Effect of Pelleted Fermented Feed in Production Performance of Laying Hens

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Abstract

Lactobacilli, Bacillus subtilis, Bifidobacterium, Saccharomyces cerevisiae were applied to produce fermented feeds (FF). The FF was pelleted to investigate for its influences in production performance for laying hens, the (FF) was ferment with 10 g/kg feed of the probiotic with a wetting ratio of half a liter/kg of feed for 48 hours where it was used at rates 0, 25%, 50%, 75%, and 100% for the treatments T1, T2, T3, T4, and T5 respectively, and the duration of the study lasted for seven periods, each period was two weeks, as for the following study results: Significant superiority (P≤0.05) for treatment T5 during The first and sixth period and the treatment T4 during the second, third and fourth periods compared with the control treatment in the percentage of egg production, in egg weight significantly increased (P≤0.05) of treatment T3 in the second, sixth and seventh periods, and treatment T4 during the third period exceeded treatment T5 during the fourth period, men while in the feed conversion factor, T4 treatment improved significantly (P≤0.05) during the third period and together with The treatment of T5 during the fourth period and all treatments of (FF) in the fifth period and the treatments T3, T5 in the sixth period and the treatment T3 in the seventh period, a significant (P≤0.05) superiority was obtained for the treatments T4 and T5 during the second, third, fourth and sixth periods in the cumulative egg production and egg mass.

Keyword: Fermentation feed, lying, Pelleting.

1. Introduction

Fermentation is to moisten the feed with water first and add beneficial microbial cultures that include several strains, including Lactobacillus, Streptococcus, and Aspergillus [1], Saccharomyces cerevisiae [2], and Bacillus subtilis [3], and then broods the forage. In the Incubator at a temperature of 37 °C for 24 hours for fermentation [4], the fermentation process of feed with these beneficial microbial cultures with the availability of suitable conditions for fermentation of humidity, temperature, and time required for this process will enhance the production of organic acids and reduce The pH values of the feed and making the medium acidic inhibit the pathogenic bacteria E. coli and Salmonella, which are characterized by intolerance to high acidity [5], multiplying the number of beneficial bacteria at the expense of harmful bacteria [6], as well as increasing the secretion of protease, amylase and lipase enzymes which It leads to improved production performance [7], and the fermentation process for fodder leads to an increase in the availability of nutrients in the forage, such as an increase in the availability of phosphorus, availability due to the activity of the enzyme phytase (Phytase) produced by the beneficial microorganisms used by fermentation, as well as the increase in the effectiveness of the internal enzymes present in the plant seeds such as wheat and barley.

The fermentation process of fodder is carried out in two ways, namely aerobic and anaerobic fermentation [8]. Among the modern technologies for the use of (FF) is to convert it into pellets to facilitate its transportation, storage, and handling [9,10]. The use of (FF) with or without the probiotic improved the production efficiency of local Putra chickens, as it increased the growth rate of chickens and improved the efficiency of food conversion compared with the control treatment, and in a study conducted by [11], to find out the effect of fermentation of fodder on laying hens and roosters where bean soyabean with probiotic containing B. subtilis KATMIRA1933 and B. amyloliquefaciens B-1895. As both strains improved the percentage of egg production, the quality of the eggs produced, and the quality of the roosters’ sperm. The researcher indicated that it is possible to use a (FF) to reduce the cost of feed due to the increase in the efficiency of using it, in addition to using the probiotic for fermentation of feed materials, so the current study aims to know the effect of (FF) after the pelleting process in the production characteristics of the layer hens.
2. Materials and Methods

2.1. Probiotic and Fermented Feed Preparation

Local probiotic contends (*lactobacilli, bacillus subtilis, Bifidobacterium, Saccharomyces Servisae*) used to fermented layer diet in table (1), aerobically fermentation with 10 g of a Probiotic / kg of feed and a wetting ratio of half a liter of water/kg of feed for 48 hours after that the (FF) was dried and pelleted by pelleting machine.

