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Effect of postbiotics on the productive traits and economic efficiency of broiler chickens

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Abstract: The metabolized substance was produced in the laboratory (postbiotics), according to three successive stages. The first stage included: isolating and identifying lactic acid bacteria from the ileum area in the small intestine of poultry, while the second stage included: activating the isolated bacteria on sterilized sorted milk media for three consecutive times. The third stage included: producing the biologically metabolized substance or biologically active compounds, in the form of a fine powder.
This substance was added to the diets of broilers at a level of (0, 1, and 2) g /kg feed, for three experimental treatments, T_0, T_1, and T_2, respectively, during the rearing period of 35 days. To study its effect on the productive traits and economic efficiency of broilers.
The results of the statistical analysis showed: a significant improvement ($P \leq 0.05$) in the rates of body weight and weight gain, in addition to a significant improvement ($P \leq 0.05$) in the food conversion rate and in the economic efficiency measure in favor of the postbiotics T_1 and T_2 treatments compared to the control treatment. T_0, while there are no significant differences in the rate of feed consumption between all the treatments studied.

Keywords: Broilers, Small intestine, Probiotic, Postbiotics, Lactic Acid Bacteria

Introduction

In recent years, poultry breeding projects have increased very rapidly. As a result of the increasing demand for its meat and egg products; Due to the tremendous growth in population density, which necessitated the adoption of intensive breeding systems and the expansion of the establishment of these projects, and these measures are accompanied by the recording of many disease cases among Chickens (Al-Salhi et al., 2022).

This prompted some researchers and poultry breeders to use antibiotics on a large scale to combat these pathogens, but they failed in some countries due to their negative impact on the consumer, which prompted the World Health Organization to ban their use. For fear of being transmitted to the consumer (Muaz et al., 2018).

After that, efforts turned to enhancing intestinal flora with probiotics, which have proven their efficiency compared to antibiotics, and whose effective role in supporting public health and increasing production is no secret to all researchers, as Xie et al. (2019) noted that exposing Chickens to a probiotic that contains 10^8 (cfu/g) of lactic acid bacteria L. *reuteri,* contributes to a significant increase in the height of the villi and improves the intestinal lining compared to the control treatment. Zhang et al. (2021) indicated that when adding 1% of the probiotic consisting of L. *reuteri* bacteria, 5 ×10^9 L.*acidophilus* (cfu/g) per liter of water for broilers led to a significant improvement in average body weight, weight gain, and feed conversion factor compared to the control treatment.

This prompted major companies to produce commercial probiotics, and their products dominated the local market. Therefore, it was necessary to find a more effective and less expensive alternative that accurately mimics the intestinal flora. Because it is isolated from the digestive tract of local Chickens, which is considered part of a series of attempts to support the intestinal flora with probiotics, but in a different way, which is to support it with metabolic products only, without enhancing it with live bacteria, as the digestive system is targeted; To simulate intestinal flora, in order to reduce the numbers of harmful bacteria, and create a state of microbial balance; To support gut health; In order to obtain the highest benefit and effectiveness at the lowest costs.

Methodology

Prepare the metabolized substance (Postbiotics)

Postbiotics was prepared according to three successive stages: The first stage included: isolating and identifying lactic acid bacteria from the ileum area in the small intestine of poultry Chickens, while the second stage included: activating the isolated bacteria on sterilized sorted milk media for three consecutive times. The third stage included: producing the biologically metabolized substance or biologically active compounds, in the form of a fine powder (Al-Salhi et al., 2024).

Experiment design

Used 135 chicks of the Ross breed, the experiment was designed after the average weight of the chicks reached 43 g. These chicks were raised in cages inside an experimental hall designated for research work. Nutritional diets were provided for them (Table 1), and all appropriate conditions were prepared for the chicks, according to Aviagen (2018) for Global Recommendations.

Postbiotics was added to the diets of broiler chickens at a level of (0, 1 and 2) g /kg of feed, for three experimental treatments T_0, T_1 and T_2, respectively, with 45 Chickens for each treatment in three replicates, during the rearing period of 35 days. To study its effect on the productive traits and economic efficiency of broilers.

