

Effect of feed form on productive performance, economic efficiency and carcass quality of broiler chickens

Aymen Mezher Noaman Al-Nassiri and Prof. Dr. Tareq Khalaf Hasan Aljumaily

Depart. Of Animal Production, College of Agriculture, Tikrit University, Iraq.

Corresponding email: Abodhai1976@gmail.com**Abstract :**

This experiment was conducted in the broiler chicken field at the Animal Production Fields, College of Agriculture, University of Tikrit, from October 12 to November 16, 2025. The study aimed to investigate the effect of the physical form of feed on productive performance, economic efficiency, and carcass characteristics of broiler chickens. A total of 90 (one-day-old) birds of the Ross-308 strain were used in the experiment. The birds were divided into three treatments, each with three replicates, and each replicate consisting of 10 birds. The first treatment was fed pelleted feed and was considered the control. The second treatment was fed crumbled feed, while the third treatment received powdered feed. After data collection and statistical analysis, the results showed a significant superiority ($P < 0.05$) of the first and second treatments over the third treatment in final body weight, weekly weight gain, empty carcass weight, dressing percentage, weekly feed intake, and total feed consumption. Additionally, significant superiority ($P < 0.05$) of the first and second treatments over the third treatment was observed in both weekly and overall feed conversion efficiency, with the second treatment achieving the best final feed conversion efficiency. No significant differences were observed among the treatments in the relative weights of the internal organs or in the relative weights of most carcass cuts, except for the wings, where the third treatment showed significant superiority ($P < 0.05$) over the other two treatments in relative wing weight. Moreover, the first and second treatments demonstrated significant superiority ($P < 0.05$) over the third treatment in economic efficiency, with the second treatment achieving the highest economic efficiency among all treatments.

Keywords: feed, productive performance, economic efficiency, carcass quality

1- Introduction :

Poultry products represent one of the most important sources of animal protein, which is a crucial and essential component of the nutrients required by humans (Al-Nassiri & Hasan, 2022). Consequently, consumers have increasingly relied on poultry meat as a primary source of animal protein, owing to its high palatability, ease of digestion, low production cost, and low content of fat and cholesterol (Al-Nassiri, 2021). Therefore, ensuring sufficient supply of animal protein has become a priority for future food security, which has, in turn, led to negative impacts on poultry health alongside the substantial increase in production (Balakrishnan et al., 2023).

Due to environmental changes, rising prices of feed raw materials, and the scarcity of certain ingredients, coupled with expectations of continued price increases, the poultry industry has become highly sensitive to these fluctuations, particularly modern broiler strains (Gouda et al., 2024). These strains are characterized by high feed conversion efficiency, resulting in rapid growth and production (Balakrishnan et al., 2023). This sector therefore requires innovative approaches to enhance growth and production, with nutrition and the development of feed types and forms according to suitable feeding programs being among the most important strategies (Habibi et al., 2019). Feed forms must be adapted to each growth and production stage, as the optimal use of feed is the main determinant for achieving maximum production efficiency (Saveewonlop et al., 2019).

Despite advances in the productive performance of broiler strains and improvements in feeding programs, these developments have introduced challenges, most notably increased production costs, particularly feed prices (Olukotun & Dairo, 2020). Feed accounts for approximately 60–70% of total production costs in broiler projects, with feed processing representing a substantial portion of this cost. The physical form of feed is a key factor influencing the productive performance of broilers (Nabi et al., 2017).

The success of broiler production projects depends not only on feed quantity and cost but also, primarily, on feed quality, nutritional value, feed conversion efficiency, and palatability, all of which are closely associated with the physical state and form of the feed (Yaung et al., 2024). The present study aimed to investigate the effect of feed form on the productive performance, economic efficiency, and carcass characteristics of broiler chickens.

2- Bird Management and Experimental Procedure:

A total of 90 (one-day-old) Ross 308 broiler chicks, with an average body weight of 42.5 g, were used in this experiment. All managerial and health-related procedures required for preparing the rearing hall were carried out, including cleaning and disinfecting the hall, equipment, and tools using 40% formalin and potassium permanganate. The cages were prepared one week prior to chick placement.

All rearing requirements were provided, including feeders, drinkers, brooding heaters, and ventilation and cooling systems. After completing all necessary preparations, the heating system was operated one day before chick placement, and the hall temperature was adjusted to 35°C. Cages with dimensions of 80 × 120 cm were used for rearing; they were arranged in tiers, with a total of nine cages. Upon arrival, chicks were randomly distributed among the cages at a rate of 10 chicks per cage.

