Impact of Adding Chitosan and Probiotic to Broiler Dietary on Productive Performance

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Abstract: This study was conducted at animal production farms at Kosar Agricultural Research Company in Arbil from July 20, 2022, to August 24, 2022 (35 days). This study aims to examine the impact of adding chitosan and probiotics to the diets of broilers on their productive performance. A total of 144 unsexed broiler chicks from Ross 308 were used in this study. The chicks were of average weight (43 g) at one-day old. These chicks were divided into six treatments with three replicates (8 per treatment). The first treatment was without any addition (control treatment); the second treatment was adding 1 g/kg of probiotic; the third treatment was adding 0.5 g/kg of chitosan; the fourth treatment was adding 1 g/kg of chitosan; the fifth treatment was adding 0.5 g/kg of chitosan plus 1 g/kg of probiotic; and the sixth treatment was adding 1 g/kg of chitosan plus 1 g/kg of probiotic. The foundation of this study was that there was a significantly increasing ($P< 0.05$) in the live body weight for T5, and a significantly increasing ($P< 0.05$) in the average of weight gain for T1. The average feed consumption for T2 and T3 improved significantly ($P< 0.05$), and the average FCR for T2 and T3 improved significantly ($P< 0.05$). According to the findings of this study, adding chitosan and probiotics to the diets of broilers improved their productivity.
Keywords: chitosan, probiotic, broiler, productive performance

1. Introduction

Poultry products are one of the most important protein sources because they are easily digestible, high in essential nutrients, and high in minerals [1]. In comparison to other animal products, poultry has been raised on a large commercial scale, and meat production is higher [2]. This interesting aspect of poultry farming coincides with the use of multiple feed additives in order to increase production, stimulate growth, and protect against infection with microorganisms and bacteria [3]. Chitosan, for example, is a non-food additive in poultry diets that is not harmful to animal or human health; it is a multi-unit form of glucosamine; and it makes up the majority of the external skeleton of marine organisms like shrimp and crabs [4,5]. Chitosan positively affects broilers' productivity performance, and it acts as an antibacterial and antifungal agent, improves the health of the small intestine, and improves digestion and absorption [5, 6]. Probiotics are the other and most popular food additive alternative to antibiotics [7, 8]. Probiotics are microorganisms; they must be one of the types of intestinal bacteria found in the intestines of poultry [8]. Probiotics provide nutrients, aid in digestion, and constrain harmful bacteria [9]. Some reports showed that many benefits could be gained by adding chitosan and probiotics to the diets of broilers. [10] The addition of chitosan to the diet of broilers resulted in an increase in FCR. In another study, Ayman et al. [11] found that adding chitosan to the diets of broilers showed a significantly (P 0.05) higher rate of live body weight and weight gain. In

addition, Hussien and Selim [12] indicated that the addition of probiotics positively affected the growth performance of broilers.

2 .Materials and Methods

2.1. Chicks and diet

144 Ross 308 unsexed broiler chicks Kosar hatcheries provided an average weight of 43 grams at one day of age. The chicks were randomly assigned to six treatment groups in three replicates (8 per group). The first treatment included no additives (control treatment), the second included 1 g/kg of probiotic, the third included 0.5 g/kg of chitosan, the fourth included 1 g/kg of chitosan, the fifth included 0.5 g/kg of chitosan plus 1 g/kg of probiotic, and the sixth included 1 g/kg of chitosan plus 1 g/kg of probiotic. Chicks were raised in individual wire cages for 35 days on a floor that was covered with sawdust 3–5 cm thick. The fodder (in the form of powder) was provided to the chicks, and feed and water were provided for ad libitum consumption.2-2 Performance: Live body weight (g) = The total weight of birds (in the replicate) at the end of the week / the bird's number (in the replicate) at the end of the week. Average body weight (g) = Average of body weight at the end of the week-an average of body weight at the beginning of the week The feed consumption (g) = The amount of consumed feed at the end of the week / The amount of consumed feed at the beginning of the week Feed conversion ratio = The amount of consumed feed at period / The total weight of the birds at the same period Mortality percentage = The number of dead birds/ The number of birds at the end of the week. These performances were calculated according to the method of [13].

All procedures involving animal care and management were in accordance with and approved by the Committee of Scientific Research Ethics at the University of Anbar, Ramadi, Iraq.

Table 1. Diets used in the experiment and the calculated chemical composition (kg).