Table 1. Chemical composition of broiler diets and their chemical analysis

Ingredients	Starter diet(1-21) days	Final diet (22-35) days
Yellow Corn	42	50
Wheat	17.2	15
Soybean Meal (48%)	32	24
Protein Concentrate (40%)	5	5
Vitamins and Minerals	1	1
Vegetable Oil (Sunflower)	0.5	3.2
Limestone	2	1.5

Table Salt	0.3	0.3
The Total	100	100
Calculated Chemical Composition		
Crude Protein %	23.43	20.03
ME kcal/kg	2956.76	3204.46
Energy to Protein Ratio	126.16	159.98
Crude Fiber %	4.11	3.58
Calcium %	1.32	1.1
Available Phosphorus %	0.47	0.46
Methionine %	0.43	0.42
Lysine%	1.24	1.03
Methionine + Cysteine %	0.9	0.81

- Protein concentrate: produced by the Dutch company Brocon, contains 40% crude protein, 2107 (kcal/kg) represented energy, 4.20% calcium, 2.65% phosphorus, 4.68% available phosphorus, 3.70% methionine, 0.66% cysteine, 3.85% Lysine, 2.20 crude fibres, 12.4% methionine and cysteine.
- The chemical composition of the materials included in the composition of the diet was calculated according to the recommendations of the NRC (1994).

Statistical analysis

The data were statistically analyzed using SPSS (2018), and the significant differences between the means were compared using the Duncan (1955) multinomial test at a significance level of 0.05.

Result and Discussion

Despite the efficiency demonstrated by postbiotics in achieving the essential feature for which it was made, which is reducing ammonia gas, the results of which became clear through previous tests (Al-Salhi et al., 2024), adding it to the feed also contributed to achieving another important feature, which is improving production performance. For poultry Chickens, as is evident from the following figures (1,2,3,4,and 5) which represent the effect of adding Postbiotics to the feed on the average live weight, the rate of weight gain, the feed consumption rate, the average feed conversion factor, and the measure of the economic efficiency of the feed: -

It is evident from Figures (1 and 2) that there was a significant improvement ($P \leq 0.05$) in the average live body weight and weight gain, starting from the second week until the end of the experiment (the fifth week), in favor of the two Postbiotics treatments (T_1 and T_2) compared to the control treatment T_0. As for Figure (3), which represents the feed consumption rate, we did not notice significant differences between all experimental treatments, while Figure (4) indicates a clear significant improvement ($P \leq 0.05$) in the feed conversion factor rate, starting from the second week and ending with Fifth, in favor of the two Postbiotics treatments (T_1 and T_2) compared to the control treatment (T_0), despite the fact that there are no significant differences between the two Postbiotics treatments (T_1 and T_2) in the indicated figures (1,2,3,and 4).

The significant improvement that occurred in the productive characteristics of Postbiotics treatments, which included: body weight, weight gain, and food conversion factor, occurred as a result of changing the intestinal environment. Due to the metabolic products of lactic acid bacteria contained in Postbiotics, the environment will be unsuitable for the growth and activity of harmful bacteria, and thus the opportunity for the host to benefit from absorbing nutrients will increase, after removing the harmful bacteria that were consuming these elements to maintain their activities, and thus the environment of the small intestine will be increased. It is prepared to work optimally through the secretion of digestive enzymes that break down nutrients, as well as its contribution to the restoration and production of the network of mucin fibers on which the mucus, secreted by goblet cells, settles, which is considered an important barrier in maintaining the layers of mucus. The small intestine by closing the receptors present on the intestinal cells, and thus this will contribute to increasing the length of the villi and the depth of the crypts, and making them in a state of continuous division and differentiation. This increase in the rate of length of the villi will reduce the diameter of the internal lumen of the intestine, which will slow down the passage of the food mass into the intestine. The intestinal lumen, which will allow it a longer period of digestion and absorption and increase the readiness of nutrients to the body, which is ultimately reflected in improved productive performance (Al-Salhi et al., 2024).