Three experimental diets were used throughout the rearing period. The starter diet was provided from 1 to 8 days of age, the grower diet from 9 to 22 days of age, and the finisher diet from 23 days of age until the end of the experiment, as shown in Table (1).

Table (1): Ingredients and Calculated Chemical Composition of the Experimental Diets (Starter, Grower, and Finisher) Feed Ingredients (%)

Feed ingredients	Starter (1 - 8 days)	Grower (9 - 22 days)	Finisher (23 - 35 days)
Yellow corn (%)	56.22	60.23	65.82
Soybean meal (48%)	34.00	33.62	28.45
*Protein concentrate (%)	5.00	2.50	2.50
Sunflower oil (%)	2.00	2.15	2.03
Dicalcium phosphate (%)	0.43	0.90	0.60
Limestone (%)	1.66	0.10	0.10
L-lysine (%)	0.19	0.13	0.14
DL-methionine (%)	0.25	0.12	0.11
Sodium chloride (salt) (%)	0.25	0.25	0.25
Total	100	100	100

Calculated Chemical Composition

Parameter	Starter	Grower	Finisher
Metabolizable energy (kcal/kg feed)	3000	3050	2101
Crude protein (%)	23.09	21.51	19.50
Crude fiber (%)	3.77	2.30	2.28
Lysine (%)	1.44	1.18	1.08
Methionine (%)	0.746	0.59	0.56
Methionine + cystine (%)	1.09	0.92	0.86
Calcium (%)	0.962	0.87	0.79
Phosphorus (%)	0.483	0.42	0.36

3- Health and Preventive Programs:

All health care and preventive vaccination programs commonly used in broiler production were applied during the experimental period. Enrosol antibiotic was administered at a dose of 1 mL/L of drinking water from day 1 to day 5 of age to prevent yolk sac infection. At three days of age, chicks were vaccinated against Newcastle disease and infectious bronchitis (IB) via eye drops. On the same day, they were also vaccinated with an oil-emulsion vaccine against Newcastle disease, avian influenza, infectious bronchitis, and viral hepatitis.

Immediately after vaccination, chicks were provided with paracetamol and vitamin C for 24 hours. At 15 days of age, birds were vaccinated against Newcastle disease using the spray method, followed immediately by administration of paracetamol and vitamin C via drinking water for 24 hours. From days 16 to 18 of age, birds received a multivitamin supplement for three consecutive days.

4- Evaluated Traits

4-1: Carcass Traits

At 35 days of age, the experiment was concluded, and two random samples (one male and one female) were collected from each replicate, resulting in six birds per treatment. Each sample was numbered, and live body weight was recorded. Following slaughtering and evisceration, the hot carcass weight was measured. The internal organs (heart, liver, gizzard, proventriculus, intestines, and abdominal fat) were removed and their relative weights recorded. The dressing percentage for each sample was then calculated. Subsequently, the carcasses were dissected into primary cuts (breast, thighs, wings, back, and neck), and the weight of each cut was recorded individually, after which the relative weight of each cut was calculated (Majid, 2020).

4-2: Production Traits

During the experimental period, weekly body weights of birds in each replicate were recorded, and the weekly weight gain for each replicate and treatment was calculated. At the end of the experiment, the final body weights of all birds were recorded, and the average bird weight per treatment was determined. Weekly feed consumption was calculated for each replicate and treatment, and total feed consumption per replicate was determined at the conclusion of the experiment. Using the weekly and final weight gains along with feed consumption data, the feed conversion ratio (FCR) was calculated weekly and for the entire experimental period for all treatments (Al-Fayadh et al., 2010).

Feathering rate and feather quality were also assessed by examining the degree of feather completeness for each bird, as well as evaluating feather texture, color, glossiness, and cleanliness.

4-3: Economic Efficiency

After completing data collection, the birds were sold, and the economic efficiency of broiler production fed on different types of feed was calculated. All production costs were determined, including chick purchase price, feed costs, mortality losses, labor, veterinary care, heating and cooling fuel, and administrative expenses. Revenue was calculated by multiplying the weight of produced birds (in kilograms) by the price per kilogram. Economic efficiency for each treatment was then determined by subtracting total production costs from total revenue (Al-Shabah & Al-Kawash, 2024).

5- Results and Discussion :

5-1: Effect of Feed Form on Production Traits and Carcass Characteristics

Upon reviewing Table (2), the results of the study indicate that feeding broiler chickens on three different feed forms (pelleted, crumbled, and mash) resulted in statistically significant differences ($P < 0.05$). The first and second treatments showed a significant superiority over the third treatment in terms of final body weight of the birds. Similarly, the first and second treatments recorded significantly higher hot carcass weight compared with the third treatment.

