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# Response of weight parameters of carcass cuts to the protein and energy rationing program on broiler diets

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**Abstract:**

The current study was conducted in the poultry field at the First Agricultural Research and Experiment Station, College of Agriculture, Al-Muthanna University, from 29/01/2024 to 03/03/2024, for a period of 35 days. 225 Ross 308 broiler chicks were used, one day old, unsexed, with an initial weight of 40.00±1.00 gm, they were randomly distributed into 5 treatments, with 3 replicates for each treatment (15 chicks for each replicate). The treatments were divided as follows: **T1:** 21% protein and 2850 energy for the starter diet and 20% protein and 2960 energy for the finisher diet. **T2:** 21% protein and 2800 energy for the starter diet and 20% protein and 2900 energy for the finisher diet. **T3:** 21% protein and 2800 energy for the starter diet and 20% protein and 2850 energy for the finisher diet. **T4:** 20.6% protein and 2700 energy for the starter and 19.8% protein and 2800 energy for the finisher. **T5:** 20.8% protein and 2700 energy for the starter and 19.5% protein and 2740 energy for the finisher. The chicks were fed with starter feed for 1-15 days and finisher feed for 16 days until the end of the experiment at 35 days of age. The results can be summarized by that rationing protein and energy levels together in broiler feed significantly affected the results of carcass weight and its main cuts, which included the relative weight of each of the breast, thigh, drumstick and the percentage of dressing with and without giblet in favor of T2. The same treatment also significantly reduced the secondary carcass cuts, which included the relative

weight of each of the wings and back, compared to the other experimental treatments, while T1 recorded a significant reduction in the relative weight of the neck. We conclude from the current study that protein and energy rationing treatments together have a positive effect in improving the weight of broiler carcass and its main and secondary cuts under moderate conditions.

**Keywords:** Protein rationing, energy levels, carcass cuts, dressing percentage.

**Introduction:**

The poultry farming sector has faced several problems proven by recent studies, the most important of which are the nutritional needs of modern broiler breeds, which exceeded the needs of old breeds, caused the emergence of a problem of low immunity and its ability to confront various stresses and high mortality rates. In addition to the shortage of important supplies represented by essential vitamins and minerals, therefore, researchers in poultry nutrition focused on studying food additives, because of their significant effects in supporting the physiological and productive state of the bird, includes in particular the addition of protein and energy to improve the digestion process [1, 2, 3].

Nutrition is an important pillar of the poultry industry and constitutes approximately 70% of the total investment costs in the production of broiler and layer chickens [4, 5, 6].

Studies and researches interested in the field of poultry nutrition have turned, to the possibility of reducing the percentage of protein in feed, by regulating the percentage of plant protein sources, which is represented by soybean meal, the most expensive among the feed components, ensuring a reduction in the release of nitrogen into the environment, reducing the high percentage of ammonia gas in poultry housing, as well as reducing the high percentage of humidity in the litter and the release of uric acid [7, 8, 9].

Reducing the protein ratio, done by ensuring an increase in the Starch: Protein Ratio (the value resulting from dividing the starch in the feed into the raw protein of the feed), by reducing the percentage of soybean meal, coupled with increasing the percentage of energy represented by increasing the main source of the main grains, such as maize or wheat [10, 11].

Nutritional requirements are often defined as the minimum nutritional concentration required to achieve maximum performance while avoiding resulting impairments in overall performance [12, 13].

The present study aims to know the effect of reducing or regulating the levels of crude protein and energy on the weight indices of carcass cuts.

**Materials and methods:**

**Field experiment:**

The experiment was conducted in the poultry field at the First Research Station, College of Agriculture, Al-Muthanna University, from 29/01/2024 to 03/03/2024 for 35 days. 225 one-day-old, unsexed, Ross 308 broiler chicks were used, with an initial weight of 40.00±1.00 gm. They were raised in a closed hall and in four-story batteries, each floor containing a cage with dimensions of 1.5 x 1 m. The chicks were randomly distributed into 5 treatments, with 3 replicates for each treatment. The treatments were divided as follows:

**T1:** 21% protein and 2850 energy for the starter diet and 20% protein and 2960 energy for the finisher diet.

**T2:** 21% protein and 2800 energy for the starter diet and 20% protein and 2900 energy for the finisher diet.

**T3:** 21% protein and 2800 energy for the starter diet and 20% protein and 2850 energy for the finisher diet.

**T4:** 20.6% protein and 2700 energy for the starter and 19.8% protein and 2800 energy for the finisher.

**T5:** 20.8% protein and 2700 energy for the starter and 19.5% protein and 2740 energy for the finisher.

The chicks were fed with starter feed for 1-15 days (Table 1) and finisher feed for 16 days until the end of the experiment at 35 days of age (Table 2).

