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Effect of fermented soybean meal with probiotic and beta-glucan on some physiological and microbial traits of broiler chickens

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Abstract

The study aimed to investigate the effect of fermented soybean meal with probiotic and beta-glucan on some physiological and microbial traits of broiler chickens. The study was conducted from 12/2/2022 to 2/5/2022, at the animal field of the College of Agriculture, University of Basrah. This study included the manufacture of a device for fermenting soybean meal to raise its nutritional value by fermenting it, with probiotics or with beta-glucan. A total of 225 unsexed chicks, one day old, 40 gm broiler chickens Ross308 were used, they were prepared from one of the private hatcheries in Basra Governorate. The chicks were distributed randomly to five treatments, with three replicates (15 chicks per replicate), according to the Complete Random Design (CRD), the treatments were as follows; **T0:** Control treatment (basal diet), **T1:** added soybean meal with the addition of 0.5g/kg probiotics (without fermentation) to the basal diet. **T2:** added soybean meal with the addition of 0.5 g / kg+ 0.2% betaglucan (without fermentation) to the basal diet. **T3:** added fermented soybean meal with probiotic 0.5g/kg to the basal diet. **T4:** added fermented soybean meal 0.5g/kg+ 0.2% betaglucan to the basal diet. The results showed a significant increase in the percentage of total protein, albumin, globulin, and the number of lactobacillus bacteria, with a decrease in coliform bacteria of the fermented treatment and fortified with probiotic and beta-glucan compared to the control and non-fermented treatment.

Keywords: fermented soybean meal, probiotic, beta-glucan, physiological, microbial, broiler chickens.

I. INTRODUCTION

In the past few years poultry production and consumption of poultry meat has increased on a large scale worldwide, as the global production of meat developed during the years from 2008 to 2020 in the developed countries of the world, as the percentage of poultry meat production reached 36% and sheep

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meat 27.5%, while beef reached 18.8%, despite the increase in poultry meat production, demand is expected to continue to increase to meet consumer requirements, the challenge facing poultry scientists is to produce a sufficient amount of poultry meat in the most effective way to meet the increase in this demand (Al-Asadi *et al*., 2018; Castro *et al*., 2023).

Antibiotics were used in the feed in therapeutic doses in poultry production, to control pathogenic bacteria, improving growth performance and quality of meat products (Al-asadi *et al*., 2020; Arsène *et al*., 2022). Excessive use of antibiotics has led to the emergence of resistant bacteria and antibiotic residues in poultry meat products, which poses a serious threat to human health, led many countries to ban or legalize the use of antibiotics as growth promoters in poultry feed (Al-Hmedawy *et al*., 2019).

There was a global effort to identify and develop effective, economical and safe alternatives to poultry production, as well as probiotics and prebiotics and the synergistic effect between them, which is known as (synbiotics), and this works to inhibit the growth of pathogenic bacteria inside the animal's body and thus improves growth performance (Abd El-Hack *et al*., 2022).

The feeding efficiency and high performance of birds are among the main goals in poultry production, diet quality must be considered along with environmental conditions and bird health to achieve these goals, one of the main ingredients of poultry feed is corn and soybean meal (SBM), despite the careful search for alternative feeds, nutrition experts have not yet been able to find an alternative that can replace corn and soy, although wheat is included in prominent levels in some countries of the world, there has been significant progress in this field, soybean meal is still one of the main ingredients in poultry diets. (Soumeh *et al*., 2019).

Soybean (SBM) is the main protein source in poultry feed, it contains 40 to 48% protein and is rich in amino acids, such as lysine, tryptophan, threonine, isoleucine and valine. Soybeans contain several antinutrients such as protein antigen factor (ANFs), trypsin inhibitor, phytic acid, and oligosaccharides, it reduces the absorption and digestion of nutrients, it leads to a deterioration of growth performance in birds (Li *et al*., 2014).

There were several ways to treat this factor, including fermentation, which improves the digestion of nutrients and increases the rate of feed conversion in birds, it activates antigen proteins. Fermentation is an effective method for destroying ANFs and improving the nutritional quality of forage (Jazi *et al*., 2019).

