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Impact of Commercial and Traditional Probiotic Supplementation on Performance, Histomorphology Meat Quality of Broiler

Nidhal A. Mustafa and Ismael Ali I. Sarmami*

Animal Resources Department, College of Agricultural Engineering Science, Salahaldin University, Erbil, Iraq.

Abstract

THE objective of this study was to investigate the impact of supplementing broiler chicken feed with local probiotics (YPP) (yogurt powder production) and commercial probiotics (MiaClost) on body performance and immune status. A total of 480 broiler chicks Ross-308 aged one day were divided into eight treatment groups; each treatment consisted of three replicates that contained 20 birds, which were distributed randomly. The experimental groups consisted of a negative control group receiving just the basal diet (B.D.), a positive control group receiving the B.D. with 0.05% oxytetracycline, and the treatment groups as follows, supplemented with B.D.: T1: 100 g/ton of YPP during phase 1 (1–18). T2: 100 g/ton of YPP during phase 2 (19–35). T3: 100 g/ton of YPP from one day old to 35. T4 100 g/ton of MiaClost during phase 1 (1–18). T5 100 g/ton of MiaClost during phase 2 (19–35). T6 100 g/ton of MiaClost from 1–35 days. The results of this study showed that mean body weight, body weight gain, carcass weight, neck and back, and Villi height were significant at T6, and mean feed conversion ratio, proventriculus, breast, against T3 from 1 to 35 was significantly ($P<0.05$) higher for broilers in the other group and T5. The liver weight was significantly larger during the finisher phase than other treatments, total feed intake, feed conversion ratio, heart, gizzard, abdominal fat, wings, and thighs. The results of the current study indicate that administering probiotics to broilers tends to enhance their growth performance, carcass weight, and villi height.

Keywords: Performance, probiotic, Histomorphology, Edible Parts and IGM, and Broiler.

Introduction

Antibiotics have been used to boost the health and production of chickens since the 1940s, but overuse can lead to bacteria becoming resistant to drugs, which can spread to people. WHO 1997 [1] and The European Union 2006 [2] have categorized the use of antibiotics in food and animal feed as a risk to public health. In 2006, the Food and Drug Administration and other American government authorities decided in 2009 that antibiotics should not be used for growth enhancement [3]. Poultry farmers face the challenge of meeting the world's food needs while adhering to the laws and regulations of the countries in which their birds are raised. Research indicates that biotics, including probiotics and prebiotics, have the potential to enhance bird growth and overall well-being. Probiotics are living bacteria, when administered in suitable quantities, confer health advantages to the host by reinstating a harmonious equilibrium of microbes in the gastrointestinal system [4]. Baker's yeast, a protein substitute, improves chicken growth, blood parameters, and immunological response. It enhances intestine composition, feed consumption, body weight, and feed conversion efficiency in chicken diets [5]. According to Aguilar-Toalá *et al.* [6], bacteriocins and organic acids are only two examples of the antimicrobial components found in postbiotics and other biotic additions; together, they may decrease the intestinal pH and halt the growth of infections in both the feed and the animal. Postbiotics, produced through the activation of probiotics by prebiotics, have the capacity to reduce the pH of the digestive system and impede the growth of several detrimental microorganisms in animal feed and the stomach [7]. Hashem suggests that probiotics can improve immunological response, animal development, meat quality, nutritional absorption, digestibility, and gut microbial composition in animal food and meat products [8]. The objective of this study was to evaluate the impacts and contrast of commercial and traditional probiotics, as potential substitutes for antibiotics, on chicken performance, intestinal health, and meat quality. Additionally, the study intends to determine which type of probiotic is best suitable for practical application.

*Corresponding authors: Ismael Ali Ismael, E-mail: ismael.ismael@soran.edu.iq , Tel.: 009647824770535
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Material and Methods

Preparation of birds and feed

The research material involved 480 one-day-old Ross 308 broiler chicks, obtained from a local hatchery, placed in a closed house at the Animal Science Department, Agricultural Engineering Sciences College, Salahaddin University, Erbil. 480 one-day-old chicks were randomly allocated into eight treatments, each included twenty birds. The experiment was conducted in three duplicates. During the first week of ages the light was provided for 23 hours with an hour of darkness. After day seven, the light period was gradually reduced to 22 hours light with 2 hours darkness in the second week. During the third week until finishing the experiment, there were 18 to 19 hours of lightness with 5-6 hours' darkness according to the Ross-308 broiler handbook guide. The heating system was based on the natural and artificial sources to provided heat during the experimental period, which was at a rate of (32±2 °C) at the starter period and decreased gradually to (20±2 °C) at the last day of grower period with 55- 65% humidity.