Regarding dressing percentage, a statistically significant increase ($P < 0.05$) was observed in the first and second treatments compared with the third treatment, with the second treatment recording the highest dressing percentage.

Concerning feathering rate and feather quality, the third treatment showed a statistically significant superiority ($P < 0.05$) compared with the first and second treatments, while the second treatment was significantly superior to the first treatment.

Table (2). Effect of Feed Form on Some Productive Traits (Mean \pm Standard Error)

Treatments	Final Body Weight (g)	Carcass Weight (g)	Dressing Percentage (%)	Feather Quality
T1	2535.63 $\hat{A} \pm 21.87$ a	2031.67 $\hat{A} \pm 54.24$ a	76.37 $\hat{A} \pm 0.28$ a	1.00 $\hat{A} \pm 0$ c
T2	2499.38 $\hat{A} \pm 68.22$ a	1979.17 $\hat{A} \pm 47.46$ a	77.05 $\hat{A} \pm 0.60$ a	2.00 $\hat{A} \pm 0$ b
T3	1934.38 $\hat{A} \pm 40.83$ b	1450.00 $\hat{A} \pm 57.79$ b	74.50 $\hat{A} \pm 0.17$ b	3.00 $\hat{A} \pm 0$ a
Level of significance	*	*	*	*

In Table (3), the results indicate that the first treatment showed a statistically significant superiority ($P < 0.05$) over the second and third treatments in weekly weight gain during the first week of the experiment. In the second week, both the first and second treatments were significantly superior ($P < 0.05$) to the third treatment in weekly weight gain. During the third week, the first and second treatments also exhibited a significant superiority ($P < 0.05$) in achieving the highest weekly weight gain compared with the third treatment. However, in the fourth week of the experiment, no significant differences ($P > 0.05$) were observed among the three treatments in weekly weight gain.

Table (3). Effect of Feed Form on Weekly Weight Gain (Mean \pm Standard Error)

Treatments	First Week (g)	Second Week (g)	Third Week (g)	Fourth Week (g)
T1	393.33 $\hat{A} \pm 4.80$ a	562.71 $\hat{A} \pm 10.03$ a	809.38 $\hat{A} \pm 1.30$ a	548.33 $\hat{A} \pm 15.25$
T2	366.79 $\hat{A} \pm 10.34$ b	573.75 $\hat{A} \pm 15.01$ a	740.83 $\hat{A} \pm 42.92$ a	601.87 $\hat{A} \pm 72.91$
T3	306.34 $\hat{A} \pm 6.57$ c	406.87 $\hat{A} \pm 11.73$ b	509.58 $\hat{A} \pm 24.86$ b	492.92 $\hat{A} \pm 5.79$
Level of significance	*	*	*	NS

The results presented in Table (4) indicate that the first and second treatments were significantly superior ($P < 0.05$) to the third treatment in weekly feed consumption during the first week of the experiment. In the second week, the first treatment showed a significant superiority ($P < 0.05$) over both the second and third treatments. During the third week, the second treatment was significantly superior ($P <$

0.05) to the first and third treatments in feed consumption. No significant differences were observed among the three treatments in weekly feed consumption during the fourth week. Regarding total feed intake, the first treatment showed a statistically significant superiority ($P < 0.05$) over the other two treatments.

Table (4). Effect of Feed Form on Feed Intake Rate (Mean \pm Standard Error)

Treatments	First Week (g)	Second Week (g)	Third Week (g)	Fourth Week (g)	Total
T1	493.33 $\bar{A} \pm 39.00$ a	918.96 $\bar{A} \pm 10.56$ a	959.38 $\bar{A} \pm 9.36$ ab	1050.83 $\bar{A} \pm 13.35$	3422.50 $\bar{A} \pm 54.52$ a
T2	447.71 $\bar{A} \pm 5.52$ a	572.92 $\bar{A} \pm 19.72$ b	1005.21 $\bar{A} \pm 29.70$ a	1090.83 $\bar{A} \pm 21.86$	3133.34 $\bar{A} \pm 49.31$ ab
T3	305.54 $\bar{A} \pm 3.27$ b	655.84 $\bar{A} \pm 86.90$ b	920.84 $\bar{A} \pm 22.26$ b	980.63 $\bar{A} \pm 57.21$	2865.83 $\bar{A} \pm 161.76$ b
Level of significance	*	*	*	NS	*

Upon examining the results in Table (5), it is evident that the third treatment showed a statistically significant superiority ($P < 0.05$) over the first and second treatments in feed conversion efficiency during the first week of the experiment. In the second week, the second treatment was significantly superior ($P < 0.05$) to both the first and third treatments. During the third week, the first and second treatments exhibited a significant superiority ($P < 0.05$) over the third treatment. In the fourth week, no significant differences were observed among the three treatments in feed conversion efficiency.