2.2. Experiment design and chicken management

The farm experiment was conducted in the poultry farm of the Faculty of Agriculture/ Al-Qasim green University for 14 week extended for the period from 10/28/2020 to 01/27/2021, wherein this experiment the 58-week-old Lohman brown chicken was used, and 150 laying hens were randomly divided into five treatments. Each treatment 30 chickens were divided into three replicates each of 10 chickens (T1: control treatment, T2: (FF) at a rate of 25%, T3: (FF) at a rate of 50%, T4: (FF) at a rate of 75%, T5: (FF) at a rate of 100%), at seven periods each period of 2 weeks.

2.3. Feed treatment

The chickens were fed on ration below, a feed ration of 115 gm/chicken/day.

| Ingredients           | %  |
|-----------------------|----|
| yellow corn           | 36.5 |
| wheat                 | 12  |
| barley                | 13.9 |
| Soybean meal (44% protein) | 25  |
| Premix                | 2.5 |
| DCP Calcium Diphosphate | 8.3 |
| Sunflower oil         | 1.8 |
| Total**               | 100 |

Metabolic energy (kilocalories/kg feed) 2758.68
Crud protein (%) 17.19
Crud fiber 3.24
Calcium% 3.81
Available phosphorus (%) 0.29
Methionine + cysteine (%) 0.73
Lysine (%) 0.95

*Premix Maxcare of Belgian origin Each 1 kg contains: crude protein 7.9%, lysine 2.4%, methionine 7.7%, methionine + cysteine 7.7%, calcium 23.1%, phosphorous 3.3%, sodium 5.5%, representative energy 2903 kcal/kg, vitamin A 400,000 IU, Vitamin D3 300,000 IU, Vitamin Hy.D 20,000 IU, Vitamin E 800 IU, Vitamin K 80 ppm, Vitamin B1 40 ppm, Vitamin B2 160 ppm, Calcium Pantothenate 320 ppm, Niacin 600 ppm, Biotin 1600 ppb, vitamin B12 1000 ppb, folic acid 40 ppm, vitamin B6 160 ppm, iron 2800 ppm, copper 600 ppm, zinc 2400 ppm, magnesium 4000 ppm, iodine 80 ppm, selenium 8 ppm.** Chemical analysis computed according to [12]. • Dicalcium phosphate with a concentration of calcium in 24%, phosphorus 18%. • 9000 kcal/kg oil.

2.4. Studied traits

2.4.1. Percentage of Egg Production

Eggs were collected at eleven o’clock in the morning during the length of the experiment, and the percentage of egg production for each replicate within two weeks was calculated based on the number of chickens at the end of each week for each replicate [13].

2.4.2. Feed Conversion Factor

According to the food conversion factor at the end of every two weeks, according to the equations referred to by [3].
2.4.3. Egg Weight

Record the weight of eggs daily every week and for each of the repeated treatments with an SF-400C scale sensitive to the nearest gram, and extract the average egg weight for one day for the repeated treatment every two weeks.

2.4.4. Cumulative Egg production (egg / chicken / period)

The cumulative number of eggs was calculated according to the equation referred to by [14].

2.4.5. Mass of Eggs Produced

The mass of eggs for each repeat during each period was calculated according to the following equation: - Egg mass (g / hen / day) = H.D x average egg weight x 14

2.5. Statistical Analysis

The Statistical Analysis System -SAS [15], was used in data analysis to study the effect of different treatments on the traits studied according to a Completely Randomized Design (C.R.D), and the mean differences between the averages were compared to the Duncan [8] polynomial test.

\[ Y_{ij} = \mu + T_i + e_{ij} \]

Yij: the value of viewing j to treatment i.
\( \mu \): general average for the trait.
\( T_i \): effect of treatment i (the study included the effect of five treatments).
\( e_{ij} \): a random error that is normally distributed with an average of zero and a variation of \( \sigma^2e \)