Experimental Procedure

Impact of commercial and traditional probiotic supplementation was investigated on the performance, immune system, and meat quality of broiler chicks. The efficacy of using local and commercial Probiotic was evaluated on the Growth Performance, Gut Health and Immune Function of the studied broilers. This experiment contains: The experimental groups included of a negative control group (receiving just the basal diet), the positive control group (received the basal diet supplemented with 0.05% oxy tetracycline), and the treatment groups that were as follows: T1 received the basal diet supplemented with 100 g/ton of YPP during phase 1 (1-18). T2 received the basal diet supplemented with 100 g/ton of YPP during phase 2 (19-35). T3 received the basal diet supplemented with 100 g/ton of YPP from one day old to 35. T4 received the basal diet supplemented with 100 g/ton of MiaClost during phase 1 (1-18). T5 received the basal diet supplemented with 100 g/ton of MiaClost during phase 2 (19-35). T6 received the basal diet supplemented with 100 g/ton of MiaClost from one day old to 35. The feed intake per cage was computed weekly and subsequently utilized to determine the feed-to-gain ratio. Phase measurements of each body weight were documented. At the end of the experiment, the birds were euthanized by severing the throat and jugular vein with a sharp knife at the first vertebra. For each treatment, used 12 birds to calculate the LBW, carcass yield, and weight of the breast. Chickens were euthanized by cutting their jugular vein, removing blood and internal organs, and their corpses were measured using a digital weight scale.

The following parameters, were recorded at the end of our investigation, are listed as follows: LBW, Weight of Carcasses, Level of Breast pH, Quality of Meat, Immunity and Histomorphology.

For each treatment, 12 birds were used to calculate live body, carcass, and breast weights

Data Analysis

The collected data was analyzed by using statistical technique CRD (Completely Randomized Design) implemented in SAS Software [9]. The Multiple Range Test of Duncan was conducted to compare the means of different groups. [10] The purpose was to determine whether there is a statistically significant difference ($P \leq 0.01$).

Results and Discussion

Effect of Probiotic on Performance and carcass characteristics:

The main effects of probiotics led to significant differences in growth performance during the both starter and finisher phase. (Table 1). As shown in Table 1, probiotic supplementation in T6 among the treatments that added commercial probiotics significantly increased live body weight and weight gain compared to controls during both the starter and finisher phases. There was no statistically significant increase in feed intake across all the treatment groups compared to the control group. It was statistically significant that the FCR went up in the treatments that included YPP compared to the control group in treatment T3.

Nabizadeh [11] found that supplementing broiler chickens with 1% inulin as a prebiotic increased total BW and BWG however had no impact on Feed Intake (FI). However, Kareem et al.,reported that using a combination of inulin and postbiotics as a dietary supplement resulted in enhanced growth performance and feed effectiveness in broiler chickens. At the same time, the study also declared that using postbiotic had no substantial impact on the final body weight in comparison with control [12].

Effect of different additives on The Percentage of Relative Carcass Cuts

Table 2 shows the percentage of relative carcass cuts of broiler chickens fed probiotics. Birds fed T6 had significantly higher ($P< 0.05$) carcass weight (CW) and neck and back in comparison with the positive control. Birds in T3 group had significantly ($P<0.05$) higher breast compared to birds in the negative group. In addition, Birds in T2 and T6 group had significantly higher ($P< 0.05$) thighs with drumstick compared to birds in the Positive and negative group controls. The study found significant increase in live body weight in T3 and T6 compared to the group of control.

Agustono et al. [13] found, when using probiotics instead of antibiotics, that significantly increased breast weight, heart and kidney in laying hen males.

Effect of different additives on the percentage of edible parts

As shown in Table 3, probiotic supplementation in T3 among the treatments that added YPP significantly Proventriculus compared to controls during both the starter and finisher phases. Birds in T5 group had significantly higher (P< 0.05) liver % compared to birds in the positive group control. There was no statistically significant increase in Heart, Gizzard and Abdomen Fat in any of the treatment groups compared to the group of control.