At the end of the experiment, the first and second treatments achieved a significant superiority ($P < 0.05$) in final feed conversion efficiency compared with the third treatment, with the second treatment recording the best feed conversion efficiency.

The superior performance of the first and second treatments in broiler production traits can be attributed to the ease of consumption of pelleted and crumbled feeds, reduced energy expenditure required for feed intake, the absence of feed component separation, prevention of selective feeding, and the higher digestibility of pelleted and crumbled feeds.

Table (5). Effect of Feed Form on Feed Conversion Ratio (Mean \pm Standard Error)

Treatments	First Week	Second Week	Third Week	Fourth Week	Overall
T1	1.25 $\bar{A} \pm 0.09$ a	1.63 $\bar{A} \pm 0.01$ a	1.17 $\bar{A} \pm 0.01$ b	1.92 $\bar{A} \pm 0.03$	1.35 $\bar{A} \pm 0.02$ b
T2	1.22 $\bar{A} \pm 0.03$ a	1.00 $\bar{A} \pm 0.03$ b	1.37 $\bar{A} \pm 0.09$ b	1.86 $\bar{A} \pm 0.20$	1.25 $\bar{A} \pm 0.01$ b
T3	1.01 $\bar{A} \pm 0.01$ b	1.60 $\bar{A} \pm 0.17$ a	1.81 $\bar{A} \pm 0.05$ a	1.99 $\bar{A} \pm 0.10$	1.48 $\bar{A} \pm 0.06$ a
Level of significance	*	*	*	NS	*

Upon examining the results in Table (6), it is evident that the three treatments did not have a significant effect on the relative weights of the carcass cuts (thighs, breast, back, and neck). However, the third treatment showed a statistically significant superiority ($P < 0.05$) over the first and second treatments in the relative weight of the wings.

Table (6). Effect of Feed Form on the Relative Weights of Carcass Cuts (Mean \pm Standard Error)

Treatments	Thighs (%)	Breast (%)	Wings (%)	Back (%)	Neck (%)
T1	27.43 $\bar{A} \pm 0.86$	38.45 $\bar{A} \pm 0.66$	9.45 $\bar{A} \pm 0.14$ b	18.02 $\bar{A} \pm 0.27$	6.20 $\bar{A} \pm 0.19$
T2	27.00 $\bar{A} \pm 0.43$	39.05 $\bar{A} \pm 0.64$	9.48 $\bar{A} \pm 0.25$ b	17.80 $\bar{A} \pm 0.25$	6.45 $\bar{A} \pm 0.17$
T3	27.54 $\bar{A} \pm 0.46$	37.35 $\bar{A} \pm 0.63$	11.03 $\bar{A} \pm 0.67$ a	16.84 $\bar{A} \pm 0.81$	6.80 $\bar{A} \pm 0.28$
Level of significance	NS	NS	*	NS	NS

The results presented in Table (7) indicate that the three treatments did not produce any significant differences in the relative weights of the internal organs of the carcass.

Table (7). Effect of Feed Form on the Relative Weights of Internal Organs (Mean \pm Standard Error)

Treatments	Heart (%)	Liver (%)	Proventriculus (%)	Gizzard (%)	Intestines (%)	Abdominal Fat (%)
T1	0.50 $\bar{A} \pm 0.02$	2.11 $\bar{A} \pm 0.12$	0.39 $\bar{A} \pm 0.02$	1.34 $\bar{A} \pm 0.19$	3.35 $\bar{A} \pm 0.09$	0.96 $\bar{A} \pm 0.05$
T2	0.51 $\bar{A} \pm 0.02$	2.19 $\bar{A} \pm 0.02$	0.34 $\bar{A} \pm 0.03$	1.16 $\bar{A} \pm 0.01$	3.73 $\bar{A} \pm 0.27$	0.80 $\bar{A} \pm 0.16$
T3	0.57 $\bar{A} \pm 0.03$	2.13 $\bar{A} \pm 0.01$	0.38 $\bar{A} \pm 0.02$	1.44 $\bar{A} \pm 0.06$	3.81 $\bar{A} \pm 0.18$	0.61 $\bar{A} \pm 0.08$
Level of significance	NS	NS	NS	NS	NS	NS

5-2: Effect of Feed Form on the Economic Efficiency of Broiler Production

The results of the statistical analysis indicate a significant effect of feed form on the economic efficiency of broiler production. As shown in Figure (1), the first and second treatments were significantly superior ($P < 0.05$) to the third treatment in terms of economic efficiency, with the second treatment achieving a higher value than the first. The higher economic efficiency of the first and second treatments can be attributed to feeding on pelleted or crumbled diets, which increases digestibility, enhances feed intake, improves feed conversion efficiency, and minimizes feed wastage.