These results agreed with what was indicated by Zhang et al. (2021) in that there was a significant improvement in the average body weight, weight gain, and feed conversion factor compared to the control treatment, when the intestinal flora of broilers was enhanced with lactic acid bacteria. They agreed with what was observed by Khabirov et al. (2021) that strengthening the digestive tract with lactic acid bacteria will contribute to improving the productive performance of broilers.

Finally, it is clear from Figure (5) that there was a significant superiority ($P \leq 0.05$) in the measure of the economic efficiency of the feed in favor of the second treatment (T_2) with the addition of 2g Postbiotics /1kg of feed over the first treatment (T_1) with the addition of 1gm Postbiotics /1kg of feed. Which in turn outperformed the control treatment (T_0) which was free of the addition.

The significant superiority achieved in the Postbiotics treatments in the economic efficiency measure was due to the improvement in the feed conversion factor, as the results recorded by the following experimental treatments (T_0, T_1, and T_2) amounted to (1350, 1087.5, and 1072.5) dinars/kg live weight, for each Treatment respectively, which are represented as prices for producing one kilogram of meat, meaning that treatment T_2 contributed to reducing the cost of producing one kilogram of meat by 1072.5 dinars/kg live weight, after it reached 1350 dinars/kg live weight in the control treatment T_0, with a difference The amount is 277.5 dinars/kg live weight, which represents the economic return resulting from the addition of Postbiotics.

Since the cost of feeding in the field of poultry farming constitutes 70% of the production cost (Smith, 1990), as is clear by applying the proportional equation by multiplying the output by the production cost, which represents (70%); To obtain the economic cost of transactions, and to prove the extent of their contribution to reducing the cost of production, which amounts to 70%.

$$\textbf{Percentage} = \frac{\textit{Cost of diet per treatment } (x)}{\textit{diet cost for control treatment}} \times 100\%$$

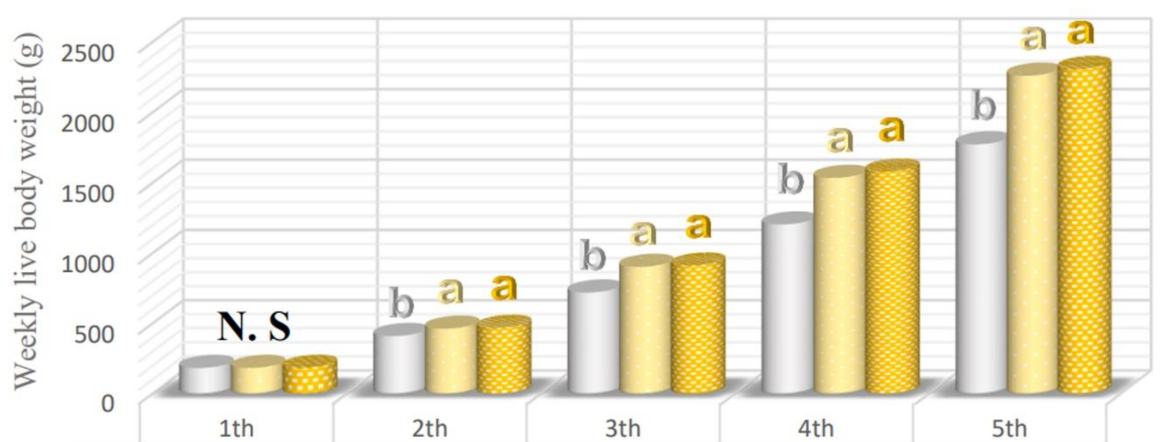
$$\textbf{The economic cost of the treatment } T_0 = \frac{1350}{1350} \times 100\% \qquad \mathbf{T_0} = 70\%$$

$$\textbf{The economic cost of the treatment } T_1 = \frac{1087.5}{1350} \times 100\% \qquad \mathbf{T_1} = 56.38\ \%$$

$$\textbf{The economic cost of the treatment } T_2 = \frac{1072.5}{1350} \times 100\% \qquad \mathbf{T_2} = 55.61\%$$

We note from the above that treatment T_2 contributed to reducing the cost of feeding by 55.61%, followed by treatment T_1, to contribute to reducing the cost by 56.38% compared to the control treatment (standard diet) which amounted to 70%, which was similar to the total feeding cost indicated by Smith (1990).