**Table (1) Chemical components of starter feed.**

| Items | Treatments | | | | |
|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 |
| Maize | 55.69 | 56.69 | 54.19 | 41.09 | 29.19 |
| Wheat flour | ---- | ---- | ---- | 1.70 | 30.00 |
| Soybean meal | 32.90 | 35.50 | 34.00 | 38.00 | 22.00 |
| Wheat bran | 7.70 | 2.00 | 10.00 | 13.60 | 13.60 |
| Premix | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| Oil | ---- | ---- | ---- | ---- | ---- |
| Dicalcium phosphate | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| Limestone | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Total | 100 | 100 | 100 | 100 | 100 |
| Chemical analysis | | | | | |
| Crude protein (%) | 20.11 | 20.80 | 21.30 | 20.20 | 19.20 |
| Metabolized energy (Kcal/ kg diet) | 2955 | 2915 | 2869 | 2734 | 2638 |
| Calcium (%) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Phosphorus (%) | 0.43 | 0.43 | 0.43 | 0.43 | 0.45 |
| Methionine (%) | 0.54 | 0.56 | 0.56 | 0.50 | 0.45 |
| Lysine (%) | 1.36 | 1.48 | 1.45 | 1.24 | 1.05 |
| Fat (%) | 2.50 | 2.40 | 2.40 | 1.90 | 1.50 |
| Fiber (%) | 3.20 | 3.20 | 3.50 | 3.70 | 4.00 |

**Table (2) Chemical components of the finisher feed.**

| Items | Treatments | | | | |
|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 |
| **Maize** | 60.19 | 61.19 | 61.19 | 43.19 | 38.19 |
| **Wheat flour** | ---- | ---- | ---- | 22.00 | 26.00 |
| **Soybean meal** | 31.00 | 34.00 | 31.00 | 24.00 | 21.00 |
| **Wheat bran** | 5.00 | ---- | 4.00 | 7.00 | 11.00 |
| **Premix** | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| **Oil** | ---- | 1.00 | ---- | ---- | ---- |
| **Dicalcium phosphate** | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 |
| **Limestone** | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| **Total** | 100 | 100 | 100 | 100 | 100 |
| **Chemical analysis** | | | | | |
| **Crude protein (%)** | 21.00 | 20.70 | 20.00 | 19.00 | 18.20 |
| **Metabolized energy (Kcal/ kg diet)** | 2889 | 3060 | 2964 | 2808 | 2908 |
| **Calcium (%)** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| **Phosphorus (%)** | 0.43 | 0.43 | 0.43 | 0.43 | 0.45 |
| **Methionine (%)** | 0.55 | 0.55 | 0.54 | 0.47 | 0.45 |
| **Lysine (%)** | 1.48 | 1.41 | 1.36 | 1.20 | 1.02 |
| **Fat (%)** | 2.40 | 2.90 | 3.10 | 3.30 | 3.50 |
| **Fiber (%)** | 3.50 | 2.90 | 3.10 | 3.30 | 3.50 |

**Studied Traits:**

The weight carcass parameters were studied after 35 days of weighing the birds, which included the carcass weight, the dressing percentage with and without the giblet, and the relative weight of each of the heart, liver, and gizzard. The relative weight of the main carcass cuts (breast, thigh, and drumstick). The relative weight of the secondary cuts (with wings, neck, and back).

**Statistical Analysis:**

The data for the studied traits were analyzed using Completely Randomized Design (CRD) to determine the effect of different treatments and the significance of the differences between treatments was tested using Duncan [14] multinomial test at a significance level of 0.05 and using the statistical program SPSS (2012) in the statistical analysis.

**Results and Discussion:**

**Carcass weight and dressing ratio with and without giblet:**

Table (3) shows that the experimental treatments had a significant effect on the carcass weight and percentage of dressing with and without giblet, T2 treatment birds recorded a significant superiority over all experimental treatments in carcass weight with the highest average (1577.66 gm), while the lowest average was achieved in treatment T5 with an average (1457.00 gm), without a significant difference with treatment T4 (1465.00 gm).

Significant differences were also recorded in the dressing ratio without giblet in treatments T1 and T2, which the highest average (72.02 and 72.29) % respectively, without any significant

difference. In contrast to treatments T3, T4 and T5, which were the lowest average (70.83, 70.76 and 70.55) % respectively, without any significant differences among them. Significant differences were found in the relative weight of the heart, T2 achieved the highest average (2.13 %), thus outperforming the other treatments, while the lowest average was recorded in birds of treatments T3, T4 and T5 (1.84, 1.81 and 1.80) % respectively, without any significant differences among them.

