Journal homepage
www.ajas.uoanbar.edu.iq
Anbar Journal of Agricultural Sciences
(University of Anbar – College of Agriculture)

IMPACT OF FEED WITHDRAWAL IN DIFFERENT PERIODS ON CARCASS CHARACTERISTICS OF FEMALE BROILER CHIKS

M. M. Mohammed, S. S. Shawkat* and Z. A. Mohammed
College of Agricultural Sciences- University of Sulaimani

***Correspondence to**: Mr. Sarood Samal Shawkat, College of Agricultural Engineering Sciences, Sulaimi University, Iraq.
E-mail: Sarood.shawkat@univsul.edu.iq

Article info

Received: 13-07-2020
Accepted: 07-10-2020
Published: 31-12-2020

DOI -Crossref:
10.32649/aagrs.2022.170522

Cite as:
Mohammed, M. M., Shawkat, S. S. and Mohammed, Z. A. (2020). Impact of feed withdrawal in different periods on carcass characteristics of female broiler chiks. Anbar Journal of Agricultural Sciences, 18(2): 167–177.

Abstract

The study was designed at the Bakrajo Poultry Farm, College of Agricultural Engineering Sciences, University of Sulaimami, Iraq. The research aimed to evaluate the impact of feed withdrawal on carcass cutting and the chemical composition of the female meat of broiler chickens. Three hundred female broiler (Ross 308) randomly distributed into 4 treatment groups with 5 replicates of 15 chicks each. The treatment groups included control T1 with no removal of feed and T2, T3, and T4 with, 6hr, 9hr. and 12 hrs. per 24hr. removal of feed respectively. Two females were randomly selected from each replication based on body weight, weighed alive and sacrificed to estimate the percentage of weight for carcass cuts. The results showed that the percentage of dressings increased in the amount of feed withdrawal in T2, also the abdominal fat was an improvement in T2, with substantial improvement ($p>0.05$) for breast percentage in T2 as well. However, no major differences were found in the thigh and drumstick percentage of female broiler chicken. The effect of treatments was not significant differences on viscera oranges. Overall, withdrawal of feed for 6hr lead to increase dressing and breast percentage also by these methods can decrease abdominal fat pad and declining feed costs of female's broilers.

Keywords: Female Broiler, Feed Removal, Meat Quality, Carcass Composition.

تأثير سحب العلف في الفترات المختلفة على صفات ذبيحة اناث فروج اللحم

محمد محمود محمد، سروود سامال شوكت* وزينا عباس محمد
كلية هندسة العلوم الزراعية ـ جامعة السليمانية

***المراسلة الى:** م. م. سروود سامال شوكت، كلية هندسة العلوم الزراعية، جامعة السليمانية، العراق.

البريد الالكتروني: Sarood.shawkat@univsul.edu.iq

الملخص

اجريت هذه الدراسة في حقول بكرجو، كلية علوم الهندسة الزراعية، جامعة السيمانية، العراق. هدفت التجربة إلى تقييم تأثير سحب العلف على قطعيات الذبيحة والتركيب الكيميائي للحوم إناث الفروج اللحم. تم استخدام 300 أنثى فروج اللحم (ROS 308)، عشوائيا وزعت على 4 معاملات مع 5 مكررات و15 كتكوت لكل مكرر. اول الاسبوعين كانت تقديم العلف لحد الاشباع، مجموع المعاملات كانت كالاتي: معاملة 1 السيطرة بدون السحب، معاملة الثانية، معاملة الثالثة ومعاملة الرابعة سحب العلف 6، 9 و12 ساعة/ 24 ساعة على التوالي. تم اختيار 2 إناث عشوائياً من كل مكرر على أساس وزن الجسم الحي وعلى اساسها تم اخذ النسب المئوية لقطعيات الذبيحة. أظهرت النتائج أن نسبة التصافي زادت في معاملة الثانية، وتحسن في دهن البطن ايضا كانت في المعاملة الثانية وتحسن معنوي في النسبة المئوية لوزن الصدر في المعاملة الثانية. ومع ذلك، لم توجد فروق جوهرية في النسبة المئوية لكل من الفخذ وعصى الطبل لإناث فروج اللحم. وليست هنالك فروق معنوي بنسبة الأعضاء الاحشاء. بشكل عام، سحب العلف لمدة 6 ساعة يؤدي الى زيادة كل من نسبة التصافي ونسبة الصدر، وايضا بهذه الطرق يمكن أن تقلل تكاليف العلف لإناث فروج اللحم

كلمات مفتاحية: أناث فروج، سحب العلف، جودة اللحم والتركيب الذبيحة.