Therefore, this study aimed to study the effect of fermented soybean meal treated with probiotic and beta-glucan on some physiological and microbial traits of broiler chickens.

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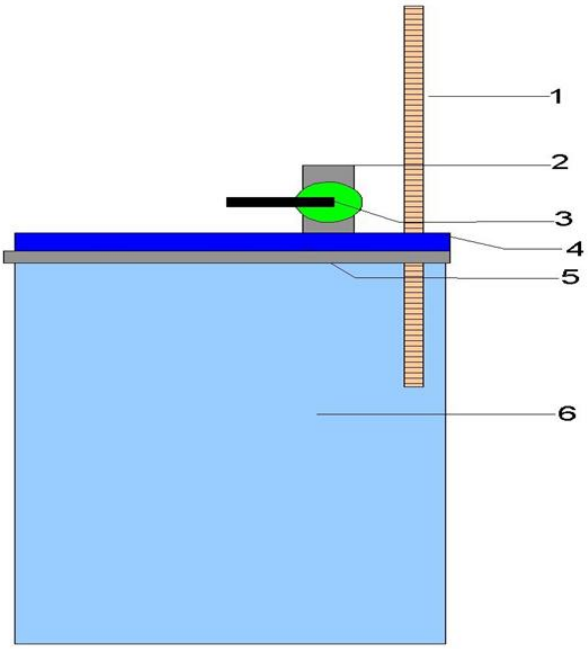
II. MATERIALS AND METHODS

Fermentation method

The probiotics was used in the form of a fine powder, contains 10^9 Bacillus coagulansDSM 32016, use of probiotic and prebiotic in the fermentation of soybean meal using a fermenter, where the device consists of a tank made of plastic with a capacity of 20 kg, a plastic cover that contains a valve that allows the exit of gases and does not allow them to enter, and the tank is closed with a sealing belt to seal it and prevent air from entering it, it also contains a thermometer to measure the temperature. Soybean meal was added with 0.5 g of probiotics, and in some treatments, in addition to probiotics, 0.2 g of glucan was added, fortified soybean meal is fermented by adding 0.5 ml of water per 1 kg of soy. The tank is locked with a locking belt tightly in order not to allow air to enter and to allow air to exit through the valve located at the top of the tank cover. The materials are stored inside the tank at a temperature of 37°C for a period of 72 hours, then they are taken out and dried for two days in a drying oven at a temperature of 50 °C in a fermentation apparatus (Figure 1). After that, the fermented fodder is mixed with the rest of the components of the diet mentioned in the diet schedule and is presented to the birds according to the treatments.



1. Thermometer. 2. Valve tube. 3. The valve. 4. The cover. 5. The locking belt. 6. The tank.

Figure (1) Fermentation device.

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Birds and diets used in the experiment:

This experiment was conducted in the animal field of the College of Agriculture, University of Basrah, from 28/4/2022 to 2/5/2022. A total of 225 unsexed chicks, one day old, broiler Ross-308 were used, it was prepared from one of the private hatcheries in Basra Governorate. The chicks were distributed randomly to five treatments, with three replicates for each treatment (15 chicks per replicate), according to the Complete Random Design (CRD). the treatments were as follows; **T0:** Control treatment (basal diet), **T1:** added soybean meal with the addition of 0.5g/kg probiotics (without fermentation) to the basal diet. **T2:** added soybean meal with the addition of 0.5 g / kg+ 0.2% betaglucan (without fermentation) to the basal diet. **T3:** added fermented soybean meal with probiotic 0.5g/kg to the basal diet. **T4:** added fermented soybean meal 0.5g/kg+ 0.2% betaglucan to the basal diet.

