, T3, T2 compared to T1 at the end of the 4^{th},5^{th} week of age and increased significantly ($p \leq 0.05$) at the 6^{th} week especially for T3, Table (2).

For the FCR there are a significant increase ($P \leq 0.05$) for T4, T3 and T2 compared to T1 at the end of the 4^{th} week of age, and a significant decrease ($P \leq 0.05$) for T4, T3 compared to T1 at the end of the 5^{th} week of age, Table (2).

There were a significant ($p \leq 0.05$) increase in the relative growth rate in the 5^{th} and 6^{th} week in T4 compared to T1 and the other groups, Table (2).

Table (2): The effect of quantitative feed restriction on body weight (g), weekly body weight increase (g/week), weekly feed intake, feed conversion ratio and relative growth ratio for Japanese Quail.

Body Weight(g)				
Age/weeks	T1(M±SE)	T2(M±SE)	T3(M±SE)	T4(M±SE)
3	107.0±0.3 a	106.8±0.5 a	106.8±0.3 a	106.5±0.2 a
4	139.9±3.9 a	128.3±1.4 ab	124.9±1.0 ab	118.0±2.0 b
5	167.2±3.9 a	152.1±1.9ab	149.6±4.6 b	146.2±4.6 b
6	187.8±6.8 a	175.6±0.6 b	176.5±3.7 b	177.1±4.4 b
Weekly Body Weight Increase(g/week)				
4	32.9±3.8a	21.4±1.8ab	18.1±0.8ab	11.5±1.8 b
5	27.3±4.2 a	23.8±1.2 a	24.7±3.7 a	28.2±4.7 a
6	20.6±3.0 b	23.6±2.3 ab	26.9±1.5 ab	30.9±1.5 a
Weekly Feed Intake(g)				
4	126.0±2.5 a	113.4±1.9ab	100.8±0.9ab	88.2±1.2 b
5	160.4±6.4 a	144.3±2.1 b	128.3±3.1abc	112.3±1.9 c
6	189.9±6.9 b	204.0±5.4ab	226.2±4.5 a	214.8±13.5ab
Feed Conversion Ratio				
4	3.9±0.4b	5.5±0.4ab	5.4±0.2ab	7.0±1.6 a
5	6.0±0.9a	6.2±0.4a	4.7±0.3b	4.8±0.7b
6	9.4±1.5 a	8.4±1.0 a	8.9±0.8 a	7.1±0.7 a
Relative Growth Rate				
4	16.1±0.09a	11.8±0.13b	10.2±0.34b	6.7±0.03c
5	11.5±0.08b	11±0.12b	11.6±0.16b	13.7±0.14a
6	7.6±0.06b	9.4±0.03b	10.7±0.17b	12.4±0.78a

M±SE, The different letters shows significant ($p \leq 0.05$) differences between the columns.

Our results for BW confirms with the results of (20, 6) who shows that in restricted Quail BW were significantly lower than *ad libitum* controls during restriction two weeks after restriction ended, however, BW were no longer different. However, (6) shown that feed intake following feed restriction from 21 to 35 days was significantly reduced, also FCR of feed restriction 7- 21day group are consistent with those of (21). Those results confirms with our results.

Several researches has shown that chickens subjected to feed restriction for short periods during the early growth phase show improvement of feed efficiency and reach normal weight to that chickens feed *ad libitum* at market weight (22, 23, 24). Compensatory growth after a feed restriction period, associated with increased feed intake and digestive adaptation allows the broilers chickens to demonstrate better food conversion efficiency and meat yield

when submitted to an early age food restriction (16). Young birds, in their post natal growth period, may reduce their growth and metabolism when facing a food shortage (25). FCR was better in birds under feed restriction 7-21days as compared to the control group ($p \leq 0.05$) (6).

Body data can be useful aids to diagnosis of diseases in birds,

moreover and managing abnormalities due to diseases change blood parameters (26, 27).

Our result shows that there are no significant changes in glucose values except for T4 where there is a non significant increase in glucose levels, Table (3). These results in agreement with (16) whose results show no statistical changes for glucose concentrations between feed restricted groups and controls. Further, non significant changes in glucose blood levels in response to feed restriction have also been previously reported by (28, 29, 8).