Introduction

Production of poultry meat has become one of the most diverse sectors of animal development. Poultry meat is considered amongst the available meat sources to be healthy and nutritious (1). (9) Reported that, Ad libitum feeding can result in consumption that exceeds bird maintenance and production requirements, as well as excessive body fat deposition that decreases the quality of meat. In the last two decades, consumer preferences for leaner meat have increased due to the correlation between cardiovascular diseases and the consumption of certain fats by humans. This in turn led the researchers to focus on lowering abdominal fat accumulation in broiler chicken, and making leaner carcasses (10). Fat is an undesirable substance that not only increases the incidence of metabolic diseases and skeletal disorders but also causes problems in feed quality, difficulties in the processing of meat, and the rejection of meat by consumers for health reasons (36). (28), Excessive body fat accumulation of full-fed broilers has been reported to be one of the main carcass and meat quality factors that are attracting increased attention from processors and consumers. Early feed restriction programs used in broiler chickens to minimize abdominal and carcass fat depend on the phenomenon called compensatory growth to achieve consumer bodyweight comparable

to control groups (29). (15), mentioned that feed restraint programs minimize abdominal and carcass fat, the early impact of, there is a variety of feed limitations on other carcass and body components. (30), that was mentioned birds tend to have greater body weight when they eat more at the market age. The improvement noted in market body weight was achieved due to increased consumption of feed, which is genetic-related and nutritionally supplied. The most suitable technique for reducing the prevalence of metabolic disorders is to subject broiler chickens too early feed restriction (2). Limited broiler feeding reduces fat content in carcasses and increases protein deposition, optimizing carcass structure (25). This experiment aimed to implement feed withdrawal to control the increase of carcass weight, reduce abdominal fat pad, decrease the response of the metabolic disease, and determine the chemical composition of carcass of female broiler chickens.

Materials and Methods

Insgesamt of 300 Female broiler chickens with identical initial body (Ross 308) Weight was randomly allocated to 4 treatments of 15 birds per pen in 5 replicates each. The experiment was carried out at Bakrajo Poultry Farm, College of Agricultural Engineering Sciences, University of Sulaimami, Iraq. Birds were fed ad libitum for the first 2 weeks and subsequently moved to daily restriction to assess the effect of withdrawal of feed on the carcass treatise of female broiler chicks. All birds were kept throughout the experiment under a 24 hours continuous light program with ad libitum access to water. The experiment was followed by a completely randomized design with 4 treatments: T1= Control, T2= Remove 9am-3pm, T3= Remove 9am-6pm and T4= Remove 9am-9pm. The chicks were grown using the following three separate diets: during the age of 1-14days including 22.5% crude protein and 2990 Kcal/kg, during the age of 15-28days including 21.25% crude protein and 3020 Kcal/kg, and the age of 29-42days including 19.5% crude protein and 3090Kcal/kg. All experimental diets have been designed to meet or exceed slightly the required broiler requirements (NRC, 1994).

Slaughtering and Preparation of Birds After a period of hunger, the slaughtering process was performed manually using a sharp knife and followed the hand scalding method after 1.5 minutes of slaughter, where the hands were caught from the legs and the carcass was dipped into the basin scalding 1.5 for 2 minutes. They were de-feathered and the legs were then cut manually from the knee joint. Instead, it has to manually eviscerate the viscera by incising around 5 cm of abdominal regions. Finally, the carcass was individually cut into pieces according to the same procedure for each carcass and its pieces were weighed. After extracting the skin from different locations, samples were then taken from the breast and thigh muscles and put in a small nylon bag to study the chemical composition and deposited within a freezer (temperature -5 0C).

Table 1 shows the component structure of the diet given to broilers aged 1 d to 42 days.