The same was for the relative weight of the liver, as treatment T2 was a significant increase that distinguished it from the rest of the treatments with an average (2.48 %), while birds in treatment T5 recorded the lowest average (2.11 %). The same thing happened in the relative weight index of the gizzard, as treatment T2 gave the highest average (0.61 %), to outperform the rest of the experimental treatments compared to treatment T5, which recorded the lowest average (0.48 %), as for the dressing ratio with giblet, the highest average (77.53 %), was achieved in treatment T2, which outperformed all treatments, while the lowest average was recorded in treatment T5 (74.96 %).

**Table (3) Effect of different levels of energy and protein on the dressing ratio with and without giblet (mean ± standard error).**

| Treatments | Carcass weight (gm) | dressing ratio with giblet | Heart relative weight | Liver relative weight | Gizzard relative weight | dressing ratio without giblet |
|---|---|---|---|---|---|---|
| **T1** | 1515.33±1.85 b | 72.02±0.03 a | 1.93±0.015 b | 2.29±0.016 b | 0.55±0.015 b | 76.80±0.02 b |
| **T2** | 1577.66±2.33 a | 72.29±0.03 a | 2.13±0.018 a | 2.48±0.017 a | 0.61±0.015 a | 77.53±0.03 a |
| **T3** | 1473.66±3.38 c | 70.83±0.13 b | 1.84±0.017 c | 2.17±0.016 c | 0.52±0.001 bc | 75.38±0.13 c |
| **T4** | 1465.00±3.21 d | 70.76±0.06 b | 1.81±0.016 c | 2.15±0.011 cd | 0.49±0.017 cd | 75.23±0.06 cd |
| **T5** | 1457.00±2.51 d | 70.55±0.14 b | 1.80±0.014 c | 2.11±0.017 d | 0.48±0.001 d | 74.96±0.12 d |
| **Sig.** | * | * | * | * | * | * |

Carcass weights and dressing ratio with and without giblet in this study were affected by the energy and crude protein reduction levels in the birds' diets, this may be attributed to the fact that the protein to energy ratio used in the research experiment, could be ideal to achieve the best carcass productivity and bird meat quality, as the experimental birds

adapted to the reduction treatments in their living nature with the amount of lower levels compared to the natural levels [15].

The increase in the dressing ratio in the carcass indicates an increase in the weight of the carcass and the weight of the live body, which is one of the most important indicators for expressing the amount of meat, as it is an important economic indicator, despite its association with age, gender and live weight [16].

This was clearly demonstrated in the weight of the giblet, including the liver, which may have been significantly affected by the study parameters, due to the low rate of fat formation in the liver of birds that were fed low-fat protein diets, which improved energy use [17].

Baghoyan [18] pointed out that the low level of energy in the feed, does not only convert dietary protein into body proteins but also into carbohydrates and fats, so the small remaining amount of protein is used by the bird to build its muscle tissues, which is positively reflected in the weight of the carcass and its internal organs.

The significant differences in the studied indicators (carcass weight and giblet) can also be attributed to what was explained by Siddiqur *et al*. [19], who showed that the direct increase in body weight and weekly weight gain, with increasing age of birds during the experiment period, could be a direct and explicit factor in causing a significant increase in carcass weight and giblet. Thus, the ability of the experimental birds to benefit from the rationed food, after determining its levels and its ability to reduce the energy requirements, that it needs in metabolic processes to develop growth as it advances in age.

**Main and secondary cuts:**

Table (4) shows that the treatments of standardization of all protein, raw and energy significantly affected the criteria of the main and secondary cuts of broiler carcasses. There were significant differences in the indicators of all the main cuts studied. T2 was a significant difference (P≤0.05) on the relative weight of the breast, thigh and drumstick by recording the highest average (38.09, 17.34 and 13.64) % respectively, while treatment T5 was the lowest averages (36.90, 16.58 and 12.67) % respectively.

Significant differences (P≤0.05) were also recorded due to the effect of the experimental treatments on the secondary cuts of the carcass. T5 was the highest average (6.81 %) on the relative weight of the neck. Thus, it outperformed all treatments, while the lowest average was recorded in T1 (6.24 %). T5 also played a role in achieving significance in the relative weight (12.30 %), without significantly differing with T4 (12.19 %), while treatment T2 recorded the lowest average (11.43 %).