All administrative measures necessary for breeding have been taken to provide appropriate temperature and ventilation within ideal limits. Gas incubators and electric heaters were used to heat the hall during the experiment period, for the purpose of maintaining the temperature within the limits of 33-35 C at the first week of life, then the temperature was reduced by 2°C per week until it reached 23-25°C at the end of the experiment. The lighting was continuous for 24 hours. The tunnel ventilation system was adopted in the experiment by using exhaust fans at the end of the hall with window openings at the beginning of the hall. Cylindrical plastic feeders were used until the second week of age, with one feeder per cage, they were replaced by semi-automatic round trowels, continued until the end of the experimental period. Ground waterers measuring 5 liters were used from the first day of the experiment until its end. Feed and water were provided to the chicks ad libitum during the 35-day experimental period. Physiological characteristics were measured total protein, albumin and globin. Measuring the number of total bacteria, coliform bacteria, and lactobacilli directly after slaughtering.

III. RESULTS AND DISCUSSIONS

Table (1) shows the effect of fermented soybean meal fortified with probiotic and beta-glucan on total protein concentration on broiler blood traits, a significant differences between the treatments. T4 treatment showed significant (P≤0.05) superiority over the other treatments, were recorded 4.96 gm/dl compared to treatments T0, T1, T2 and T3, which recorded 3.31, 3.42, 3.65 and 4.43 gm/dl, respectively. T3 treatment also had a significant (P≤0.05) superiority compare to T0, T1 and T2.

There was a significant increase on the albumin ratio (P≤0.05) in T3 and T4 treatments, compared to the other treatments, as they were recorded 2.80 and 3.15 gm/dl, respectively, compared to T0, T1 and T2 treatments, which recorded 1.83, 1.89 and 2.13 gm/ dl, respectively.

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As for globulin, there were a significant increase (P≤0.05) in the T4 treatment (gm/ dl 1.81) compared to T0, T1 and T2 treatments, which recorded 1.48, 1.53 and 1.51 gm/ dl, respectively. There are no significant differences between T3 and T4 treatments.

Table (1) Effect of fermented soybean meal with probiotic and beta-glucan on the concentration of total protein, albumin and globulin in the blood of broiler chickens.

Parameters	Treatments					Sig.
	T0	T1	T2	T3	T4	
Total protein(g/dl)	٣.31±0.04c	3.42±0.08c	3.65±0.05c	4.43±0.33b	4.96±0.05a	0.05
Albumin(g/dl)	1.83±0.00b	1.89±0.00b	2.13±0.03b	2.80±0.26a	3.15±0.03a	0.05
Globulin(g/dl)	1.48±0.04b	1.53±0.08b	1.51±0.04b	1.63±0.09a	1.81±0.02a	0.05

Biochemical measurements in blood serum are considered important measurements, as a result of metabolic changes, which is a criterion and reflection of the health status of birds, elevation of total protein values in serum, it indicates that it results from a good metabolism of a large part of the protein in the organs of the body of birds (Viana *et al*., 2022).

The significant improvement in serum proteins increased total protein, albumin and globulin, belongs to lactic acid bacteria, which was a product of the fermentation process of soybean meal with probiotic and beta-glucan, where these bacteria increase the concentration of protein, by increasing the availability of nutrients, including proteins as well as increasing absorption, as well as an increase in the absorption of the amino acid lysine, which secrete some types of lactic acid bacteria, reflected in an increase in total protein in the serum, increases the concentrations of albumin and globulin, (Mukherjee *et al*., 2016).

The results obtained by Amer *et al.* (2022) did not agree with the results of the study, no significant differences were observed in the percentage of total protein, albumin, and globulin in serum when feeding broiler chickens on fodder fermented with probiotic and beta-glucan.

Figure (2) shows the effect of fermented soybean meal with probiotic and beta-glucan on the logarithmic numbers of total bacteria in the ilium fraction of broiler chickens, there were significant differences in the logarithmic numbers of some types of bacteria. T0 treatment was significantly superior (P<0.05) on the number of total bacteria compare to others, T1 and T2 treatments were significantly superior (P<0.05) compare to T3 and T4 treatments.