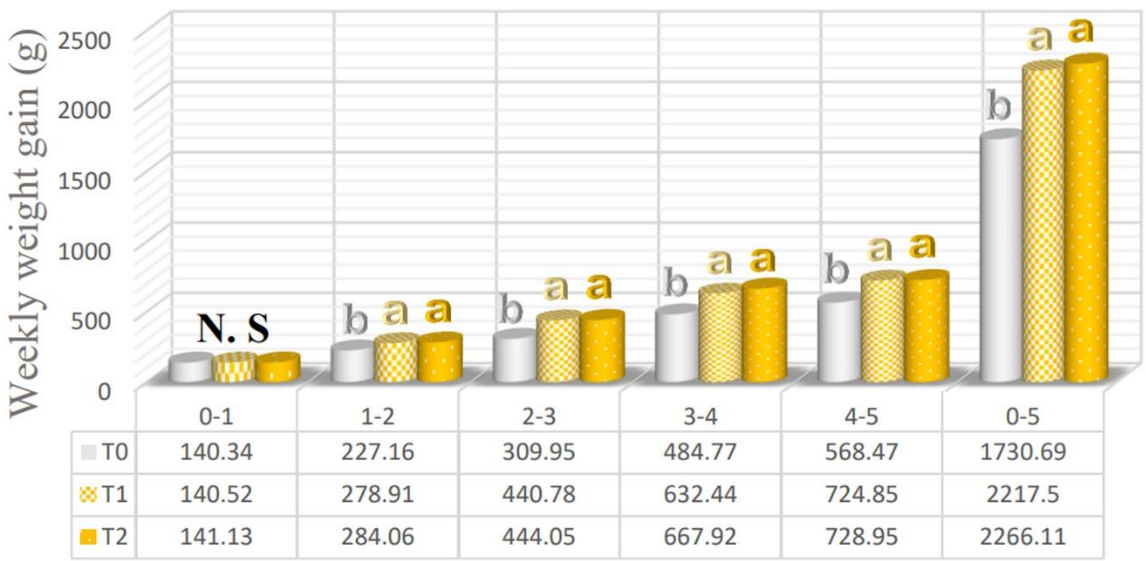
This result, in terms of reducing the economic cost of the diet, agreed with what was found by Odeh (2017), who concluded that the use of kefir milk, which contains lactic acid bacteria, contributes to reducing the measure of the economic efficiency of the diet. It did not agree with what Sabaa (2020) noted in that there were no significant differences in the measure of economic efficiency, when using the probiotic containing lactic acid bacteria to the broiler feed, compared to the control treatment.



	1th	2th	3th	4th	5th
T0	183.34	410.5	720.45	1205.22	1773.69
T1	183.52	462.43	903.21	1535.65	2260.5
T2	184.13	468.19	912.24	1580.16	2309.11