Components Finisher	Starter diet (1-11 day)	Growth diet (12-21 day)	diet (22-42 day)
Wheat	377.25	327.25	588.85
Bran	100	100	100
Soya bean meal	320	272	165
Yellow Maize	150	200	100
Vegetarian Oil	10	16	10
Premix	10	8	-
Methionine	1.3	0.25	1
Lysine	1	1.2	2
Choline	1	1	0.5
Threonine	0.5	1.2	0.8
Enzyme	-	0.5	0.5
Anti-coccidiosis	1	0.5	0.25
Toxbond fort	-	1	1
Genex	-	-	0.5
Limestone	18.25	17	-
Calcium	8	-	-
Salt	1.6	-	-
Between finisher	-	-	7
Crude protein	22%	21%	20%
M.E.	3000kcal/kg	3100 kcal/kg	3175Kcal/kg
Energy : protein	1:15000	1:14761	1: 15875

3. Results and Discussion

3.1. Live body weight

We note frome table (2) that there are no significant differences between the treatments of second and fourth week in the average of live body weight. However, we notice significant differences ($P< 0.05$)

in the first week between T1 and T2 only, without significant differences with the rest of treatments. In the third week we notice that the treatment T2 was significantly differences (P< 0.05) superior with T1 and
T6. In the fifth week we notice that the treatment T5 significantly differences (P< 0.05) superior with T1, T4 and T6. This study agrees with [4].

3.2. Weight gain

We note from table (3) that there are no significant differences between the treatments of second and fourth week in the rate of weight gain. However, we notice significant differences (P< 0.05) in the first week between treatment T1 and T2 only, without significant differences with the rest of treatments. In the third week we notice that the treatment T2 was significantly differences (P< 0.05) superior to treatment T6 only. However, we notice that the treatment T5 significant differences (P< 0.05) superior to all teratments in the fifth week. Recording the total weight gain (1–35) days we notice that T4 significant differences (P< 0.05) superior to T1 and T6, without differences with other treatments, this study agrees with [11].

3.3. Feed consumption

There were no significant differences (P< 0.05) among treatments during the first week. However, at the second week, the T2 significantly outperformed the T3, but there was no difference between the other treatments. In addition, by the third week, there were significant differences (P< 0.05) between T2 and T3 over T1. There were no significant differences (P< 0.05) among the different treatments during the fourth and fifth weeks. During the cumulative periods (1-35) days, there was a significant superiority (P< 0.05) for T2 and T3 over T4. This result agrees with [14].

3.4. Feed conversion ratio

The addition of Chitosan and probiotics to broiler diets resulted in a significant improvement in FCR (g feed/g weight gain); there was no significant improvement during the first, second, or fourth weeks, but there was a significant improvement (P< 0.05) during the third week for T3 over T1, T5 and T6. During the fifth week, there was a significant improvement (P< 0.05) in the FCR for T4 over all treatments. According to the total FCR (1–35 days), there was significantly more improvement (P< 0.05) for T4 over all of the treatments. This result agrees with [10].

3.5. Mortality percentages

There was no mortality during the experience. The improvement that appeared in the productive performance of broilers in this study in the treatments that contain the probiotic and the treatments that contain chitosan with or without the probiotic may be due to the significant effect on increasing the utilization of nitrogen and amino acids in the feed [4]. In addition, chitosan affects the nature of the intestinal flora, as it reduces harmful microorganisms and increases beneficial ones [10]. This improvement leads to a rise in villi and, thus, an increase in the efficiency of the absorption of important nutrients. In addition, chitosan increases the viscosity of the nutrients present in the gastrointestinal tract, which works to delay the passage of nutrients from the gastrointestinal tract, allows for increased absorption of nutrients, and thus works on improving productive qualities and performance. [15, 16]. In addition to this, the probiotic plays an effective role in achieving the balance of microorganisms in the intestinal tract and creating an acidic environment that inhibits harmful microorganisms through the production of volatile fatty acids. In addition, the probiotic activates beneficial bacteria and thus elongates the villi of the intestine, which leads to the expansion of the circle of digestion and absorption, and this is reflected positively in the average body weight as well as weight gain. [17, 10]. According to mortality, no dead birds were recorded during the experiment, and this may be due to the immune-enhancing substance, as it stimulates the immune reaction by binding

to a special receptor on the membrane of phagocytes or lymphocytes, and it may have an effect on IgS immunoglobulins that work to protect the body against diseased organisms, and this works to stabilize the health status of birds [18].

Table 2. Effect of adding Chitosan and probiotic to the diet of broiler on average live body weight.

