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# Research Article
# Effects of Feeding Time Restriction During the Whole Rearing Period on the Growth Performance of Broiler Chickens

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## Abstract

**Background and Objective:** Feeding time restriction is an alternative lower-intensity feed restriction practice and could be less stressful than higher-intensity feed restriction practices. Feeding time restriction is more likely to provide the beneficial effects of feed restriction without adverse effects on growth. This study aimed to determine the effects of feeding time restriction on the growth performance of broiler chickens during the 35 days production period. **Materials and Methods:** Three hundred 1-day-old unsexed broiler chickens of the Lohmann commercial strain were used in a completely randomized design with 4 treatments and 5 replications. The treatments were as follows: broilers were fed *ad libitum* as a control group (P-0); broilers had free access to feed for 8 h day$^{-1}$ from 1-21 days of age and then were fed *ad libitum* from 22-35 days of age (P-1); broilers had free access to feed for 8 h day$^{-1}$ from 1-21 days of age and then for 12 h day$^{-1}$ from 22-35 days of age (P-2); broilers had free access to feed for 12 h day$^{-1}$ from 1-21 days of age and then were fed *ad libitum* from 22-35 days of age (P-3); and broilers had free access to feed for 12 h day$^{-1}$ from 1-35 days of age (P-4). Body weight and feed intake values were recorded weekly and body weight gains and feed conversion ratios were calculated. Two broiler chickens from each pen were used to measure the size of the carcass, abdominal fat pad and internal organs at 35 days of age. **Results:** At 21 day of age, the body weight and body weight gain values of the broilers that had feeding time restrictions (P-1, P-2, P-3 and P-4) were significantly lower than those of the broilers fed *ad libitum* (P-0). No significant effects of the feeding time restriction treatments on body weight gains were found during the growing period from 22-35 days of age but at 35 day of age, the P-3 broilers had no significant differences in body weight compared to the weight of the broilers fed *ad libitum* (P-0). At 21 day of age, feed intake values and feed conversion ratios in the feeding time restriction treatments were significantly lower than those in P-0. However, the P-2 and P-4 broilers had lower feed intake values and feed conversion ratios during the growing period at 35 day of age. There were no differences among the treatments in the weights of the carcass, abdominal fat pad and gizzard; however, the weights of the internal organs, such as the liver, small intestine and pancreas, were significantly increased in broilers that experienced smaller feeding time restrictions. **Conclusion:** Program for restricting feed for 12 h day$^{-1}$ from 1-21 days of age could be applied as a useful rearing management technique, resulting in a lower feed intake and no detrimental effects on the performance of broiler chickens.

Key words: Broiler, feed intake, feed restriction, growth performance, rearing management

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

In Indonesia, most smallholder poultry production systems use a conventional open-sided house without an equipped temperature control to raise broiler chickens. In tropical countries, high ambient temperatures are an inhibiting factor for the best genetic potential of broiler chickens. Al-Aqil *et al.*[1] reported that broilers raised in a conventional open-sided house with high temperature and humidity (24-34°C and 65-75% RH) showed decreased growth, feed intake and feed conversion.

Restricting feed during hot days is a strategy that reduces heat stress through the processes of decreasing metabolic heat production and body temperature[2,3]. Christensen *et al.*[4] indicated that an increase in body temperature reflects physiological stress that affects the performance of chickens. Previous studies have shown that feed withdrawal during high environmental temperatures can improve feed conversion and reduce mortality without affecting body weight[5], increase resistance to heat stress and improve the immune response[6,7] as well as lower body temperature through the process of decreasing the metabolic rate[4]. Based on this condition, feed withdrawal during the hot hours of the day may be helpful to reduce metabolic heat production and thus may be a practice promoting animal welfare, at least under hot rearing conditions.

Feed restriction in the production of broiler chickens in tropical environments becomes an option to improve production efficiency and increase resistance to heat stress. However, a quantitative feed restriction of 60% of *ad libitum* intake during the early period had a negligible effect on growth performance but alleviated both stress and fear reactions in broilers[1] and a 50% feed restriction during the grower period decreased the performance of broilers[8]. This result implies that quantitative feed restriction during the early and growing periods could be applied. Therefore, quantitative feed restriction during these times is an alternative to lower-intensity feed restriction[9] and is less stressful[10].