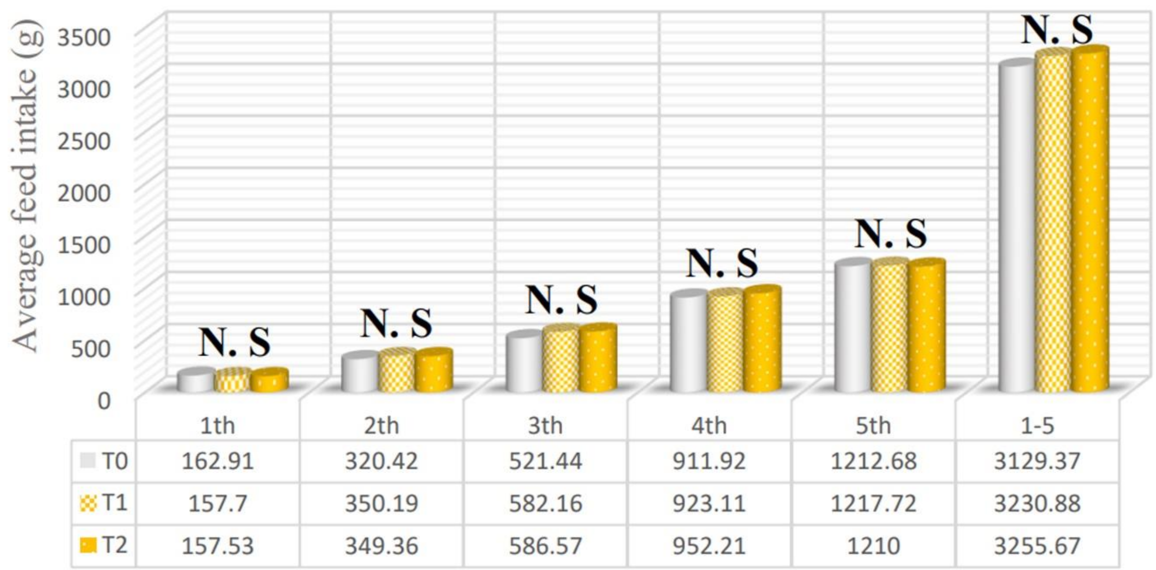
T_0: control treatment, (without addition). T_1 and T_2 add (1 and 2) g Postbiotics /kg feed, respectively
*Different letters indicate significant differences at the 0.05 probability level.
*N.S: indicates that there are no significant differences between the averages of the coefficients

Figure 1. Effect of adding Postbiotics on the live weight of broilers



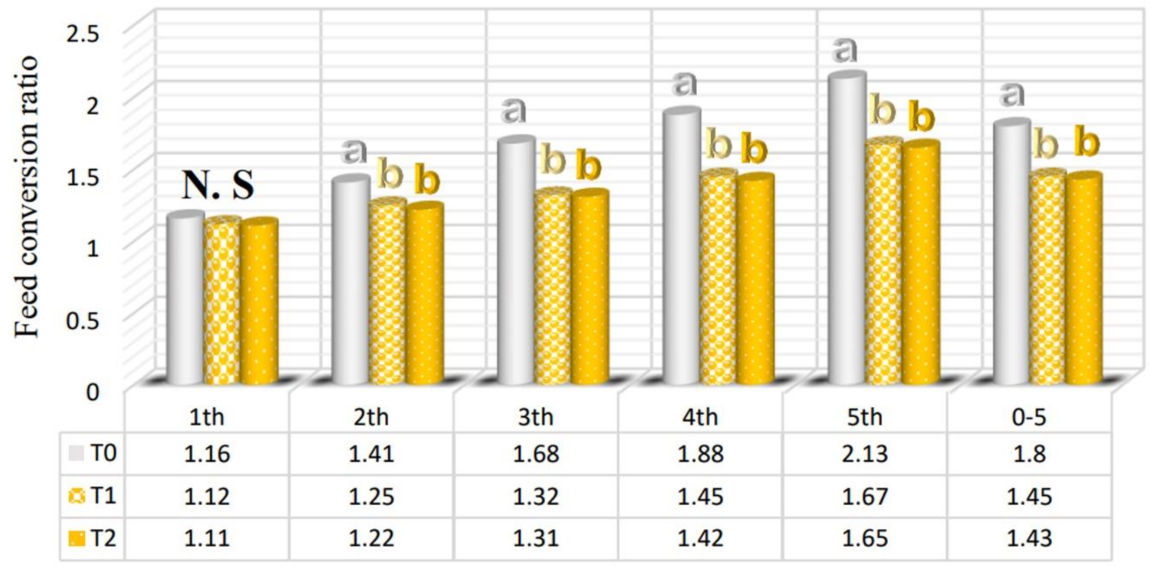
T_0: control treatment, (without addition). T_1 and T_2 add (1 and 2) g Postbiotics /kg feed, respectively
*Different letters indicate significant differences at the 0.05 probability level.
*N.S: indicates that there are no significant differences between the averages of the coefficients