3. Result and Discussion

3.1. Percentage of Egg Production

It is noted from Table (2) the effect of the study on the percentage of egg production of hen Day eggs, and it is noticed in the first period a significant superiority (P≤0.05) for treatment T5 compared to the rest of the treatments and the superiority of treatment T4 over treatment T1 and there was no significant difference between the treatments T2, T3, T4 and also the coefficients. T1, T2, T3. In the second and third period, there was a significant superiority (P≤0.05) for the two treatments T5 and T4 over the two treatments T1 and T2, and the two treatments T2, T3 over treatment T1. No significant difference was obtained between the treatment T3, T4, T5, as well as the two treatments T3. The significant superiority of (P≤0.05) for the two treatments T4 and T5 continued during the fourth period compared to the rest of the treatments, and the significant superiority of the treatment T3 over the two treatments T1 and T2, and no significant differences were observed between the treatments T4 and T5 and also between the treatments T1, T2 and in the fifth period, it was significantly higher (P≤0.05) treatment T5 compared to the rest of the treatments, and treatment T4 outperformed the treatment T1, T2, T3, and there was no significant difference between the treatment T1, T2, T3, and the significant superiority (P≤0.05) for treatment T5 withdrew to the sixth period compared to treatment T1, T2, T3 and superior The two treatments T3, T4 over treatment T1. There were no significant differences between the treatments, T4 and T5, between the treatments T2, T3, T4, and also T1, T2.

3.2. Egg Weight

Table (3) shows the effect of the studied treatments on the weight of eggs produced during the trial period, and it becomes clear during the first period that there are no significant differences between the treatments, and in the second period it was found that the significant (P≤0.05) was superior to treatment T3 compared to the rest treatments and the treatments T2 and T4 outperformed treatment T1. There was no significant difference between the treatment T1, T5, as well as between the treatment T2, T4, and T5, but in the third period, the treatment T4 was significantly superior (P≤0.05) compared to the rest of the treatments, and the treatment T2, T3, T5 exceeded compared to the treatment T1, and no significant difference appeared. Among the treatment T2, T3, T5, and in the fourth period, it was found that there was a significant superiority (P≤0.05) for the treatment T5 compared to the treatment T1, and there was no significant difference between the treatment T2, T3, T4, T5
and also between the treatment T1, T2, T3, and T4. It was significantly superior (P≤0.05) for all the fermented feed treatments compared to the control treatment, and there was no significant difference between the treatments T2, T3, T4, and T5. In the sixth and seventh periods, a significant (P≤0.05) was obtained for treatment T3 over treatment T1, and it did not appear. There were significant differences between the treatment T2, T3, T4, T5, and also between the treatment T1, T2, T3, T4.

3.3. Feed Conversion Factor

Table (4) indicates the effect of the study on the feed conversion factor, and it is noticed during the first and second periods that there are no significant differences between the studied treatments. In the third period, it was found that there is a significant improvement (P≤0.05) for treatment T4 compared to the rest of the treatments and the improvement of the treatments T2, T3, T5 compared with treatment T1, there were no significant differences between the treatments T2, T3, and T5. However, in the fourth period, a significant improvement (P≤0.05) was found for treatment T5 compared to treatment T1, and there were no significant differences between the treatments T2, T3, T4, T5, as well as the treatments T1, T2, T3, T4, and in the fifth period, a significant improvement was found (P≤0.05) for all the fermented feed treatments compared to the control treatment, and no significant differences occurred between the treatments T2, T3, T4, T5, and in the sixth period, a significant improvement was found (P≤0.05). For the two treatments T3, T5 compared to the treatment T1, there were no significant differences between the treatments T2, T3, T4, T5, and also the treatments T1, T2, T4. In the seventh period, there was a significant improvement (P≤0.05) for treatment T3 compared to treatment T1, and there were no differences. Significance of the parameters T2, T3, T4, T5, as well as the parameters T1, T2, T4, T5.

3.4. Cumulative Egg Production

Table (5) shows the effect of the study on cumulative egg production. It is noticed during the first period that there were no significant differences between the studied treatments. In the second, third, and fourth periods, it was found that there was a significant superiority (P≤0.05) for the treatments T5 and T4 compared to the two treatments T1, T2 and the superiority of treatment T3 on the treatment T1, there was no significant difference between the treatment T3, T4, and T5, as well as between the two treatment T2, T3. In the fifth period, it was found that a significant superiority (P≤0.05) was obtained for treatment T5 compared to the rest of the studied treatments, and there was no significant difference between the treatment T3, T4. In the sixth period, there was a significant superiority (P≤0.05) for the treatments T4 and T5 compared to the rest of the treatment, and it was not found that there was a significant difference between the treatment T1, T2, T3 as well as between the treatment T4 and T5. In the seventh period, a significant superiority occurred (P≤0.05) for the treatment T3 compared to the rest of the treatments, and no significant differences were found between the treatments T1, T2, T4, and T5.