Table (3): The effect of quantitative feed restriction on glucose, cholesterol and triglycerides for Japanese Quail.

	T1(M±SE)	**T2**(M±SE)	**T3**(M±SE)	**T4**(M±SE)
Glucose(mg/dl)	193.5±27.3 a	191.8±24.2 a	196.8±17.4a	197.8±19.1 a
Cholesterol(mg/dl)	166±21.9 b	165.2±12.9b	166.5±16.6b	169.2±12.9 a
Triglycerides(mg/dl)	98.2±15.5 a	97.5±3.9 a	95.2±10.4 b	95.3±11.0 b

M±SE, The different letters shows significant ($p \leq 0.05$) differences between the columns.

In fact, it would be expected that early after starting feed restriction glucose blood levels would decrease, in association to fasting. Changes in some blood parameters, such as glucose and other metabolites, are expected following diet restrictions in particular when they are extended in time (16).

Changes in the blood metabolites profiles, as well as in the results, may vary with the sort of feed restriction regimen, the diet composition, the duration of food deprivation, the deepen of the induced restriction and with the moment of the rearing period when food restriction is imposed (6, 28, 8).

The higher levels of serum glucose in restricted-fed birds may be due to better FCR, nutrient absorption and glucose synthesis via gluconeogenesis (6).

For the cholesterol concentration the results shows significant increase in T4 and a significant decrease ($P \leq 0.05$) in triglycerides levels in T3 and T4 compared to T1, with agree to (16) results who found a sticking increases in total cholesterol for the mild feed deprivation groups, which parallels a slight decrease in triglycerides levels in blood suggesting that birds are more susceptible to protein catabolism during fasting. (30) who indicated that meal-fed or starved chickens have been shown to have higher plasma cholesterol than control birds. On the other hand birds submitted to severe feed restriction for 2 weeks showed the highest triglycerides, suggestive of an increased protein catabolism and increased lipid availability for fat deposition (16).

Table (4): The effect of quantitative feed restriction on Hb, PCV and RBCs count, MCV,MCH and MCHC for Japanese Quail.

	T1(M±SE)	**T2**(M±SE)	**T3**(M±SE)	**T4**(M±SE)
Hb (g/dl)	14.6±1.0 a	14.3±0.8a	14.3±0.4a	13.3±0.5 b
PCV %	39.8±4.3a	38.2±4.6a	38.8±1.9a	37.8±4.3b
RBCs x10^6	4.3±0.9 a	4.0±0.1a	4.1±0.2 a	3.9±0.3 a
MCV(fl)	94.3±10.5a	94.7±8.7a	94.6±4.6 a	96.1±8.8 a
MCH (pg)	34.8±4.9 a	35.4±1.3 a	34.7±1.4 a	33.7±1.1 a
MCHC (g/dl)	36.8±1.4 a	37.6±2.5 a	36.8±2.3 a	35.3±3.1 a

M±SE, The different letters shows significant ($p \leq 0.05$) differences between the columns.

Hematological parameters can act as indicators for the state of birds health (31, 32). Hb concentration, PCV decreased significantly ($p \leq 0.05$) in T4 compared to T1 and the other groups. For MCV, MCH, MCHC there are no significant changes, but the MCH, MCHC decreased in T4 which may contribute to the decreased values of Hb and PCV in the same group. This result in agreements with the results of (6) who found significant decrease in hematocrit value as compared to full-fed broilers. And with (33) whose results shows that mean RBC, Hb and MCHC generally decreased as the severity of early skip a day feed withdrawal increased (34).

The decrease in Hb, PCV and RBCs is a normal event as there are several factors including diet contents (35), feed restriction (36, 37) and fasting (2) affect the blood profiles of healthy birds. We suggest from our result that moderate to severe feed restriction may affect Hb formation in Quails and this will affect PCV.

Conclusion:

For concluding, data gathered in the present study showed that quantitative feed restriction starting by day 21-35 of age, followed by *ad libitum* was associated with changes in body weight, weekly body weight, weekly feed intake, feed conversion ratio and relative weight gain for Japanese Quail, which in conclusion the use of such feed regimen programs have an economical values for the farmers, on the other hand it have some bad effect on cholesterol, Hb and PCV. So special attention should be taken by the poultry industries when applying such feed regimen programs.

