Chelonian Conservation And Biology

Vol. 18 No. 2 (2023) | https://www.acgpublishing.com/ | ISSN - 1071-8443

DOI: doi.org/10.18011/2023.11(4).246.255

EFFECT OF FERMENTED SOYBEAN MEAL WITH PROBIOTIC AND BETA-GLUCAN ON SOME PRODUCTIVE AND CARCASS TRAITS OF BROILERS

Noora K. Al-Hmedawy and Majid H. Al-Asadi

College of Agriculture, University of Basrah, Iraq.

Abstract:

This study aimed the effect of fermented soybean meal with probiotic and beta-glucan on some productive and carcass traits of broiler, from 12/2/2022 to 2/5/2022, at the animal field, College of Agriculture, Basrah University. This study included two stages, the first stage was manufacturing a device for fermenting soybean meal with beta-glucans, to increase its nutritional value, by fermenting the feed with the probiotic on some interactions. The second experiment was the field experiment by rearing broiler chickens. A total of 225 unsexed, one day, broiler Ross 308 chicks were used, 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 Complete Randomized Design (CRD). The experimental treatments were: **T0:** (control) basal diet. **T1:** added soybean meal with 0.5 gm/ kg probiotics (without fermentation) to the basal diet. **T2:** added soybean meal with 0.5 gm/ kg probiotics + 0.2% beta glucan (without fermentation) to the basal diet. **T3:** added fermented soybean meal with 0.5 gm/ kg probiotics to the basal diet. **T4:** added fermented soybean meal with 0.5 gm/ kg probiotics + 0.2% beta glucan to the basal diet. The results of the experiment indicate that there was a significant increased ($P \leq 0.05$) for the treatments T3 and T4 on the average final body weight, in weight gain, with a significant decrease ($P \leq 0.05$) on the amount of feed intake in T1, T2 and T3 treatments compared with the control treatment (T0).

Keywords: Probiotic, fermentation, soybean meal. beta glucan.

Introduction

Poultry meat is a very popular foodcommodity around the world due to its lowcost of production, low fat content,highnutritional value, distinct flavor (Al-Hmedawy,.*etal2018)*The poultry industry is one of the fastest growing meat producing industries, despite the increase in poultry and meat production, demand is expected to continue to increase to meet the animal protein requirements of the population, increasingly, poultry production. The consumption of its meat has become widespread in the world, to meet the needs of the growing population and to secure a high level of food. The development of global meat production during

the years from 2008 to 2020 for the developed countries of the world was different, where the percentage of poultry meat production reached 36%, sheep meat 27.5%, and beef meat 18.8%. The contribution of poultry meat to the total meat consumption in the world amounted to 35%, despite the increase in poultry and meat production, however, it is expected that the demand will continue to increase to meet the ever-increasing requirements of animal protein for the consumer, the challenge for poultry scientists and industry to produce a sufficient amount of poultry meat in the most efficient way (Al-Mhsenawi *et al*., 2021; Grzinic *et al*., 2023).

The feeding efficiency and high performance of birds are among the main goals in poultry production, therefore, 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 yellow corn and soybeans (Goran Gržinić et al., 2022).

Despite the careful search for alternative feeds, the nutrition experts have not yet been able to find an alternative that can replace corn and soy, wheat was included in prominent levels in some countries of the world, there has been remarkable progress in this field (Soumeh *et al*., 2019).

Soybean (SBM) is the main protein source in poultry feed, it contains 40 to 50% protein and is rich in amino acids, such as lysine, tryptophan, threonine, isoleucine and valine. Soybeans contain several antinutrients, such as protein antigenic factor (ANFs), trypsin inhibitor, phytic acid and oligosaccharides, therefore, it reduces the absorption and digestion of nutrients, it leads to a deterioration of growth performance in birds (Irawan, *et al*., 2022).

Some of these ANFs lead to the elimination of trypsin inhibitors, there were several ways to treat these factors, including fermentation, which improves the digestion of nutrients and increases the rate of feed conversion in birds, it activates antigen proteins. Over the past few years fermentation has been considered an effective way to break down ANFs, improving the nutritional quality of forage (Zhang *et al*., 2021).