Feeding time restriction is a feed restriction schedule where chicks have daily free access to feed at specific times. Onbasilar *et al.*[11] observed that 4 h (08:00 to 12:00) of daily feed removal from 7-21 days of age had no significant effects on body weight, feed intake, feed efficiency and carcass characteristics in broiler chickens. Benyi *et al.*[12] recommended that a 10 h day$^{-1}$ feed removal program from 8-28 days of age could be used for efficient Ross 308 broiler production in tropical areas. Similar to Azis[13], Azis *et al.*[14,15] reported that a feeding time restriction of 8 or 9 h day$^{-1}$ during the hottest part of the day had no effects on the performance and physiological aspects of broiler chickens from 7-21 days of age. A report by David and Subalini[16] found that feed withdrawal for 7 h day$^{-1}$ (09:00-16:00) did not affect the performance and carcass characteristics of broiler chickens from 10-30 days of age. Therefore, Saeed[17]concluded that an intermittent feeding system during the grower period was beneficial for broiler chickens at 21 day of age. Withdrawing feed during the hottest periods of the day and feeding during the cooler periods have been shown to have ameliorating effects[2]. The beneficial effects of feed restriction are achieved by changing bird feeding behavior; consequently, during cooler periods, birds become accustomed to eating more in a shorter time, which improves feed efficiency and it may be possible for birds to eat to their maximal physical capacity[18] during the time of feed availability. de Silva and Kalubowila[19] found that when feed was offered after three hours of deprivation (13:00-16:00), broilers consumed higher amounts of feed within the first two hours (16:00-18:00) than did broilers fed *ad libitum* during the same time period.

Despite the benefits of intermittent feeding systems, however, there is little information regarding the effects of feeding time restriction during the starter and growing periods on the performance of broiler chickens. Therefore, the objective of the present study was to determine the effects of feeding time restriction during the 35 day production period on the growth performance of broiler chickens.

## MATERIALS AND METHODS

**Chickens, feed and housing:** A total of 300 unsexed Lohmann broiler chicks bought from a commercial hatchery (PT Japfa Comfeed, Lampung, Indonesia) were used in the study. Chicks were fed a standard starter diet (crumble; 21% CP) from 1-21 days of age and a finisher diet (pellet; 19% CP) from 22-35 days of age. The feed was purchased from Poultry Shop (manufactured by PT Japfa Comfeed, Lampung, Indonesia). All the chicks were reared in a conventional open-sided house with natural cyclic temperatures (minimum, 25°C; maximum, 34°C). The chicks were assigned to 20 floor pens with 15 chicks/pen (l' w' h; 2' 1.25' 0.75 m). Each pen was equipped with a hanging tube feeder and a hanging tube waterer.

**Treatments and experimental design:** On 1 day of age, all birds were weighed and randomly allotted to a floor pen. A completely randomized design with 5 treatments and 4 replications was used in this study. The treatments were as follows: broilers were fed *ad libitum* as a control group (P-0); broilers had free access to feed for 8 h day$^{-1}$ from 1-21 days of

age and then were fed *ad libitum* from 22-35 days of age (p-1); broilers had free access to feed for 8 h day$^{-1}$ from 1-21 days of age and then for 12 h day$^{-1}$ from 22-35 days of age (P-2); broilers had free access to feed for 12 h day$^{-1}$ from 1-21 days of age and then were fed *ad libitum* from 22-35 days of age (P-3) and broilers had free access to feed for 12 h day$^{-1}$ from 1-35 days of age (P-4).

**Variable measurements and statistical analyses:** All birds were weighed individually at 1, 7, 14, 21, 28 and 35 days of age. Body weight was measured between 18:00 and 19:00 h when food was still available to all groups. Feed intake was measured based on pen values and feed conversion was calculated as the ratio of feed intake to average weight gain, adjusted for mortality. Feed intake, body weight gain and feed conversion ratios were calculated for the periods of 1-21, 22-35 and 1-35 days of age.

At the end of the experiment (35 day of age), 2 broilers per pen (10 broilers from each treatment) with body weight measurements close to the mean pen weight were selected for the determination of carcass, abdominal fat pad and internal organ weights. The broilers were fasted for 6 h, weighed individually and then slaughtered by severing the jugular vein. Following bleed-out, broilers were scalded at 60°C for sixty seconds, defeathered in a machine picker and chilled in ice water for 8-10 h. Whole carcasses were drained for 5 min and eviscerated before determining carcass weight. Carcass weight was determined as the mass of the carcass without blood, feathers, head, feet, viscera (except the kidney and lung) and glands (including the thymus and bursa of Fabricius). The viscera were manually removed and the weights of the internal organs, such as the gizzard, liver and small intestine, were recorded. The abdominal fat pad was manually separated from the carcass and weighed.