Ingredient, % as feed-basis	Starter percentage From 1 – 14 days	Growth percentage From 15 – 28 days	Finisher percentage From 29 – 42 days
Wheat	23.6	23	27.5
Corn	35.5	34.8	39.7
Meat and bone meal (40%)	3	0.6	0.4
Soybean meal (%44)	29.9	33.04	23.28
Sunflower seed Oil	4	5	5
Dual-calcium phosphate	2.3	1.94	1.86
Limestone	1.15	1.16	1.11
Salt	0.25	0.25	0.25
Methionine	0.2	0.11	0.8
Premix	0.1	0.1	0.1
Total	100	100	100
Chemical analysis of the diet			
** Crude protein %	22	20	17
* Metabolisable energy Kcal/kg	2919	3056	3079
** Ether extract %	5.3	6.05	6.12
* Crude fiber %	3.57	3.65	4.00
** Calcium %	1.19	1.11	1.22
** Phosphor %	0.76	0.55	0.57
* Lysine %	1.19	1.2	1.01
* Methionine + Cysteine %	0.89	0.92	0.89

Premix (Vitamin. A 800.000 IU; Vitamin. D3 170.000 IU; Vitamin. E 980 mg; Vitamin. K 95 mg; Vitamin. B1 13 mg; Vitamin. B2 220 mg; Vitamin. B6 75 mg; Vitamin. B12 800 mg; Folic acid 20 mg; Choline Chloride 12.000 mg; Antioxidant 1.900 mg; Iron 2.500 mg; Copper 400 mg; Zinc 2.600 mg; Selenium 7.5 mg; Calcium 24.00%; Sodium 5.40%; Phosphorus 8.40%; Methionine 5.40%; Methionine + Cystine 5.70% and Lysine 5.60%.

Data collection, after 42 days of raising, the characteristics of the carcass were taken: From each replication, two females were randomly selected based on body weight, weighed alive and sacrificed to estimate the percentage of weight for dressing, breast, back, wings, thigh, and drumstick.
The proportion of dressing determined from the equation:

$$\textbf{Dressing percentage (without edible viscera)} = \frac{\textbf{weight of carcass (g)}}{\textbf{live weight (g)}} \times 100 \quad (13)$$

Breast, Back, Wings, Thigh, Drumstick and Leg percentage, the main parts of the breast, back, wings, thigh, drumstick, and leg were calculated according to (14).Viscera internal rate of ingested into the live body weight: After slaughtering of birds and separation of the edible viscera (liver, heart, gizzard and abdominal fat), each proportion was calculated according to (14). Chemical Analysis of Carcass:
Analysis of meat sample taken from breast, thigh, and wings at 42 days of age: Determination of protein, the method mentioned in the (6) was followed to estimate the protein by finding percentages of all nitrogen in meat samples using Micro-Kjeldahl, Determination of fat, to estimate the fat, the method (Soxhlet), mentioned by (3) was followed, determination of moisture. The method described in the (6) was followed by system Oven to estimate moisture at temperature 105 c for 24h.

Determination of ash the method described by (19) for estimating 5-6h of the Ash by system Muffle Furnace at 550 c temperature.

Methods of data analysis using Excel software, all data collected in the experiment were analyzed. Calculations of the parameters would be performed for the different treatments. Using XLSTAT (37), the data were analyzed. By using Duncan test significant differences at the meaning level of (0.05), a comparison of means is also conducted. The mathematical model for a project is as follows:

$Xij = \mu + Tj + eij$

Xij: Observation of the i replicate in j treatment

μ: Mean of all the data

Tj: The effect of j experimental treatments

eij: The effect of experimental error

Results and Discussion

The impact of feed withdrawal factor on dressing, breast, back, wings, thigh, and dramatics percentage of females showed in Table (2). The results of all characteristics percentage were no significant differences in all treatments except the breast percentage. The impact of feed withdrawal factor on breast percentage, the results indicate important differences (P≥0.05), great percentage Represented in T2 (42.69%), and was different from others. The lowest percentage was in T1(control) (39.16%).