The inclusion of probiotics in the diet had an impact on the yield of broiler chicken carcasses, specifically in terms of carcass weight. Rocha *et al.* [16] found that the use of probiotics in broiler feed increased breast weight. Qasim and Zeyad confirm that the use of probiotics in broiler diets results in increased carcass rates [17]. In addition, Humam *et al.* [18] pointed out that the use of probiotics and postbiotics as feed additives resulted in considerably higher carcass weights.

Effect of Probiotics on Cooking loss and Tenderness.

Humam *et al.* [18] the impact of various feed additives on cooking loss, drip loss and tenderness of major muscles in broiler chickens is shown in Table 4. Birds in T5 group had significantly lower (P< 0.05) drip loss % compared to birds in the negative group. The cooking loss of treated was significantly lower in T4. Moreover, there was no significant difference (P< 0.05) between negative and positive controls for cooking loss. Shear force of Pectoralis major muscle in broiler chickens was significantly greater (P< 0.05) in the T5 group compared with the control group that was negative.

Feeding probiotics minimized the cooking loss in chicken meat. This result agrees with findings of Kareem *et al*. [19], who reported that postbiotic and inulin as a (prebiotic) additive groups indicated that dietary treatments did not affect cooking loss in breast meat. Furthermore, Ali [20] reported that chickens were given probiotics saw reduced cooking losses in comparison to the control group. However, Khalafalla *et al*. [21], found that probiotics and prebiotics had no effect on the cooking loss of broiler breast meat. Additionally, the birds that were fed B. subtilis showed increased softness. In addition, Zhou [22] stated that the addition of probiotics, specifically B. coagulants ZJU0616, to the baseline feed showed beneficial effects on the sheer force of chicken meat. General organoleptic evaluations for appearance, texture, moistness, and overall acceptability were greater in probiotics (Lactobacillus) compared to a regular base diet [23].

Effect of Probiotic on pH and color.

The results of color values (b* L* a*) and pH of the meat samples of broiler chickens fed various additives are displayed in Table 5. The value of pH after 25 minutes of slaughter was lower significantly in the meat samples of chickens fed Positive control over all treatment groups. The pH in T5 (Basal diet + MiaClost 100 g / ton) significantly (P<0.05) higher when compared with all the treatment groups. In addition, no significant variation (P> 0.05) was found in (L*) lightness among all the treatment groups. The a* value significantly (P<0.05) higher in the T6 and b* value significantly (P<0.05) higher in the Positive control when compared with all the treatment groups.

Kareem *et al.* [19], found that all postbiotic and inulin additions showed a substantial drop in pH value after 25 minutes of slaughter compared to the control groups. In addition, Maiorano *et al*. [24], also found similar results. Factors such as age, sex, strain, food, intramuscular fat, processing, and pH have the potential to modify the color of chicken meat [25]. Although there is no difference between groups, however L* readings below 55 indicate perfectly normal breast meat [26]. More importantly, the L* value observed in this investigation was within the range considered to be healthy (46 < L* ≤ 53). Our study's findings contrast the findings of Zhao *et al*. [27], who observed significant impacts of probiotics and prebiotic treatment strategies on the redness (a∗) of fillets and significant effects of probiotics and prebiotic administration methods on fillet's redness (a∗). There was no significant difference in redness (a∗) in this study between all treatments.

Effect of different additives (YPP and MiaClost) on histomorphology.

Table 7 shows the height of villus and depth of crypt in birds fed YPP and MiaClost at 35 days old. Birds in T6 had higher villi and greater crypt depth compared to the negative and positive control groups. T1 birds had the highest V/C ratio, significantly higher than T3, T5, and negative control groups.

The findings of this research agree with Kareem *et al*. [12], who unveiled those birds fed with postbiotic and inulin supplementation augmented significantly increased height of villus in the jejunum than the negative control in broiler chickens. Conversely, crypt depth in the jejunum did not vary noticeably (p > 0.05) across treatments. While in this study the drypt depth in probiotic treatment groups differed significantly than positive and negative groups. Furthermore, this result partly agrees with Kridtayopas *et al.* [28], who stated that symbiotic supplements had the greatest villi height [28]. Overall, the depth of crypt in the intestine was not impacted much by the treatments. Changes in villi length and crypt depth have been linked to decreased food absorption, decreased gastrointestinal (GI) enzyme output, and slower development in broilers [29]. However, Sohail *et al.* [30], found that articulated that probiotic did not affect stress-induced damage in the intestinal morphology of 42-day-old layer.