3.5. Egg mass

Table (6) indicates the effect of the treatments on the mass of egg production. During the first period, it was evident that there was a significant superiority (P≤0.05) for treatment T5 compared to the rest of the treatments and the superiority of the treatments T2, T3, T4 on treatment T1. No significant differences were found between the treatments T3, T4 in the second period, there was a significant superiority (P≤0.05) for treatments T4 and T5 compared to treatments T1 and T2, and for the treatment T3 over the treatment T1. No significant differences were found between the two treatments T2, T3, and also between the treatments T3, T4, and T5 in the third period. It was shown that there was a significant superiority (P≤0.05) for the treatment T4 compared to the treatments T1, T2, and T3 and for the treatment T5 to the treatment T1. No significant differences were found between the two treatments T4, T5, and also between the treatments T2, T3, T5. In the fourth period, a significant superiority was obtained. (P≤0.05) for the treatment T5 compared to the two treatments T1, T2 and the treatments T2, T3, T4 exceeded the treatment T1 and there was no significant difference between the treatments T3, T4, T5 as well as between the treatments T2, T3, T4. In the fifth period, the table showed a significant superiority (P≤0.05) for treatment T5 compared to treatments T1, T2, T3, and for treatments T3, T4 superior to treatment T1 and no significant differences were found. Among the treatments T1, T2 and also the treatments T2, T3, T4, as well as the treatments T4, T5, and in the sixth period, a significant superiority was found (P≤0.05) for the treatment T5 compared to the rest of the treatments and the superiority of the two treatments T3 and T4 over the treatment T1 and there were no significant differences between the treatments. T1, T2, and also the treatments T2, T3, and T4. As for the seventh period, there was a significant superiority (P≤0.05) for treatment T3 compared to the rest of the experiment coefficients, and for the treatments T2, T4, T5 on treatment T1, there was no significant difference between the treatments T2, T4, T5.

The improvement of the production characteristics of the (FF) treatments T3, T4, and T5 may be due to the fermentation of the fodder with the probiotic, where the probiotic has important roles for the laying hens through increasing the feed consumption and improving the feed conversion factor [10,16], and higher resistance. Against parasitic diseases [5,17]
increased immune function [5], production of larger eggs [6], increased egg production and quality [9-14], reduced egg cholesterol [14,18], as well as reduced ammonia emissions [19], and reduced oxidative stress [1]. Likewise, the fermentation process of fodder and through micro-organisms that work on the secretion of digestive enzymes such as protease, amylase, lipase, phytase, and catalase, and thus the decomposition of complex nutrients such as carbohydrates, proteins and fats into simpler units that are easy to digest and absorb by domestic chickens [20], because domestic chickens with a simple stomach do not contain all of these enzymes in their digestive system, so the amylase breaks down carbohydrates and turns them into simple sugars that are easily absorbed [21], the lipase that breaks down fats into free fatty acids [4] and an enzyme, Protease breaks down proteins into amino acids and thus increases the efficiency of utilizing the feed ingested, which is reflected in the productivity of chickens, also during the fermentation process, the probiotic bacteria, especially lactic acid bacteria, work to produce bacteria that contribute to increasing the competitiveness of the bacteria producing them against the pathogenic species in the (FF), [22], as well as the ability of the probiotic bacteria to eliminate competitively within the bird's gut, Against harmful bacteria and thus improving intestinal health [19], which is positively reflected on the production of chickens fed on (FF), as well as modern techniques for using (FF) is to dry it and convert it into pellets to benefit from the products of the fermentation process and the remaining microorganisms in the feed after pelleting, which results in It benefits from the benefits of the pellets process in terms of storage, transportation and also economically.