Table 2 Impact of feed withdrawal in different periods on dressing, breast, back, wings, thigh, and drumstick percentage of female broiler chicks:

T.	Percentage				
	Breast	Back	Wings	Thigh	Drumstic
T1	39.16 ± 0.31^{b}	21.40 ± 0.20^{a}	9.87 ± 0.42^{a}	16.85 ± 0.30^{a}	11.16 ± 0.19^{a}
T2	42.69 ± 0.38^{a}	20.33 ± 1.02^{a}	9.26 ± 0.57^{a}	14.50 ± 1.35^{a}	13.00 ± 2.33^{a}
T3	40.24 ± 0.38^{ab}	20.41 ± 0.03^{a}	10.20 ± 0.71^{a}	16.85 ± 1.85^{a}	10.27 ± 0.27^{a}
T4	39.96 ± 1.09^{b}	20.17 ± 0.72^{a}	9.62 ± 0.08^{a}	16.82 ± 1.02^{a}	12.06 ± 0.14^{a}

There are different values within columns in different letters (P≥0.05)

T1= Control, T2= Remove 9am-3pm, T3= Remove 9am-6pm and T4= Remove 9am-9pm

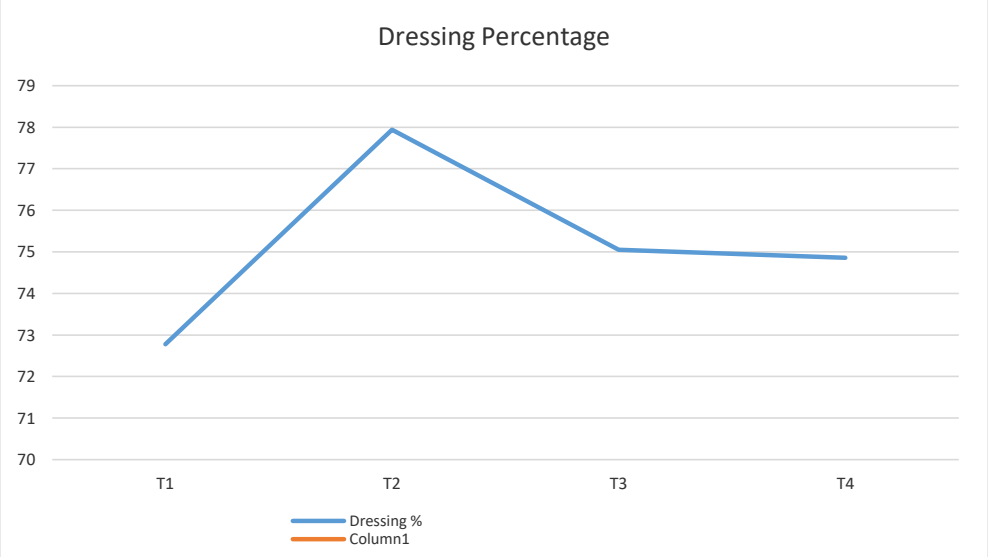

Figure 1 Impact of feed withdrawal in different periods on dressing percentage

The impact of feed withdrawal factor on viscera internal was shown in Table (3). The effect of treatment on liver, heart, gizzard, and abdominal fat showed no significant differences.

Table 3 Impact of feed withdrawal in different periods on liver, heart, gizzard, abdominal fat, and leg percentage of female broiler chicks (Mean ± S.E.)

T.	Percentage				
	Liver	Heart	Gizzard	Abdominal fat	Leg
T1	2.78 ± 0.03[a]	0.53 ± 0.08[a]	1.10 ± 0.11[a]	1.26 ± 0.09[a]	2.72 ± 0.270[a]
T2	3.68 ± 0.37[a]	0.51 ± 0.14[a]	1.07 ± 0.10[a]	0.95 ± 0.05[a]	2.76 ± 0.080[a]
T3	3.10 ± 0.08[a]	0.45 ± 0.02[a]	1.28 ± 0.15[a]	1.16 ± 0.17[a]	2.27 ± 0.190[a]
T4	3.11 ± 0.39[a]	0.52 ± 0.06[a]	1.24 ± 0.24[a]	1.11 ± 0.22[a]	3.10 ± 0.445[a]

There are different values within columns in different letters (P≥0.05)
T1= Control, T2= Remove 9am-3pm, T3= Remove 9am-6pm and T4= Remove 9am-9pm

Table 4 show the impact of feed withdrawal factor on moisture, protein, ash, and fat percentage of breast. Moisture, protein, ash, and fat percentage in the breast were not significantly affected by treatments in females.