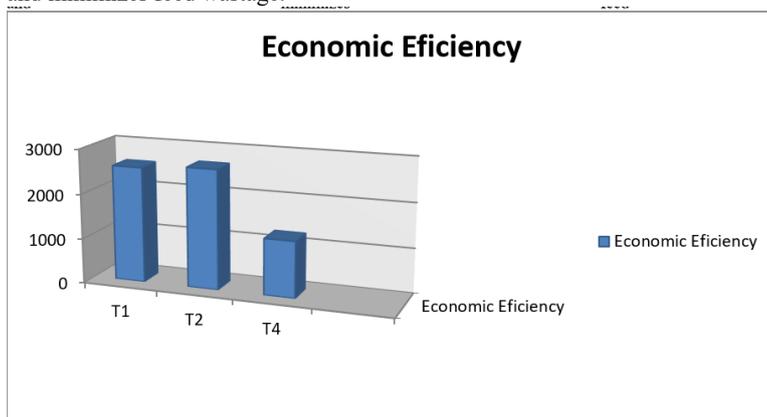


Figure (1) Effect of Feed Form on the Economic Efficiency

- Al-Fayadh, H. A., Naji, S. A. and Al-Hajo, N. N. (2010).** Poultry product technology. College of Agriculture – University of Baghdad – Iraq.
- Al-Nassiri, A. M. N. (2021).** Effect of adding different levels of Rosella flowers powder (*Hibiscus sabdariffa*) on the characteristics of carcasses and meat of broilers. Requirements for diploma degree, college of Agriculture-university of Tikrit-Iraq.
- Al-Nassiri, A. M. N. and Hasan, M. O. (2022).** Effect of adding different levels of Roselle flowers powder (*Hibiscus Sabdariffa*) to the dietary on meat traits of broilers . *Biochem. Cell. Arch.*, 22(1): 2879-2884.
- Al-Shabah, A. S. and Al-Kawash, O. A. (2024).** Economic efficiency of private sector broiler chicken farms in the Green Mountain region. *Derna university journal of humanities and social sciences*, 2(3): 429-451.
- Balakrishnan, K. N., Ramiah, S. K. and Zulkifli, I.(2023).** Heat shock protein response to stress in poultry . *Animals Sci.* 13: 317-345.
- Gouda, A., Tolba, S., Mahrose, Kh., Felemban, Sh. G., Khafaga, A. F., Khalifa, N. E., Jaremko, M., Moustafa, M., Alshaharni, M. O., Algotish, U. and Abd El-Hack, M. E. (2024).** Heat shock proteins as a key defense mechanism in poultry production under heat stress condition. *Poultry Sciences*, 103: 2314-2323.
- Habibi, M. F., Harimurti, S., Sasongko, W. H., Ariyadi, B., Sudaryati, S., Sekarlangit, K. and Putri, Y. S. (2019).** The effect of different feed forms on the performance and carcass yield of broiler chickens . *Earth and environmental science*, 387: 67-71.
- Majid, A. A. (2020).** Poultry product technology. College of Agriculture – University of Anbar – Iraq .
- Nabi, F., Rind, M. I., Li, J., Zulqarnain, M., Shahzad, M., Ahmed, N., Iqbal, M. K. and Rehman, M. U. (2017).** Influence of different feed forms and particle size on efficiency of broiler production . *Journal of animal and feed research*, 7(2): 24-28.
- Olukotun, A. A. and Dairo, F. A. S. (2020).** The effect of physical forms of feed and time regimes of feeding on the growth performance and nutrient digestibility of broiler chickens . *Nigerian journal animal science*, 22(2): 163-172.
- Savewonlop, N., Rattanabtimtong, S., Ruangpanit, Y., Songserm, O. and Attamangkune, S. (2019).** Effect of different phase-feeding programs with different feed forms on broiler growth performance, carcass traits and intestinal morphology . *International journal of poultry science*, 18(4): 181-186.
- Yaung, S., Parptiwi, W. I. I. and Lesik, M. M. N. N. (2024).** The influence of the form of feed on the productivity of broiler chickens . *Earth and environmental science*, 1341: 73-81.