**Table 2.** Effect of pelleted fermented feed in percentage of egg production H. D %.

| Treatments | first period | Second period | Third period | Fourth period | Fifth period | Sixth period | Seventh period |
|------------|--------------|---------------|-------------|--------------|-------------|-------------|--------------|
| T1         | 71.59±3.49   | 70.94±3.54    | 71.42±7.21  | 70.73±4.98   | 72.68±2.52  | 3.64±66.24  | 70.19±0.31   |
| T2         | bc73.68±3.63 | b76.23±3.84   | b76.61±0.85 | c73.80±4.76  | c±3.1773.17 | cb67.26±2.59 | 70.38±3.14   |
| T3         | bc73.94±1.11 | ab79.04±5.37  | ab80.40±3.03| b78.57±5.15  | c73.80±4.16 | b69.92±2.08 | 72.02±9.92   |
| T4         | b76.05±0.38  | a80.07±3.10   | a81.99±1.74 | a79.43±5.19  | b75.84±6.13 | ab72.87±5.19 | 70.38±8.79   |
| T5         | a78.42±2.07  | a81.77±1.07   | a82.05±1.06 | a79.69±0.84  | a79.02±1.12 | a73.12±4.42 | 70.19±4.55   |

Means with different letters indicate a significant difference in probability level 0.05, N. S: Not significant * (P≤0.05). The treatment T1, T2, T3, T4, T5 are control treatments without addition, adding 25%, 50%,75%, 100% fermented feed, respectively.

**Table 3.** Effect of pelleted fermented feed in weight of the eggs produced g/egg.

| Treatments | first period | Second period | Third period | Fourth period | Fifth period | Sixth period | Seventh period |
|------------|--------------|---------------|-------------|--------------|-------------|-------------|--------------|
| T1         | 1.10±65.41   | 0.74±63.80±   | 1.49±62.57± | 1.20±63.69±  | 0.84±62.37± | 0.83±64.09± | b 64.44±0.52 |
| T2         | 0.7264.83±   | 0.61±65.26±   | 1.61±67.37± | 0.56±67.03±  | 1.17±65.37± | 1.57±65.69± | ab66.20±1.90 |
| T3         | 1.1666.96±   | 0.21±66.07±   | 0.30±66.37± | 1.28±66.97±  | 0.14±66.64± | 1.36±68.24± | ab68.58±0.86 |
| T4         | 0.6765.18±   | 0.46±65.60±   | 3.08±68.35± | 0.70±66.74±  | 0.48±65.95± | 0.88±66.49± | ab66.78±0.56 |
| T5         | 1.8365.45±   | 1.05±64.63±   | 0.57±66.73± | 1.48±68.11±  | 0.58±67.11± | 0.55±67.57± | ab67.42±0.52 |

Means with different letters indicate a significant difference in probability level 0.05, N. S: Not significant * (P≤0.05). The treatment T1, T2, T3, T4, T5 are control treatments without addition, adding 25%, 50%,75%, 100% fermented feed, respectively.
### Table 4. Effect of pelleted fermented feed in feed conversion factor (g feed/g egg/chicken).

| Treatments | First period | Second period | Third period | Fourth period | Fifth period | Sixth period | Seventh period |
|------------|--------------|---------------|--------------|---------------|--------------|--------------|----------------|
| T1         | 0.02 ± 1.75 | 0.02 ± 1.80   | 0.04 ± 1.83  | 0.03 ± 1.80   | 0.02 ± 1.79  | 0.01 ± 1.78  |
| T2         | 0.02 ± 1.75 | 0.01 ± 1.75   | 0.04 ± 1.70  | 0.01 ± 1.71   | 0.03 ± 1.75  | 0.04 ± 1.73  |
| T3         | 0.03 ± 1.71 | 0.06 ± 1.73   | 0.06 ± 1.72  | 0.01 ± 1.71   | 0.05 ± 1.72  | 0.03 ± 1.68  |
| T4         | 0.01 ± 1.76 | 0.01 ± 1.74   | 0.07 ± 1.68  | 0.01 ± 1.71   | 0.01 ± 1.74  | 0.02 ± 1.72  |
| T5         | 0.04 ± 1.75 | 0.02 ± 1.77   | 0.03 ± 1.68  | 0.01 ± 1.71   | 0.01 ± 1.70  | 0.01 ± 1.70  |

**Significant**

N. S

Means with different letters indicate a significant difference in probability level 0.05, N. S: Not significant * (P≤0.05). The treatment T1, T2, T3, T4, T5 are control treatments without addition, adding 25%, 50%, 75%, 100% fermented feed, respectively.