Table 4 Impact of feed withdrawal in different periods of chemical composition Percentage on the breast of female broiler chicks (Mean ± S.E.)

T.	Percentage			
	Moisture	Protein	Fat	Ash
T1	72.06 ± 0.47[a]	19.59 ± 0.16[a]	0.68 ± 0.02[a]	1.02 ± 0.47[a]
T2	73.17 ± 1.15[a]	19.78 ± 0.31[a]	0.52 ± 0.03[a]	1.17 ± 0.45[a]
T3	72.16 ± 1.49[a]	19.51 ± 0.40[a]	0.51 ± 0.03[a]	1.23 ± 0.46[a]
T4	74.11 ± 0.99[a]	20.03 ± 0.27[a]	0.69 ± 0.14[a]	1.11 ± 0.40[a]

There are different values within columns in different letters (P≥0.05)
T1= Control, T2= Remove 9am-3pm, T3= Remove 9am-6pm and T4= Remove 9am-9pm

Table 5 show the effect of feed withdrawal factor on moisture, protein, ash, and fat percentage of wings. Moisture, protein, ash, and fat percentage in wings were not significantly affected in females.

Table 5 Impact of feed withdrawal in different periods of chemical composition Percentage on wings of female broiler chicks (Mean ± S.E.)

T.	Percentage			
	Moisture	Protein	Fat	Ash
T1	74.85 ± 2.40[a]	20.23 ± 0.65[a]	1.50 ± 0.10[a]	1.34 ± 0.23[a]
T2	75.18 ± 1.59[a]	20.32 ± 0.43[a]	1.31 ± 0.05[a]	1.22 ± 0.03[a]
T3	74.58 ± 0.84[a]	20.16 ± 0.23[a]	1.42 ± 0.12[a]	1.46 ± 0.21[a]
T4	74.75 ± 0.86[a]	20.21 ± 0.23[a]	1.47 ± 0.18[a]	1.18 ± 0.07[a]

There are different values within columns in different letters (P≥0.05)
T1= Control, T2= Remove 9am-3pm, T3= Remove 9am-6pm and T4= Remove 9am-9pm

Table (6) show the impact of feed withdrawal factor on moisture, protein, ash, and fat percentage of Thigh. Moisture, protein, ash, and fat percentage in Thigh were not significantly affected by treatments in females.

Table 6 Impact of feed withdrawal in different periods of chemical composition Percentage on the Thigh of female broiler chicks (Mean ± S.E.)

T.	Percentage			
	Moisture	**Protein**	**Fat**	**Ash**
T1	75.05 ± 0.67[a]	20.29 ± 0.18[a]	0.84 ± 0.04[a]	1.18 ± 0.06[a]
T2	75.16 ± 1.05[a]	20.31 ± 0.28[a]	0.66 ± 0.07[a]	1.19 ± 0.03[a]
T3	73.75 ± 0.96[a]	19.93 ± 0.26[a]	0.82 ± 0.10[a]	1.17 ± 0.06[a]
T4	75.02 ± 0.42[a]	20.28 ± 0.12[a]	0.74 ± 0.16[a]	1.18 ± 0.08[a]

There are different values within columns in different letters (P≥0.05)
T1= Control, T2= Remove 9am-3pm, T3= Remove 9am-6pm and T4= Remove 9am-9pm

The feed withdrawal groups showed a higher percentage of the dressing in contrast with the control. (1), reported that the feed restriction there was no substantial difference (P>0.05) in percentage dressing between the experimental groups. (17) obtained the same spectrum of dressing percentage. Feed withdrawal improved breast percentage (P<0.05), In contrast with the control because the pieces of the body are positively linked to the weight of the living body, particularly the main pieces that are mainly the breast because the increase in weight is the product of having a large portion of meat and a small portion of the bone (3) and (30). (11), it got the same range, feed restrictions improved FCR (P<0.01), increased breast relative weight (RW) (P<0.05) compared to the control groups. Restriction of broiler performance and carcass characteristics during the second/third week of age and indicated that the severity and duration of the restraint of carcass, breast, and abdominal fat were significant (p>0.5) (21). (34), it got the same result, the feed restriction methods were significant differences were found among breast percentage of (p≥0.05) when compared with the control group in female's broiler chicks. In a research undertaken to determine the effect of restricting feed on duck carcass traits, (27), reported that feed restriction while no substantial (P<0.05) variations between, leg, back, wing, and nick weights were observed.