All data were analyzed based on a completely randomized design using SAS software[20]. Data are presented as the mean±STD. The significant differences between the treatment means were determined by Duncan's multiple range test. All statements of significance were based on testing at $p<0.05$.

## RESULTS

**Growth performance:** The results of feeding time restriction on body weight and body weight gain are summarized in Table 1. The analyses indicated that at 21 day of age, as expected, the body weight and body weight gain of the broilers with feeding time restrictions were lower ($p<0.05$) than those of the broilers fed *ad libitum* (P-0). Among the group with feeding time restrictions, the body weight and body weight gains of P-1 and P-2 were lower ($p<0.05$) than those of P-3 and P-4. Broilers under the feeding time restrictions of 8 h day$^{-1}$ (P-1 and P-2) and 12 h day$^{-1}$ (P-3 and P-4) had 20.64 and 8.58% reductions in body weight, respectively. At 22-35 days of age, there were no significant differences in body weight gain among the treatments. At 35 day of age, P-3 broilers were the only ones that showed no significant differences in body weight compared to the weight of the broilers fed *ad libitum* (P-0).

**Feed intake and feed conversion ratio:** The responses of feeding with respect to feed intake and the feed conversion ratio are shown in Table 2. For 1-21 days of age, the feed intake values among the broilers with feeding time restrictions were lower ($p<0.05$) than those of the broilers fed *ad libitum* (P-0). The feed intake values of P-1 and P-2 were lower ($p<0.05$) than those of P-3 and P-4 during these periods. The feed intake values of the broilers that had feed restricted

Table 1: Body weight gain (BWG) and body weight (BWG) of broiler chickens subjected to feeding time restriction

| | Treatments | | | | |
|---|---|---|---|---|---|
| Variables | P-0 | P-1 | P-2 | P-3 | P-4 |
| **Body weight gain (g/chick)** | | | | | |
| 1-21 days | 991.48±27.06$^{a}$ | 779.20±38.41$^{c}$ | 770.96±35.78$^{c}$ | 905.30±26.90$^{b}$ | 897.25±18.69$^{b}$ |
| 22-35 days | 1304.09±17.57 | 1345.20±94.87 | 1304.77±23.03 | 1310.30±52.34 | 1270.80±71.84 |
| 1-35 days | 2295.58±30.16$^{a}$ | 2124.39±129.00$^{bc}$ | 2075.73±15.43$^{c}$ | 2215.60±31.25$^{ab}$ | 2168.05±31.25$^{bc}$ |
| **Body weight (g/chick)** | | | | | |
| 1 day | 52.73±1.97 | 53.42±0.52 | 52.39±0.40 | 52.64±0.89 | 52.21±0.60 |
| 21 days | 1043.21±28.81$^{a}$ | 832.62±38.57$^{c}$ | 823.34±35.97$^{c}$ | 957.93±26.90$^{b}$ | 949.47±19.22$^{b}$ |
| 35 day | 2347.31±31.64$^{a}$ | 2177.81±129.18$^{bc}$ | 2128.12±15.50$^{c}$ | 2268.24±31.80$^{ab}$ | 2220.26±90.82$^{bc}$ |

$^{a,b,c}$Means within a row with no common superscripts differ at $p<0.05$. Broilers fed *ad libitum* (P-0); broilers that had free access to feed for 8 h day$^{-1}$ (07:00 to11:00; 16:00 to 20:00) from 1-21 day$^{-1}$ and were fed *ad libitum* from 22-35 days of age (P-1); broilers that had free access to feed for 8 h day$^{-1}$ (07:00 to11:00; 16:00 to 20:00) from 1-21 days and for 12 h day$^{-1}$ (07:00 to11:00; 16:00 to 24:00) from 22-35 days$^{-1}$ of age (P-2); broilers that had free access to feed for 12 h day$^{-1}$ (07:00 to 11:00; 16:00 to 24:00) from 1-21 days and were fed *ad libitum* from 22-35 days$^{-1}$ of age (P-3); broilers that had free access to feed for 12 h day$^{-1}$ (07:00 to 11:00; 16:00 to 24:00) from 1-35 days of age (P-4)