Effect of different additives (YPP and MiaClost) on fecal LAB and ENT of gut

Table 7 shows the results of digesta LAB and ENT of gut of birds fed various treatment groups at two stages (35 days). The data obtained showed that the population of LAB significantly (P< 0.05) increased in T2 compared to the positive control groups, T1, T3, T4, T5, and T6 except negative group control. The ENT was the lowest in T1 compared to the positive control groups.

The result of this study agrees with Hardy [31], who reported that gut defense function might be improved by probiotic Lactobacillus species by competitive exclusion of intestinal pathogens or through activation and augmentation of local cell-mediated immunity against specific enteric pathogens. Probiotic Lactobacillus strain feeding has been shown to significantly increase the variety of lactobacilli in the ileum of broilers, as corroborated by the research conducted by Nakphaichit [32]. Kareem *et al*. [12], in a study revealed that birds fed different treatment groups had significantly lower feces LAB, ENT, and pH compared to the negative and positive controls.

Effect of different additives (YPP and MiaClost) on Immunity

Table 8 presents the effect of immunity and immunoglobin concentrations (IgM) in blood serum of birds that were given various groups of treatments at two stages, including the starting- phase and the finishing-phase. The data obtained showed that the IGM significantly (P< 0.05) increased in T2 and T3 compared to the positive control groups in poultry fed YPP from 18 to 35 days of age. However, on the other hand, The T6 groups had significantly higher Bursa of Fabricius weight (P< 0.05) compared to the positive control Groups. In addition, no significant variation (P< 0.05) was found in Spleen among all treatments.

Conclusion

The study found that probiotic supplementation significantly enhances broiler growth, carcass weight, and histomorphology parameters in broilers, improving body weight, feed conversion ratio, and breast weight. however, in a Comparison between groups given probiotics at different stages, the best groups were given full probiotics for two stages (35 days). Overall, there is no significant difference between yoghurt powder and MiaClost, so we recommend using yoghurt powder, which is both natural and cheaper. Poultry farmers can benefit from yoghurt powder supplements, but they must process, and package them into a unique commercial product for sufficient supply to chicken farms.

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Declaration of Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical of approval

Not applicable.

TABLE 1. Impact of Different Additives (YPP and MiaClost) on Broiler Performance.

Treatment Groups[A]	Initial Body Weight (gm)	LBW 35 (gm)	Total WG 35 (gm)	Feed Intake 35(gm)	Total FCR (g:g)
Negative control	38	2162.67[d]	2124.67[d]	3237	1.506[a]
Positive control	38.66	2193[d]	2154[d]	3176.33	1.484[ab]
T1	39	2273.33[bcd]	2234.67[bcd]	3226	1.435[abc]
T2	38.33	2375[abc]	2337[abc]	3308.67	1.441[abc]
T3	38.66	2441.67[ab]	2.403[ab]	3232.33	1.379[c]
T4	38.66	2261.67[dc]	2223.33[cd]	3318.67	1.499[a]
T5	38	2435[ab]	2398[ab]	3316.67	1.407[bc]
T6	38	2510[a]	2472[a]	3329	1.397[c]
SEM[B]	0.0002	0.03	0.03	0.02	0.01

[a, b, c, d] Mean values within the same row were significantly different (P≤0.01). [B]SEM: Means of the standard Error

TABLE 2. Impact of Different Additives5 (YPP and MiaClost) on the Percentage of Relative Carcass Cut (gm)/%.

Treatment Groups^{A}	Live body weight (gm)	Carcass Weight (gm)	Back and Neck (g)	Wings (g)	Thighs and Drumstick (g)	Breast (g)
Negative control	2260^{cd}	1593.33^{bc}	177.67^{b}	165	645^{bc}	585^{b}
Positive control	2205^{d}	1581.67^{c}	175^{b}	183.33	641.67^{bc}	605^{ab}
T1	2273.3^{bcd}	1656.67^{bc}	191.67^{ab}	143.33	650^{bc}	591.67^{b}
T2	2375^{ab}	1726.67^{abc}	201.67^{ab}	171.67	718.33^{a}	631.67^{ab}
T3	2441.7^{a}	1750^{abc}	205^{ab}	156.67	658.33^{bc}	675^{a}
T4	2261.7^{cd}	1584.33^{bc}	181.67^{b}	161.67	623.33^{c}	595^{b}
T5	2435^{a}	1755^{ab}	210^{ab}	155	676.67^{ab}	655^{ab}
T6	2327^{bc}	1828.33^{a}	223.33^{a}	170	710^{a}	665^{ab}
SEM^{B}	16.69	23.70	4.83	4.84	10.93	9.94