This refers to the proportion of the thigh piece after breast which is the largest piece, and its dominance is due to the rise in body weight (12). After all, the body parts are positively related to living body weight, which means that any rise in living body weight raises the thigh and drumstick proportion because the increase is due to its large meat portion and small bone portion. (38), reported that, not statistically relevant variations (P > 0,05) were found in the relative weights Carcass percentage and cut-out sections (head, leg, thigh, and, back). Feed restriction was not significantly affected on leg and wing yields expressed as carcass (31).

(1) Showed that the general pattern of increased liver percentage and gizzard when extreme feed withdrawal were imposed on the birds. (24), indicated that as compared to the control group, heart weight still shows no noticeable difference. (24) Also reported that the feed removal between 4-8 hr. in females was no affected significantly

on liver and heart percentage. Feed removal decreases the amount of feed intake and raises the amount of feed means maximum gizzard, resulting in increased frequency of gizzard contractions, resulting in increased muscle gizzards and finally a large gizzard scale (26). The lowest abdominal fat percentage showed in the feed withdrawal groups when compared to the control. (16), Noted that the abdominal fat pad weight of limited broilers was lower than that of ad libitum broilers but not statistical significance; except those limited to 50% of ad libitum. Considerable attention has been given to the use of overall Early-age feed limitation to generate compensatory production, enhanced feed quality, and reduced abdominal fat surface (22). (29), showed that the rapid growth restriction due to feed restriction has resulted in enhanced feed performance due to decreased maintenance energy consumption and improved carcass quality leading to declining fat deposition. The feed withdrawal did not change carcass, liver, gizzard, and abdominal fat weights significantly (4). (20) Also proved the higher abdominal fat content in restrained chickens. Also, the same researchers concluded a rise in the abdominal fat percentage was more actually spelled with the female broilers than with the males. Our research has seemed to endorse this declaration, since this bird-group display a tendency towards a larger proportion of the breast muscle in the carcass. The trend towards higher levels it was also evident in T4 of crude protein in the muscles relative to the control group, around the same time, however, the muscles of these birds were distinguished by greater amounts of fat than those of the other classes. (5) Findings, also recommend a large proportion of crude protein and crude fat in feeding-restricted broiler muscles. (32), (35) and (8) previously reported the we found higher levels of ash in the meat of restrained rabbit broilers. On the other hand, feed restriction methods were no significant differences in chemical composition on carcass cuts (34). In closing, this study indicated that a 6hr feed removal from 2 weeks old was a suitable technique to increase RW of the breast's and dressing percentage, with a decrease in the abdominal fat percentage of female’s broiler chickens. Deception of feed withdrawal can be advantageous for female broiler chicken production because: it improves feed quality, reduces carcass fat deposition sequential occurrence of metabolic disorder and human health problem, and increases productivity by decreasing feed loss.

References

1. Abdelraheem, N., Ahmed, M. M. M., and Hou, F. (2018). Effect of Feed Restriction on Broiler Chicks Prior to Slaughter. Open Journal of Animal Sciences, 9(1): 12-22.
2. Afsharmanesh, M., Lotfi, M., and Mehdipour, Z. (2016). Effects of wet feeding and early feed restriction on blood parameters and growth performance of broiler chickens. Animal Nutrition, 2(3): 168-172.
3. Abubakar, I., Irvine, L., Aldus, C. F., Wyatt, G. M., Fordham, R., Schelenz, S., and Hunter, P. R. (2007). A systematic review of the clinical, public health and cost-effectiveness of rapid diagnostic tests for the detection and identification of

bacterial intestinal pathogens in faeces and food. Health technology assessment (Winchester, England), 11(36): 1-216.