Table 2: Feed intake (FI) values and feed conversion ratios (FCRs) of the broiler chickens subjected to feeding time restriction

| | Treatments | | | | |
|---|---|---|---|---|---|
| Variables | P-0 | P-1 | P-2 | P-3 | P-4 |
| **Feed intake (g/chick)** | | | | | |
| 1-21 days | 1324.44±32.67[a] | 932.08±39.54[c] | 915.32±37.70[c] | 1096.24±19.62[b] | 1101.35±5.99[b] |
| 22-35 days | 2230.24±50.36[a] | 2238.63±90.70[a] | 2124.89±24.66[b] | 2296.28±22.96[a] | 2136.64±59.60[b] |
| 1-35 days | 3554.69±80.22[a] | 3170.71±129.75[c] | 3040.20±54.38[d] | 3392.52±23.52[b] | 3237.99±62.12[c] |
| **Feed conversion ratios (g $g^{-1}$)** | | | | | |
| 1-21 days | 1.336±0.03[a] | 1.197±0.04[b] | 1.188±0.06[b] | 1.211±0.02[b] | 1.228±0.02[b] |
| 22-35 days | 1.711±0.06[ab] | 1.667±0.05[bc] | 1.629±0.03[c] | 1.754±0.06[a] | 1.684±0.05[abc] |
| 1-35 days | 1.549±0.03[a] | 1.494±0.03[bc] | 1.465±0.03[c] | 1.531±0.02[ab] | 1.495±0.04[bc] |

[a,b,c]Means within a row with no common superscripts differ at p<0.05. Broilers fed *ad libitum* (P-0); broilers that had free access to feed for 8 h $day^{-1}$ (07:00 to 11:00; 16:00 to 20:00) from 1-21 days and were fed *ad libitum* from 22-35 days of age (P-1); broilers that had free access to feed for 8 h $day^{-1}$ (07:00 to 11:00; 16:00 to 20:00) from 1-21 days and for 12 h $day^{-1}$ (07:00 to 11:00; 16:00 to 24:00) from 22-35 days of age (P-2); broilers that had free access to feed for 12 h $day^{-1}$ (07:00 to 11:00; 16:00 to 24:00) from 1-21 days and were fed *ad libitum* from 22-35 days of age (P-3); broilers that had free access to feed for 12 h $day^{-1}$ (07:00 to 11:00; 16:00 to 24:00) from 1-35 days of age (P-4)

Table 3: Relative carcass and organ weights (% of body weight) of the broiler chickens subjected to feeding time restriction

| | Treatments | | | | |
|---|---|---|---|---|---|
| Variables | P-0 | P-1 | P-2 | P-3 | P-4 |
| Carcass (%BW) | 74.80±1.59 | 75.14±0.91 | 73.68±1.08 | 75.71±0.38 | 74.21±1.56 |
| Abdominal fat pad (%BW) | 1.56±0.19 | 1.59±0.27 | 1.56±0.21 | 1.65±0.40 | 1.69±0.33 |
| Gizzard (%BW) | 0.96±0.15 | 1.03±0.08 | 1.09±0.08 | 1.04±0.08 | 1.08±0.12 |
| Liver (%BW) | 1.89±0.16[b] | 2.25±0.13[ab] | 2.61±0.31[a] | 2.07±0.27[b] | 2.16±0.35[b] |
| Pancreas (%BW) | 0.19±0,01[c] | 0.25±0,01[a] | 0.23±0,02[ab] | 0.22±0,01[b] | 0.22±0,02[b] |
| Small intestine (%BW) | 1.62±0.12[b] | 1.89±0.19[a] | 1.98±0.14[a] | 1.74±0.17[ab] | 1.75±0.17[ab] |

[a,b]Means within a row with no common superscripts differ at p<0.05. Broilers fed *ad libitum* (P-0); broilers that had free access to feed for 8 h $day^{-1}$ (07:00 to 11:00; 16:00 to 20:00) from 1-21 days and were fed *ad libitum* from 22-35 days of age (P-1); broilers that had free access to feed for 8 h $day^{-1}$ (07:00 to 11:00; 16:00 to 20:00) from 1-21 days and for 12 h $day^{-1}$ (07:00 to 11:00; 16:00 to 24:00) from 22-35 days of age (P-2); broilers that had free access to feed for 12 h $day^{-1}$ (07:00 to 11:00; 16:00 to 24:00) from 1-21 days and were fed *ad libitum* from 22-35 days of age (P-3); broilers that had free access to feed for 12 h $day^{-1}$ (07:00 to 11:00; 16:00 to 24:00) from 1-35 days of age (P-4)