References:

1. Banks, W.A., Lebel, C.P. (2002). Strategies for the delivery of leptin to the CNS. J. Drug Targ., 10 (29),7-308.

2. Lamosova, D., Macajova, M., Zeman, M. (2004). Effects of short-term fasting on selected physiological functions in adult male and female Japanese quail. Acta Vet. Brno., 73, 9-16.

3. Sahraei, M. (2012). Feed restriction in broiler chickens production. Bio. in Anim. Husb. 28 (2), 333-352.

4. Cangar, O., Aerts, J. M., Vranken, E., Berckmans, D. (2007). Online growth control as an advance in broiler farm management. Poult. Sci., 86(3), 439-443.

5. Vakili, R., Akbarogli, F. (2006). Effect of feed restriction method during rearing on growth and blood indices of stress in broiler breeder. Proceedings of the XII European Poultry Conference. Ital. J. of Wor. Poult. Sci., pp 6.

6. Boostani, A., Ashayerizadeh, A., Mahmoodianfard, H. R., Kamalzadeh, A.(2010). Comparison of the effects of several feed restriction periods to control ascites on performance, carcass characteristics and hematological indices of broiler chickens. Braz. J. Poult. Sci., 12(3), 171-177.

7. Dunnigton, EA., Siegel, PB. (1996). Long-term divergent selection for eight-week body weight in white Plymouth rock chickens. Poutl. Sci., 78, 1168-1179.

8. Rezaeipor, V., Palangi, M., Irani, M. (2010). Effect of early feed restriction with or without enzyme supplementation on performance, nutrients digestibility and blood biochemical parameters of broiler chickens. J. of Ani. Vet. Ad., 11(5), 622-626.

9. Savory, C.J., Kostal, L., Nevison, I.M. (2006). Circadian variation in heart rate, blood pressure, body temperature and EEG of immature broiler breeder chickens in restricted-fed and ad libitum-fed states. Brit. Poult. Sci., 47(5), 599-606.

10. Azis, A. (2012). Performance and heterophil to lymphocyte (H/L) ratio profile of broiler chickens subjected to feeding time restriction. Int. J. of Poult. Sci., 11(2), 153-157

11. Maxwell, MH. (1993). Avian blood leukocyte responses to stress. W. Poult. Sci. J., 49,34-43.

12. Karesh, W.B., Campo. A.D., Braselton, E., Puche, H., Cook, R.A. (1997). Health evaluation of free ranging and hand reared macaws (Ara spp.) in Peru. J. of Zoo and Wild Life Med., 28, 368-377.

13. Robinson, M. , Clandinin1, M. T. , Bodnar, L. (1990). Growth and body composition of broiler chickens in response to different regimes of feed restriction. Poult. Sci., 69, 2074-2081.

14. Khan, TA., Zafar, F, (2005). Haematological study in response to varying doses of estrogen in broiler chicken. Int. J. Poult. Sci., 10, 748-751.

15. Dozier, WA., Lien, RJ., Hess, JB., Bilgili, SF., Gordon, RW., Laster, CP., Vieira, SL. (2002). Effects of early skip-a-day feed removal on broiler live performance and carcass yield. J. Appl. Poult. Res., 11, 297-303.

16. Hossein, J., Alireza, S., Ali, A. A., Rita, P.C. (2013). Effects of two levels of quantitative feed restriction for a 7- or 14- days period on broilers blood parameters. Acta Sci. Vet., 41, 1144.

17. Mohamed, Kh. H., Mohamed, O.A. (1990). "Practical Animal Physiology " Mousl, Dar El-Hekima publications. Pp 25-31.

18. Afrose, S., Hossain, M. S., Maki, T., Tsujii, H. (2009). Karaya root saponin exerts a hypocholesterlemic response in rats fed a high cholesterol diet. Nutr. Res., 29,350-354.