4. Ali, S. M.; Abdalla H. O. and Abaseid. M. A. (2011). Effects of skip-a-day feeding, feed removal and feed dilution on broiler performance under the tropics. Egyptian J. Nutrition and Feeds. 14 (3): 445-452.
5. AL-Taleb, S. S. (2003). Effect of an early feed restriction productive performance and carcass quality. Journal of Biological Sciences, 3:607-611.
6. AOAC. Association of Analytical Chemists. (1985). Official Methods of Analysis Washington DC, USA.
7. Avcilar, Ö. V. and Onbasilar E. E. (2016). Effects of breeder age and early energy restriction on fattening performance, some meat quality traits and plasma leptin concentration of broilers. Ankara Ankara Universitesi Veteriner Fakultesi, 63; 69-76.
8. Bovera, F., Piccolo, G., D'Urso, S., Nizza, S., and Cutrignelli, M. I. (2008). Feed restriction during summer: effect on rabbit carcass traits and meat quality. In Proceedings of the 9th World Rabbit Congress, Verona, Italy, 10-13 June 2008 (pp. 1325-1330). World Rabbit Science Association.
9. Butzen, F. M., Ribeiro, A. M. L., Vieira, M. M., Kessler, A. M., Dadalt, J. C., and Della, M. P. (2013). Early feed restriction in broilers. I–Performance, body fraction weights, and meat quality. Journal of Applied Poultry Research, 22(2): 251-259.
10. Cabel, M. C., and Waldroup, P. W. (1990). Effect of different nutrient-restriction programs early in life on broiler performance and abdominal fat content. Poultry Science, 69(4): 652-660.
11. Davoodi-Omam M., Dadashbeiki M., Corazzin M. and Alireza S. (2019). Effect of feed restrictions on performance, blood variables and immunity of broiler chickens. Veterinarski Arhiv 89 (1): 71-86.
12. Dozier III, W. A., Lien, R. J., Hess, J. B., and Bilgili, S. F. (2003). Influence of early skip-a-day feed removal on live performance and carcass yield of broilers of different sexes and strain sources. Journal of applied poultry research, 12(4): 439-448.
13. Fayad, H. A. A. and Naji S. A. H. (1989). Technology Poultry Products. The first edition, the printing press directorate of the Ministry of Higher Education, Baghdad, pp. 78.
14. Hadmi, J. N. (1994). The Scientific Manual for the Production of Meat and Layer chicken, the first edition, the madena Establishment for Press, Dar alam. Jeddah, Saudi Arabia.
15. Jahanpour, H., Seidavi, A., Qotbi, A. A. A., Van Den Hoven, R., Rocha e Silva, S., Laudadio, V., and Tufarelli, V. (2015). Effects of the level and duration of feeding restriction on carcass components of broilers. Archives Animal Breeding, 58(1): 99-105.
16. Jalal, A. R. M. and Zakaria H. A. (2012). The Effect of quantitative feed restriction during the starter period on compensatory growth and carcass characteristics of broiler chickens. Pakistan Journal of Nutrition, 11(9):719-724.