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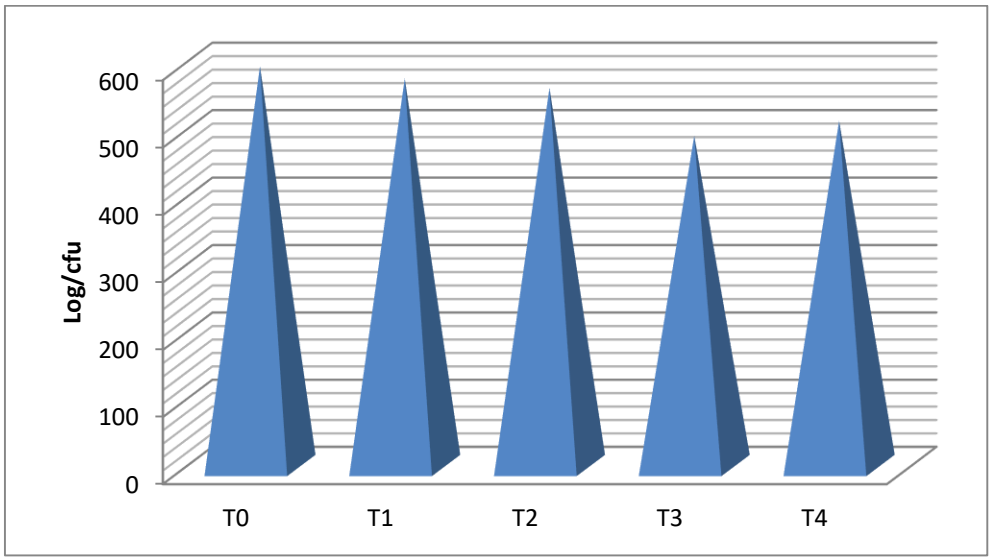

Figure (2) Effect of fermented soybean meal with probiotic and beta-glucan on the logarithmic numbers of total bacteria in the ilium fraction of broiler chickens.

Figure (3) shows a significant effect due to the effect of adding fermented soybean meal with the probiotic and beta-glucan on the logarithmic numbers of coliform bacteria (*E. coli*) in the ileum of broiler chickens, where T0 treatment (344.66 CFU) was significantly superior (P<0.05) compare with T1, T2, T3 and T4 treatments, where recorded 253.33, 221.66, 172.66 and 133.66 CFU, respectively. T1 and T2 treatments were significantly superior (P<0.05) to T3 and T4.

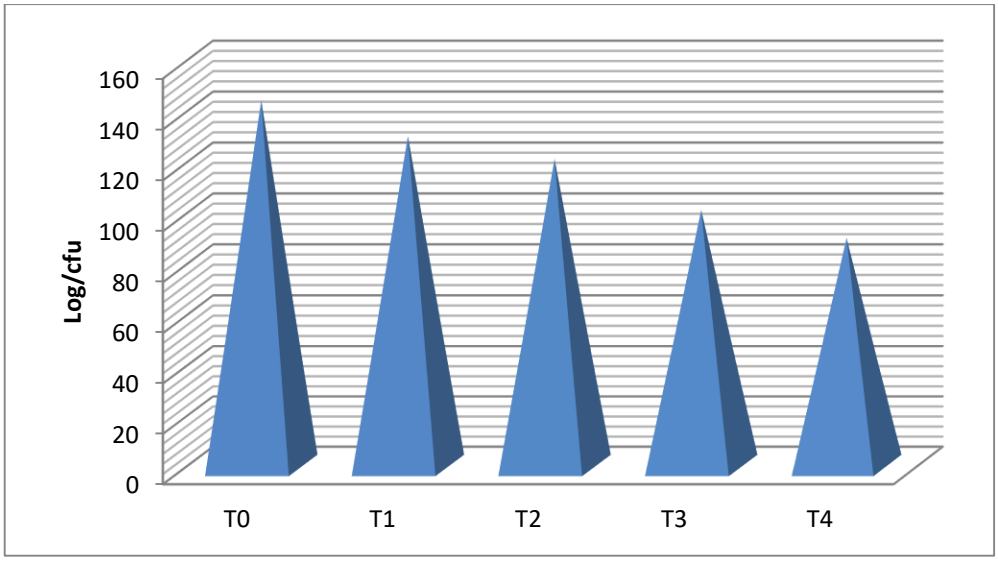

Figure (3) Effect of fermented soybean meal with probiotic and beta-glucan on the logarithmic numbers of *E. coli* in the ilium fraction of broiler chickens.