Treatments weeks	T1	T2	T3	T4	T5	T6
1st	4.40±263.3 b	1.66±274.16 a	2.20±265.83 ab	0.83±266.66 ab	3.60±270.83 ab	4.40±296.16 a
2nd	12.21±686. a	13.64±693.33 a	12.27±684.16 a	16.91±688.33 a	10.13±689.16 a	7.63±687.5 a
3rd	18.98±985. 41 c	30.04±1109.1 6 a	5.45±1066.66 ab	19.16±1078.3 3 ab	17.24±1053.7 5 ab	10.45±11.81 b.
4th	42.58±1698 a	30.62±1784.1 a	28.03±1759.1 a	28.12±1771.2 a	39.90±1784.3 a	22.40±1710 a
5th	37.52±2112 c	59.91±2322.5 ab	51.28±2266.6 abc	37.20±2245.8 bc	63.25±2417.0 a	28.91±2238.3 bc

Different letters vertically indicate the existence of significantly differences between the average at the probability of (P< 0.05)

Table 3. Effect of adding Chitosan and probiotic to the diet of broiler on average body weight gain (g).

Treatments weeks	T1	T2	T3	T4	T5	T6
1st	0.40±220.33 b	1.66±231.16 a	2.20±222.83 ab	0.83±223.66 ab	3.63±327.83 ab	4.40±226.16 ab
2nd	9.04±418.75 a	12.01±419.1 a	11.66±418.33 a	16.09±421.66 a	12.44±418.33 a	4.40±418.33 a
3rd	29.45±403.33 ab	18.87±415.8 a	12.33±382.5 ab	3.81±390 ab	12.33±364.58 ab	4.33±357.5 b
4th	27.14±672.9a	29.82±675 a	22.68±692.5 a	25.12±692.91 a	53.06±694.58 a	11.45±665 a
5th	5.06±414.16 c	31.03±538.3 b	22.76±507.5 b	35.65±645.83 a	10.00±497.5 b	28.66±528.33 b
(1-35) d	18.20±2016. c	20.14±2279. ab	19.27±2223.6 ab	25.36±2374.08 a	19.34±2222.83 ab	16.20±2204.33 c

Different letters vertically indicate the existence of significantly differences between the average at the probability of (P< 0.05)

Table 4. Effect of adding Chitosan and probiotic to the diet of broiler on feed consumption rate (g).

Treatments weeks	T1	T2	T3	T4	T5	T6
1st	3.26±147.83 a	2.60±148.75 a	0.58±148.66 a	0.72±148.91 a	1.06±149.37 a	2.72±146.62 a
2nd	1.25±66.04 ab	2.42±369.91 a	8.29±335.58 b	12.63±343.1 ab	12.71±351.6 ab	10.00±350 ab
3rd	18.43±571.1 b	2.42±628.45 a	5.13±619.62 a	12.85±611.9 ab	12.77±605.4 ab	17.83±593.1 ab
4th	21.29±865.8 a	10.80±880.8 a	7.19±879.37 a	16.60±872.7 a	24.82±847.0 a	20.27±842.9 a
5th	11.34±1120 a	8.48±1138.9 a	5.97±1132.9 a	13.41±1130. a	8.96±1125.7 a	7.60±1112.5 a
(1-35) d	20.22±3070.	18.23±3166.	21.06±3116.	24.63±3107.	20.09±3079.	17.45±3045.

	ab	a	a	ab	ab	b

Different letters vertically indicate the existence of significantly differences between the average at the probability of (P< 0.05)

Table 5. Effect of adding Chitosan and probiotic to the diet of broiler on feed conversion ratio (g feed / g weight gain).

Treatments weeks	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
1st	0.02±0.67a	0.01±0.64a	0.005±0.66a	0.005±0.66a	0.005±0.65a	0.006±0.64a
2nd	0.02±0.86a	0.01±0.88a	0.003±0.8a	0.003±0.81a	0.006±0.84a	0.01±0.83a
3rd	0.04±1.62a	0.06±1.51ab	0.08±1.41	0.02±1.56a	0.02±1.65a	0.02±1.65a
4th	0.02±1.28a	0.04±1.3a	0.03±1.26	0.04±1.25	0.06±1.21	0.01±1.26
5th	0.05±2.23b	0.10±2.12b	0.08±2.26b	0.07±1.75c	0.04±2.69a	0.10±2.1b
(1-35) d	0.07±1.52a	0.04±1.38b	0.03±1.40b	0.03±1.30c	0.07±1.39b	0.07±1.38b

Different letters vertically indicate the existence of significantly differences between the average at the probability of (P< 0.05).

4. Conclusion

The addition of chitosan and probiotics to the diets of broilers caused a significantly (P< 0.05) favorable effect. This effect is demonstrated by increased productivity. In my opinion T4 achieved the best result.

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