for 8 h $day^{-1}$ (P-1 and P-2) and 12 h $day^{-1}$ (P-3 and P-4) were approximately 30.26 and 17.04%, respectively. From 22-35 days of age, the feed intake values of P-1 and P-3 were not significantly different from those of P-0. Among the group with feeding time restrictions, the feed intake values of P-2 and P-4 were lower (p<0.05) than those of P-1 and P-3. From 1-35 days of age, the feed intake values of the broilers that had restricted feeding times were lower (p<0.05) than those of the broilers fed *ad libitum* (P-0). The feed intake values of P-1, P-2, P-3 and P-4 were 10.81, 14.47, 4.56 and 8.91%, respectively.

From 1-21 days of age, the feed conversion ratios (FCRs) of the broilers that had all feeding time restrictions were lower (p<0.05) than those of the broilers fed *ad libitum* (P-0). There were no significant differences among the different feeding time restrictions during this period. The FCRs of P-2 and P-4 were lower (p<0.05) than those of the broilers fed *ad libitum* (P-0) from 22-35 days and for the overall period from 1-35 days of age.

**Carcass and internal organ weights:** The carcass and internal organ weights are shown in Table 3. No differences were observed (p>0.05) in the weights of the carcass, abdominal fat pad or gizzard, which were considered the percentage of body weight between the broilers that had access to feeding time restrictions and the broilers fed *ad libitum* (P-0). There was a significant increase (p<0.05) in the weights of the liver, pancreas and small intestine due to feeding time restriction.

## DISCUSSION

As expected, during the starter period (1-21 days of age), feed intake and body weight gain were lower with feeding time restrictions. The feed intake values of the P-2 and P-4 broilers were lower than those of the P-1 and P-3 broilers. Our findings suggest that limiting the availability of feed during feed restriction reduced the feed intake and growth rate. This is because feed restriction decreases the energy and nutrient supply needed to support optimal tissue growth. These results are in line with previous reports indicating that in broilers 21 day of age, feeding time restriction for 9 or 15 h $day^{-1}$ from 7-21 days of age produced lower feed intake values and body weight gains than that seen in the control group[21,15]. During the refeeding periods (22-35 days of age), the feed intake

values and body weight gain of the P-1 and P-3 broilers were not different from those of the broilers fed *ad libitum* (P-0). Although, the broilers that had a feed restriction time of 12 h day$^{-1}$ were significantly lighter than the broilers fed *ad libitum* at 21 day of age, the two groups showed no significant differences in weight gain and reached the same final weight. These results indicated that at 35 day of age, the broilers that had access to feed for 12 h day$^{-1}$ for 21 day were able to attain the required compensated growth to equal the final body weight of the broilers fed *ad libitum*. This result was in agreement with the previous study showing that time restriction for 8 h day$^{-1}$ at 8-16 days of age[22], 8 h day$^{-1}$ for 14 day at different ages[23] and 8 or 9 h day$^{-1}$ at 7-21 days of age[21,15] allowed the recovery of final body weight by 42 day of age. In line with these results, Azis and Afriani[24] reported that broilers with free access to feed for 15 h day$^{-1}$ from 21-35 days of age had a similar response to broilers fed *ad libitum*. Similarly, Alkhair *et al.*[25] observed that at 37 day of age, broilers that had reduced feeding times or feed removal for 3 h day$^{-1}$ (9:00 to 12:00 am) or 6 h day$^{-1}$ (9:00 to 3:00 pm) from 8-28 days of age were able to compensate for growth and had the same body weight as broilers fed *ad libitum*. In contrast to this study, Konca *et al.*[26] found that broilers subjected to meal-time feeding (01:00 to 09:00 and 15:00 to 23:00) from 7-21 days of age were unable to adapt their feed intake and did not compensate for body weight losses until the slaughter age of 45 day. The different results in the literature are due to a number of factors that can influence the responses of broilers to feed restriction. These factors include the nature, timing, severity and duration of undernutrition as well as genetic factors such as strain and sex[27].