### Table 5. Effect of pelleted fermented feed in Cumulative egg production (egg/chicken/period).

| Treatments | First period | Second period | Third period | Fourth period | Fifth period | Sixth period | Seventh period |
|------------|--------------|---------------|--------------|---------------|--------------|--------------|----------------|
| T1         | 3.25 ± 10.02 | c9.93 ± 2.13  | c9.99 ± 1.80 | c9.90 ± 2.73  | b10.17 ± 2.00 | b9.29 ± 1.00 | b9.82 ± 1.73  |
| T2         | 10.31 ± 3.00 | b10.67 ± 2.35 | b10.72 ± 1.90| b10.33 ± 2.88 | b10.24 ± 2.27 | b9.41 ± 1.25 | b9.85 ± 1.28  |
| T3         | 3.11 ± 10.35 | ab11.06 ± 2.10| ab11.25 ± 1.75| ab10.99 ± 2.51| b10.33 ± 2.09 | b9.78 ± 1.53 | a10.08 ± 1.88 |
| T4         | 2.90 ± 10.64 | a11.20 ± 2.50 | a11.47 ± 1.55| a11.12 ± 2.33 | b10.61 ± 2.10 | a10.20 ± 1.25 | b9.85 ± 1.13  |
| T5         | 2.75 ± 10.97 | a11.44 ± 2.00 | a11.48 ± 1.37| a11.15 ± 2.06 | a11.06 ± 2.74 | a10.23 ± 1.41 | b9.82 ± 1.36  |

**Significant**

N. S

Means with different letters indicate a significant difference in probability level 0.05, N. S: Not significant * (P≤0.05). The treatment T1, T2, T3, T4, T5 are control treatments without addition, adding 25%, 50%, 75%, 100% fermented feed, respectively.

### Table 6. Effect of pelleted fermented feed in Egg mass (g/hen/day).

| Treatments | First period | Second period | Third period | Fourth period | Fifth period | Sixth period | Seventh period |
|------------|--------------|---------------|--------------|---------------|--------------|--------------|----------------|
| T1         | c4.52 ± 655.57 | c633.63 ± 3.62| c625.62 ± 3.69| c630.67 ± 1.78| c634.62 ± 1.92| c            | ±595.96 ± 4.13 |
| T2         | b688.73 ± 4.10 | b696.46 ± 3.28| b722.57 ± 3.11| b692.55 ± 3.51| bc           | bc           | ±618.47 ± 2.19 |
| T3         | b5.13 ± 693.14 | ab731.10 ± 3.74| b747.06 ± 3.09| b736.65 ± 2.18| b688.52 ± 2.71| b            | ±667.98 ± 3.17 |
| T4         | b4.22 ± 693.97 | a735.36 ± 4.01| a784.56 ± 3.20| ab            | ab           | b            | ±700.23 ± 3.04 |
| T5         | a5.74 ± 718.56 | a739.87 ± 3.98| ab766.52 ± 2.94| a759.87 ± 3.25| a742.42 ± 3.20| a            | ±691.70 ± 2.99 |

**Significant**

N. S

Means with different letters indicate a significant difference in probability level 0.05, N. S: Not significant * (P≤0.05). The treatment T1, T2, T3, T4, T5 are control treatments without addition, adding 25%, 50%, 75%, 100% fermented feed, respectively.
Recommendation

The (FF) has been widely used and gave good results in the poultry sector, but drying it and converting it into pellet is a modern technology where in addition to the benefits of the fermentation process, the benefits of fermentation can be used, which is easy to transport and circulate and can rely on the products of the fermentation process despite the survival of some microorganisms of Probiotics are alive even after pelleting and require more research to find the easiest methods for fermentation, drying, and pelt formation for the (FF) to be used on a large commercial scale.

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