Figure 2. Effect of adding Postbiotics on the rate of weight gain of broilers



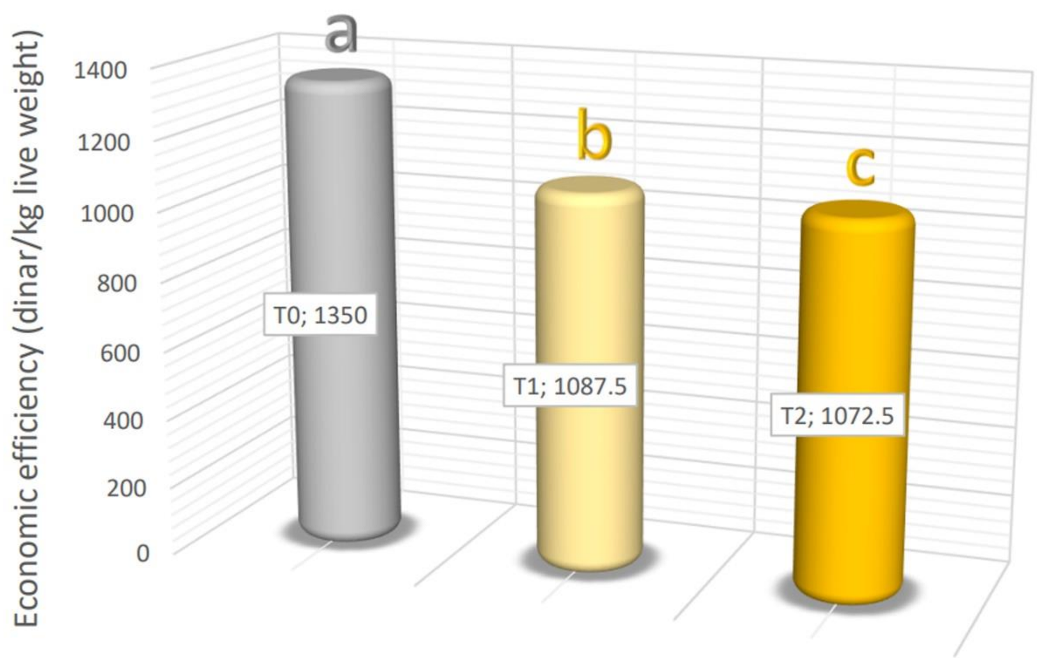
T_0: control treatment, (without addition). T_1 and T_2 add (1 and 2) g Postbiotics /kg feed, respectively
*Different letters indicate significant differences at the 0.05 probability level.
*N.S: indicates that there are no significant differences between the averages of the coefficients

Figure 3. Effect of adding Postbiotics on the rate of feed intake of broilers



T_0: control treatment, (without addition). T_1 and T_2 add (1 and 2) g Postbiotics /kg feed, respectively
*Different letters indicate significant differences at the 0.05 probability level.
*N.S: indicates that there are no significant differences between the averages of the coefficients

Figure 4. Effect of adding Postbiotics on the feed conversion ratio of broilers



T_0: control treatment, (without addition). T_1 and T_2 add (1 and 2) g Postbiotics /kg feed, respectively
*Different letters indicate significant differences at the 0.05 probability level.
*N.S: indicates that there are no significant differences between the averages of the coefficients

Figure 5. Effect of adding Postbiotics on measuring the economic efficiency of broiler

Conclusion

We conclude from this study, and as indicated by the results of the statistical analysis, that the use of Postbiotics in broiler diets contributed to a significant improvement ($P \leq 0.05$) in body weight rates, weight gain, feed conversion factor, and a measure of the economic efficiency of the feed, in favor of the Postbiotics T_1 and T_2 treatments, Compared to the control treatment T_0, and these results were reflected positively in the economic feasibility calculation in favor of the two Postbiotics treatments compared to the control treatment.

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