$^{a, b, c, d}$ Mean values within the same row were significantly different (P≤0.01). ^{B}SEM: Means of the standard Error

TABLE 3. Impact of Different Additives (YPP and MiaClost) on Percentage of Edible Parts

Treatment Groups^{A}	Heart (gm)	Liver (gm)	Gizzard (gm)	Abdomen Fat (gm)	Proventriculus (gm)
Negative control	10.27	55.99^{abc}	37.56	18.617	9.59^{abc}
Positive control	10	51.30^{c}	36.42	20.133	8.49^{bc}
T1	10.32	59.23^{a}	34.96	16.863	7.97^{c}
T2	9.996	53.20^{bc}	40.44	25.06	10.51^{a}
T3	11.58	57.24^{ab}	39.43	22.97	11.07^{a}
T4	10.44	54.61^{abc}	34.81	20.18	7.90^{c}
T5	11.55	59.59^{a}	37.57	25.03	9.82^{ab}
T6	11.23	58.47^{a}	37	21.53	10.24^{ab}
SEM^{B}	0.234	1.109	0.892	0.977	0.287

$^{a, b, c}$ Mean values within the same row were significantly different (P≤0.01). ^{B}SEM: Means of the standard Error

TABLE 4. Impact of Different Additives (YPP and MiaClost) on drip loss, cooking loss and tenderness.

Treatment Groups^{A}	Drip loss	Cooking loss	Tenderness
Negative control	6.433^{a}	19.066^{ab}	336.167^{a}
Positive control	5.500^{ab}	19.502^{ab}	334.667^{ab}
T1	4.400^{bcd}	18.985^{ab}	333.500^{abc}
T2	4.833^{abc}	19.122^{ab}	332.167^{abc}
T3	5.033^{abc}	18.988^{ab}	334.500^{ab}
T4	5.333^{abc}	16.116^{b}	328.000^{bc}
T5	2.973^{d}	22.027^{a}	327.000^{c}
T6	3.567^{dc}	22.545^{a}	333.667^{abc}
SEM^{B}	0.39	0.59	0.91

$^{a, b, c}$ Mean values within the same row were significantly different (P≤0.01). ^{B}SEM: Means of the standard Error

TABLE 5. Effect of different additives (YPP and MiaClost) on pH & Color

Treatment Groups ^{A}	pH	L	a	b
Negative control	6^{c}	50.753	8.270^{b}	9.253^{abc}
Positive control	5.97^{c}	49.943	11.357^{ab}	11.340^{a}
T1	6.26^{ab}	51.240	8.720^{ab}	9.423^{abc}
T2	6.153^{b}	51.853	9.680^{ab}	8.060^{c}
T3	6.196^{ab}	51.450	8.457^{ab}	9.317^{abc}
T4	6.26^{ab}	48.640	9.497^{ab}	10.627^{ab}
T5	6.27^{a}	53.350	9.780^{ab}	9.980^{abc}
T6	6.246^{ab}	50.307	12.597^{a}	8.667^{bc}
SEM^{B}	0.02	0.57	0.47	0.29

$^{a, b, c}$ Mean values within the same row were significantly different (P≤0.01). ^{B}SEM: Means of the standard Error

TABLE 6. Impact of Different Additives (YPP and MiaClost) on Histomorphology (µm/ratio)

Treatment Groups [A]	Villi height (µm)	Crypt depth	V/C
Negative control	786[d]	84[d]	9.36[c]
Positive control	875[c]	89[c]	9.83[ab]
T1	929[b]	91[b]	10.21[a]
T2	943[b]	95[b]	9.93 [ab]
T3	993[ab]	102[ab]	9.74[ab]
T4	988[b]	102[ab]	9.69[b]
T5	1005[ab]	106[ab]	9.48[b]
T6	1146[a]	112[a]	10.43[b]
SEM[B]	43.8	11.9	0.52

[a, b, c, d] Mean values within the same row were significantly different (P≤0.01).