17. Janocha, A., Osek, M., Klocek, B., Wasilowska, Z., and Turyk, Z. (2003). Quality evaluation of broiler chickens of various genetic groups. Journal of Applied Scientific Reports, 68(4): 141-148.
18. Khurshid A., Khan A. A., Banday M. T., Ganai A. M., Khan H. M., Choudhary A. R., Adil S., Manzoor A, Afzal I. and Madeeha U. (2019). Effect of feed restriction on performance of broiler chicken. Journal of Entomology and Zoology Studies, 7(2): 1054-1056.
19. Leeson, S., Caston, L., Kiaei, M. M., and Jones, R. (2000). Commercial enzymes and their influence on broilers fed wheat or barley. Journal of applied poultry research, 9(2): 242-251.
20. Lippens, M., Room, G., De Groote, G., and Decuypere, E. (2000). Early and temporary quantitative food restriction of broiler chickens. 1. Effects on performance characteristics, mortality and meat quality. British Poultry Science, 41(3): 343-354.
21. Mirshamsollahi A. (2013). Effect of different food restriction on performance and carcass characteristics of Arian and Ross broiler chickens. International Journal of Agriculture: Research and Review, 3(3): 495-501.
22. Naji, S. A. H. (2006). Commercial Broiler Production Manual. Technical bulletin. Iraqi International of Poultry Science Association, pp. 34
23. NRC (National Research Council). (1994). Nutrient Requirements of Poultry. Nine Revised Edition, National Academy Press, Washington DC. pp. 67
24. Nwabuzor, C. (2008). Quantitative Feed Restriction on Broiler Chickens; Effect on the growth performance and carcass characteristics. Agriculture diary.
25. Omosebi D.J., Adeyemi O. A., Sogunle M. O., Idowu O. M. O. and joku C. P. N. (2014). Effectsof duration and level of feed restriction on performance and meat quality of broiler chickens. Arch. Zootec., 63: 611–621.
26. Okuda, Y., Ono, M., Shibata, I., Sato, S., and Akashi, H. (2006). Comparison of the polymerase chain reaction-restriction fragment length polymorphism pattern of the fiber gene and pathogenicity of serotype-1 fowl adenovirus isolates from gizzard erosions and from feces of clinically healthy chickens in Japan. Journal of veterinary diagnostic investigation, 18(2): 162-167.
27. Osman A. M. A. (1993). The effect of quantitative feed restriction on growth performance, carcass traits and meat quality of male peking ducks. Tropical agriculture, magazine for the agriculture in the tropics and subtropics 94 vintage. april. 45-57.
28. Richards, M. P., and Proszkowiec-Weglarz, M. (2007). Mechanisms regulating feed intake, energy expenditure, and body weight in poultry. Poultry science, 86(7): 1478-1490.
29. Saber, S. N., Maheri-Sis, N., Shaddel-Telli, A., Hatefinezhad, K., Gorbani, A., and Yousefi, J. (2011). Effect of feed restriction on growth performance of broiler chickens. Ann. Biol. Res, 2(6): 247-252.
30. Sahraei, M. (2012). Feed restriction in broiler chicken's production: a review. Global Veterinaria, 8(5): 449-458.

31. Saleh, E. A., Watkins, S. E., Waldroup, A. L., and Waldroup, P. W. (2005). Effects of early quantitative feed restriction on live performance and carcass composition of male broilers grown for further processing. Journal of Applied Poultry Research, 14(1): 87-93.
32. Santoso, U. (2001). Effects of early feed restriction on growth, fat accumulation and meat composition in unsexed broiler chickens. Asian-Australasian Journal of Animal Sciences, 14(11): 1585-1591.
33. Seyyed N. S., Maheri-Sis N., Shaddel-Telli A., Hatefinezhad K., Gorbani A.and Yousefi J. (2011). Effect of feed restriction on growth performance of broiler chickens. Annals of Biological Research, 2(6):247-252.
34. Shawkat, S. S. and Rashid S. A. (2018). Effect of Different Feeding Programs on Carcass Traits of Broiler Chicks. Journal of Zankoy Sulaimani. JZS. (2018) Special Issue, 2nd International Conference of Agricultural Sciences.
35. Tumová, E., Skřivan, M., Skřivanová, V., and Kacerovska, L. (2002). Effect of early feed restriction on growth in broiler chickens, turkeys, and rabbits. Czech Journal of Animal Science, 47(10), 418-428.
36. Urdaneta-Rincon M. and Leeson S. (2002). Quantitative and Qualitative Feed Restriction Growth Characteristics of Male Broiler Chickens. Poultry Science.; 81:679-688.
37. Yamin, S., and Kurniawan, H. (2009). SPSS Complete: Teknik Analisis Statistik Terlengkap dengan Software SPSS. Jakarta: Salemba Infotek.
38. Yakubu A., Idahor K. O., Usman E. A., Jonathan L. F. and Musa-Azara I. S. (2013). Effect of feed restriction on growth performance, body conformation, carcass characteristics and cost-benefit in btroiler chicken. Wayamba Journal of Animal Science, P704-P713.
39. Yang, Y. X., Guo, J., Yoon, S. Y., Jin, Z., Choi, J. Y., Piao, X. S., ... and Chae, B. J. (2009). Early energy and protein reduction: effects on growth, blood profiles and expression of genes related to protein and fat metabolism in broilers. British Poultry Science, 50(2): 218-227.