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Figure (4) shows a significant effect due to the effect of adding fermented soybean meal with the probiotic and beta-glucan on the logarithmic numbers of Lactobacilli, T4 was significantly superior (P<0.05) compare with others, T3 treatment was significantly superior (P<0.05) compare with T0, T1 and T2 treatments, T2 and T3 treatments were significantly superior (P<0.05) compare to T0 treatment.

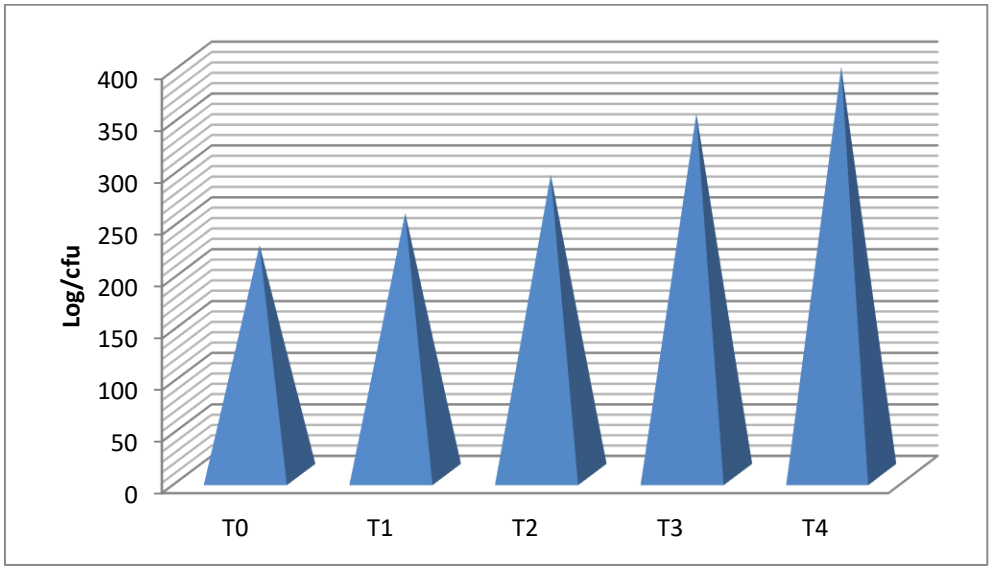

Figure (4) Effect of fermented soybean meal with probiotic and beta-glucan on the logarithmic numbers of *Lactobacilli* in the ilium fraction of broiler chickens.

Probiotics of all kinds have an essential role in promoting and supporting the microbial balance of the gut environment (Varela-Trinidad *et al*., 2022). Probiotics have a role in the competitive exclusion of harmful bacteria outside the body, by creating a living environment that is not suitable for the growth of harmful microorganisms, by reducing the pH to less than 6, in order for the medium to become acidic and unsuitable for the growth of pathological intestinal bacteria (Enterobacteriacase), including salmonella bacteria, or by closing the bacterial receptors on epithelial cells by probiotic bacteria and preventing the adhesion of pathological bacteria. Probiotic bacteria also stimulate the epithelial cells lining the intestines, mucin production on the myosin fiber network covering the intestinal villi, w Which is a nutritious environment for the types of beneficial bacteria and increase their numbers and dominance. The intake of broiler chickens of the probiotic with the feed leads to a significant increase in the numbers of Lactobacillus and Bifidobacreruim bacteria in the small intestine and caecum, while no significant differences were observed in the numbers of total aerobic bacteria and coliforms. The addition of commercial probiotic in broiler diets has a role in raising the number of Lactobacillus and Enterococcus bacteria in the intestine compared to the two treatments of adding organic acids and control (Changa *et al*., 2020).

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