[B]SEM: Means of the standard Error

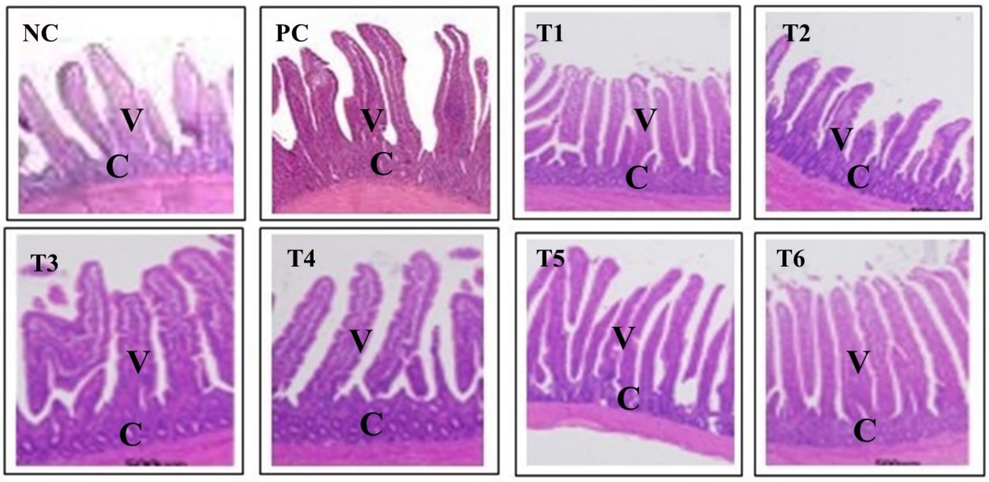

Fig. 1 The impact of adding YPP and MiaClost in diets of broiler Histomorphology of jejunum organ at age 35 days. NC: Negative control, PC: positive control, V: villi Hight, C: Crypt depth.

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تأثير مكملات البروبيوتيك التجارية والمحلية على الأداء وجودة اللحم والتشريح النسيجي في دجاج التسمين

نضال مصطفى وإسماعيل علي سرمامي

قسم الثروة الحيوانية - كلية علوم الهندسة الزراعية - جامعة صلاح الدين – أربيل – العراق.

الخلاصة

هدفت هذه الدراسة تأثير تكملة علف الدجاج اللاحم بالبروبيوتيك التقليدي YPP (إنتاج مسحوق الزبادي) والبروبيوتيك التجاري (MiaClost) على أداء الجسم والحالة المناعية. حبث تم تقسيم 480 فرخ فروج نوع Ross-308 بعمر يوم واحد إلى ثماني معاملات، كل معاملة تكونت من ثلاث مكررات تحتوي على 20 طائر وزعت عشوائياً .تكونت المجموعات التجريبية من مجموعة مراقبة سلبية تتلقى فقط النظام الغذائي الأساسي (B.D)، ومجموعة مراقبة إيجابية (حصلت على نظام غذائي أساسي مع 0.05% أوكسي تتراسيكلين)، وكانت المعاملات على النحو التالي مكملة لنظام BD: T1 100 غم/طن من YPP خلال المرحلة 1 (1-18). T2 100 غم/طن من YPP خلال المرحلة 2 (19-35). T3 100 غم/طن من YPP من عمر يوم واحد إلى 35. T4 100 غم/طن من MiaClost خلال المرحلة 1 (1-18). T5 100 غم/طن من MiaClost خلال المرحلة الثانية (19-35)،T6 100غم/طن مياكلوست من 1- 35 يوم.

اظهرت النتائج ارتفاع معنوي في متوسط وزن الجسم، وزن الجسم، وزن الذبيحة، الرقبة والظهر وارتفاع الزغابات مقابل T6 ومتوسط FCR، مقارنة مع T3 من عمر يوم واحد إلى 35 كان أعلى معنويا (P <0.05) بالنسبة لدجاج التسمين في المعاملات الأخرى وفي T5 كان وزن الكبد أكبر بكثير من جميع المعاملات الأخرى في المرحلة النهائية، ولكن لم يكن هناك تأثير كبير على وزن الجسم الحي، كفاءة التحويل الغذائي ، TFI، القلب، القانصة، دهن البطن، الأجنحة والفخذ. تشير نتائج الدراسة الحالية إلى أن إعطاء البروبيوتيك لدجاج التسمين يؤدي إلى تحسين أداء النمو ووزن الذبيحة وارتفاع الزغب.

الكلمات المفتاحية: الأداء، بروبايتك، الأجزاء الصالحة للأكل، التشريح النسيجي، IGM ، فروج لحم.