19. Duncan, D. B.(1955). Multiple range and multiple F tests. Biometrics., 11,1-42.

20. Gebhardt-Henrich, S.G., Marks, H.L. (1995). Effects of feed restriction on growth and reproduction in randombred and selected lines of Japanese quail. Poult. Sci. 74 (2),402-406.

21. Pan, JQ., Tan, X., Li, JC., Sun, WD., Wang, XL. (2005). Effects of early feed restriction and cold temperature on lipid peroxidation, pulmonary vascular remodelling and ascites morbidity in broilers under normal and cold temperature. Brit. Poult. Sci., 46,374-381.

22. Zubair, A.K., Leeson, S. (1994). Effect of varying period of early nutrient restriction on growth compensation and carcass characteristics of male broilers. Poult. Sci., 73, 129-136.

23. Tolkamp, B.J., Sandilands, V., Kyriazakis, I. (2005). Effect of qualitative feed restriction during rearing on the performance of broiler breeders during rearing and lay. Poult. Sci., 84, 1286-1293.

24. Zhan, XA., Wang, MH., Ren, RQ., Zhao, JX. Li., Tan, ZL. (2007). Effect of early feed restriction on metabolic programing and compensatory growth in broiler chickens. Poult. Sci., 86, 654-660.

25. Bernt R., Anne, S., Mortensen Børge, Moe., Olivier Chastel, Augustine Arukwe, Claus Bech. (2009). Food restriction in young Japanese quails: effects on growth, metabolism, plasma thyroid hormones and mRNA species in the thyroid hormone signalling pathway. J. Exp. Biol., 212, 3060-3067.

26. Elizabeth, M., Paulillo, A.C., Elizabeth, S., Rosangela L. D., Edson G. de O. (2007). Haematological and serum chemistry values for the Ringnecked pheasant variation with sex and age. Int. J. of Poult. Sci., 6 (2),137-139.

27. Huss, D. G., Poynterand L., R. (2008). Japanese quail as a laboratory animal model. Lab. Anim., 37,513-519.

28. De Jong, IC., Van Voorst, AS., Blokhuis, HJ. (2003). Parameters for quantification of hunger in broiler breeders. Phys. Beh., 78 (4-5), 773-783.

29. Wang, K.H., Musa, H.H. (2007). The impact of obesity on serum biochemical components. J. of Cell and Ani. Biol.,1 (5), 87-91.

30. Church, D.C., Pond, W.G. (1998). "Basic Animal Nutrition and Feeding". New York, USA: John Wiley and Sons Press. Pp. 185.

31. Thrall, M.A. (2004). " Veterinary Haematology and Clinical Chemistry". Lippincott and Wilkins, Philadelphia. Pp. 518.

32. Elagib, H.A.A., Ahmed, A.D.A. (2011). Comparative study on haematological values of blood of indigenous chickens in sudan. Asian J. of Poult. Sci.,5 (1), 41-45.

33. Iheukwumere, F.C., Abu, A.H., Ameh, M. (2006). Effect of human menopausal gonadotropin on haematological and serum biochemical parameters of Nigerian indigenous chickens. Int. J. Poult. Sci., 5, 632-634.

34. Bratte, L. (2011). Influence of early skip-a-day feed withdrawal on the haematological indices, serum protein and nutrient digestibility of broilers. Pak. J. of Nut., 10 (9), 831-835.

35. Kurtoglu, F., Kurtoglu, V., Celik, T., Keceri, T., Nizamlioglu, M. (2005). Effects of dietary boron supplementation on some biochemical parameters, peripheral blood lymphocytes, splenic plasma cells and bone characteristics of broiler chicks given diets with adequate or inadequate cholecalciferol (vitamin D3) content. Br. Poult. Sci., 46, 87-96.

36. Galip, N. (1999). The effect of restricted feeding on some blood parameters and live weight of turkeys. Vet. Fakult. Derg., Uludag Uni., 18, 149-158.

37. Al-Rawashdeh, O.F., Gumaa, A.Y., Saeed, M., Orban, J.I., Patterson, J.A., Nour, A.Y.M. (2000). Effects of sucrose thermal oligosaccharide carmel and feed restriction on performance, haematological values and ceacal bacteriological count of broiler chickens. Acta Vet. Beograd., 50, 225-239.