During the growing period (22-35 days of age), the broilers with access to feed for 12 h day$^{-1}$ (P-2 and P-4) had significantly lower feed intake values than the broilers fed *ad libitum*. The feed intake values of the P-2 and P-4 broilers decreased by approximately 4.72 and 4.20%, respectively. Body weight at 35 day of age was reduced by 9.33% in P-2 and 5.41% in P-4 compared to that of the broilers fed *ad libitum*. This result implies that feed restriction during the growing period did not encourage compensatory growth. Compensatory growth could occur if the restriction was applied during the early period. Several factors may influence the growth rate of animals during feed restriction, such as limiting the intake of nutrients and energy for tissue growth[28], reducing the triiodothyronine hormones and thyroxine[29-32,14] and decreasing the enzyme activity of protein digestion[10].

The broilers subjected to feeding time restriction during 1-21 days of age had a better feed conversion ratio (FCR) than the broilers fed *ad libitum*. However, during the growing period from 22-35 days of age, the best FCR was achieved in the P-2 and P-4 broilers and was related to a lower feed intake, since there was no difference in body weight gains among the treatments. When the whole experimental period from 1-35 days of age was considered, the best FCR was also achieved in the P-2 and P-4 broilers. This result could be related to the higher metabolic efficiency of the broilers that had feeding time restriction during the hottest part of the day (11:00 to 16:00 pm). During this time, the ambient temperature and relative humidity ranged from 31±0.65-32±1,02°C and 52.70±3.25-67.32±2.55%, respectively. This result is in accordance with the finding of Uzum and Toplu[33], who reported that broilers from 21-42 days of age that fasted for 8 h day$^{-1}$ (09:00 to 17:00) under heat stress conditions had significantly better feed efficiency than those in the *ad libitum* fed group. This is similar to the finding of Konca *et al.*[26], who reported that meal-time fed broilers had a poor live body weight and feed intake but a better feed efficiency than broilers fed *ad libitum*. However, Ozkan *et al.*[34] reported that feed restriction in broilers during the summer did not have a significant effect on the feed conversion ratio. The differences between studies regarding the effect of feed restriction on the feed conversion ratio are probably related to the timing, severity and duration of feed restriction.

The feeding time restriction had no effect on the relative weight of the carcass and abdominal fat pad at 35 day of age. Based on these results, feeding time restriction did not exert any adverse effect on the broiler carcasses; however, it could not reduce the abdominal fat pad. Similar findings have been reported that daily feed removal for 3, 4, 6, 8 and 16 h did not significantly affect carcass and abdominal fat pad characteristics[9,11,34-37].

In broilers, the liver is the main site of lipid production, whereas fatty tissue, especially in the abdomen, is the main site for fat storage[38]. Feed restriction reduces the metabolic efficiency of the liver; therefore, the intensity and duration of the feed restriction may cause a reduction in liver weight[39]. However, our results showed that the broilers under feeding time restriction (P-2) had heavier relative weights of the liver, pancreas and small intestine than the broilers fed *ad libitum* (P-0). These results are in line with Pinchasov *et al.*[40], who reported that intermittent feeding was accompanied by a consistent increase in the relative weights of the liver, pancreas and gastrointestinal tract, including the small intestine. Likewise, Zubair and Leeson[41] indicated that during feed restriction, the relative weights of the digestive organs were generally heavier in feed-restricted broilers than in full-fed broilers. Furthermore, Susbilla *et al.*[42] noted that the relative weight of the digestive tract of restricted broilers

at the end of the restricted period was higher than that of the full-fed birds. The increased relative weight of the gastrointestinal tract may be attributed to the adaptation to feed restriction. The adaptation to feed restriction includes an increased capacity and slower evacuation of the gastrointestinal tract to increase the supply of nutrients during the periods of feed deprivation[43].

## CONCLUSION

The feeding time restriction of 12 h day$^{-1}$ in broilers from 1-21 days of age resulted in an approximately 4.56% lower feed intake than in broilers fed *ad libitum* and enabled the compensatory growth necessary to equal the live body weight of the *ad libitum* fed birds. The feeding restriction programs had no effects on the carcass and abdominal fat pad weights; however, the internal organs, such as the liver, small intestine and pancreas, were shown to be heavier after feed restriction. Thus, feeding time restriction programs could be usefully applied as a rearing management technique with no detrimental effects on the performance of broiler chickens.

## SIGNIFICANCE STATEMENT

This study discovered that feeding time restriction can be used as a feed restriction technique and is beneficial for the improvement of feed efficiency in broiler chicken production. This study will help the researcher or producer establish feeding management practices for commercial broiler chicken production farms that are alternatives to feed restriction.

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