**Table (4) Effect of different levels of energy and protein on the relative weight of the main cuts (breast, thigh, and drumstick) and the secondary cuts (neck, wings, and back) (mean ± standard error).**

| Treatments | Main cut (%) | | | Secondary cuts (%) | | |
|---|---|---|---|---|---|---|
| | Breast | Thigh | Drumstick | Neck | Wings | Back |
| T1 | 37.76±0.05 b | 16.98±0.003 b | 13.11±0.051 b | 6.24±0.029 e | 11.72±0.021 c | 13.99±0.06 b |
| T2 | 38.09±0.09 a | 17.34±0.081 a | 13.64±0.031 a | 5.78±0.023 d | 11.43±0.008 d | 13.52±0.09 c |
| T3 | 37.07±0.07 c | 16.64±0.037 c | 12.84±0.016 c | 6.60±0.037 c | 12.05±0.045 b | 14.49±0.05 a |
| T4 | 36.99±0.03 c | 16.61±0.058 c | 12.74±0.010 d | 6.71±0.036 b | 12.19±0.085 ab | 14.58±0.14 a |
| T5 | 36.90±0.03 c | 16.58±0.028 c | 12.67±0.024 d | 6.81±0.031 a | 12.30±0.066 a | 14.64±0.19 a |
| Sig. | * | * | * | * | * | * |

The experimental treatments had a significant effect on the relative weight of the back, with treatment T5 recording the highest average of 14.64 %, thus outperforming (P≤0.05) treatments T1 and T2 only, without significantly differing with treatments T3 and T4, which recorded an average of (14.49 and 14.58) %, respectively, while the lowest average in birds of treatment T2 (13.52 %).

The decrease in the weights of the carcass cuts resulting from the experimental treatments may be due to the difference in the type of diet and feed content followed in this study, by the change in the values of protein and energy provided in the feeding rations [20].

The results of the study did not agree with Arif *et al*. [21], who found no significant differences in the weights of the main cuts (thighs and breast) and secondary cuts (neck), and relative weight of liver, gizzard and heart, and carcass weight, when reducing the levels of protein and energy in the diet of broiler birds raised in temperate tropical conditions.

The significant improvement shown in Tables (3-4), for the dressing indicators and carcass cuts, may be due to the role of the rationing treatments in the starter and finisher stages, may be attributed to achieving optimal growth in broiler birds fed a low-protein diet, may be related to the role of the strategy of rationing dietary protein from 21% to 20.8% in the starter and 20% to 19.5% in the finisher, and energy from 2850 to 2700 in the starter and 2960 to 2740 in the finisher, which may be due to

the significant increase in body cuts due to the fact that the feed during the starter and growth stages (Tables 1 and 2) of the two research experiments, contained a reasonable amount of the amino acid lysine. Here, consuming higher amounts of feed during the starter stage that is fed a low-protein and energy-reduced feed may lead to increased intake Lysine. Many researchers have confirmed that consuming high amounts of lysine is directly reflected in increasing the accumulation of breast meat and carcass cuts [22].

This is what Tallentire *et al*. [23] confirmed that the amino acid content of the feed, may mitigate the impact of reducing protein and energy levels from the diet, especially in the weight rates of the main and secondary cuts.

As for the decrease in the weight indicators of the main and secondary cuts towards the comparison treatment, inversely with the standardization treatments, which showed a linear increase in the weights of the secondary cuts and a linear decrease in the weights of the main cuts that were fed on the experimental treatments successively. It may have depended to some extent on the energy levels provided in the diet, which may indicate that the birds are satisfied with supplying other nutrients at the lower nutritional level of crude protein, as protein provides the bird with higher calories than carbohydrates and fats, represented in the energy that the bird needs in the processes of digestion, absorption and metabolism [24]. This may be due to the fact that the decrease in growth indicators negatively affected the performance of birds treated with nutritional rationing treatments, which may cause an imbalance in amino acids and an increase in the level of ammonia in the blood, as well as a change in the level of net energy achieved to metabolizable energy [25].

Managing the diet in terms of quantity and quality is an important factor that greatly affects the weight of the carcass cuts, including amino acids, which enter into the composition of the bird's tissues. Their percentage of protein metabolism reaches about 65%, in skeletal muscles, of the total daily protein [26].

Kamran *et al*. [27] concluded that the weights of the main and secondary broiler cuts, subjected to a regulated protein and energy diet, improved due to the decrease in heat gain associated with protein metabolism, concluded that the low protein level in the diet helps to increase the digestibility of amino acids required, for the formation of the carcass organs through their ability to improve feed utilization, therefore the response of carcass weights. May be a result of their response to low protein diets, resulting from the better utilization of protein.

The results of the experiment were consistent with the findings of Awad

*et al*. [28], who found that reducing the crude protein level in the broiler diet from 22.2% to 16.2% in the starter and 19.5% to 13.5% in the finisher, improved the digestibility of protein and many amino acids, thus significantly improved the weight parameters of the carcass.

**Conclusions:**

We conclude from the current study that the treatments of rationing crude protein and energy in broiler feed, were positively reflected in improving the weight carcass characteristics and the net percentage of broiler birds according to the experimental conditions, as the diet followed in the feed was sufficient to meet the nutritional needs of the bird, as a result achieved a significant response in the weights of the pieces, which gives a good economic indicator.

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