Studies have demonstrated that the biochemical results and changes in the metabolic activity of microorganisms during fermentation, it may lead to a decrease in ANFs and unwanted compounds, improved digestibility Fermentation can enhance the nutritional value of SBM, improving growth performance and increasing meat production improving its quality properties (Sun *et al*., 2022).

In view of the recent trends towards the use of probiotics in poultry feeding, therefore, the main objective of this study was the effect of fermented soybean meal with probiotic and beta-glucan on productive and carcass traits of broiler.

Materials and Methods

Fermentation method

Commercial probiotic and beta-glucan were used, probiotic was in the form of a fine powder containing 10^9 of Bacillus coagulans DSM 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 and a plastic cover, it contains a valve that allows the exit of gases that do not allow them to enter, the tank was closed with a locking belt to tighten it and prevent air from entering, it also contains a thermometer to measure the temperature, 20 kg of soybean meal is added with 0.5 g of probiotics, in some treatments, in addition to probiotics, 0.2 g of glucan was added, also, add 0.5 liters of water per 1 kg, and close the tank with the locking belt, tightly. In order not to allow air to enter and the air to exit through the valve at the top of the tank cover. The materials remain inside the tank at a temperature of 37°C for 72 hours, then they are taken out and dried for two days in a drying oven at a temperature of 50 °C in the fermentation apparatus (Figure 1). After that, the fermented feed is mixed with the remaining components of the diet mentioned in the diet schedule, it was given to the birds according to the transactions. The feed is fermented by the fermentation device manufactured in the microbiology laboratory, College of Agriculture, Basrah University. 20 kg of soy beans meal were placed with 0.5 g of probiotics, in some treatments, 0.2% of beta glucan was added and the materials were mixed well, then, water is added at a rate of 0.5 liters / kg of soybean meal, the device is closed with a tightly closed belt, and the material remains inside the tank for 72 hours at a temperature of 37 °C. The temperature is set by the thermometer in the device later, the material is taken out and dried in a drying oven at a temperature of 50 °C for two days, after that, it is mixed with the feed to be offered to the birds according to the ratio mentioned in the experimental treatments.

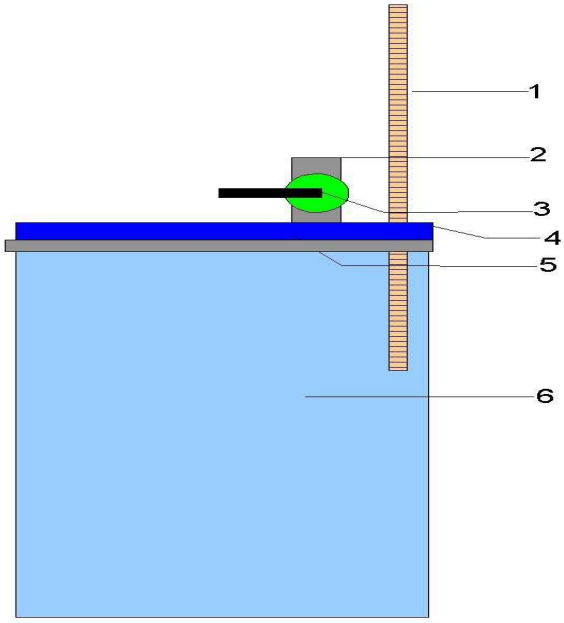

Figure (1) of the fermentation apparatus used in the study and consists of 1. Thermometer. 2. Valve tube. 3. Valve. 4. The cover. 5. Closure belt. 6. Tank.

Birds and diets used in the experiment:

This experiment was conducted in the animal field of the College of Agriculture, Basrah University, from 28/3/2022 to 2/5/2022. A total of 225 unsexed, one day, broiler Ross 308 chicks 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 (15 chicks per replicate), according to the Complete Random Design (CRD). All administrative measures necessary for rearing have been taken to provide appropriate heat and ventilation within the ideal limits. Gas incubators and electric heaters were used to heat the hall during the experiment period, for maintaining the temperature in the range of 33-35 °C in 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 is used in the experiment, 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 life, with one feeder per cage, after that, it was replaced with semi-automatic circular choppers, which continued until the end of the experiment 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 freely during the 35-day experimental period. Body weight, weight gain, amount of feed intake, and feed conversion factor were measured and recorded from the age of one day to 35 days., as indicated by Al-Fayyadh et al.(2011) and Al-Zubaidi (1986).

Statistical analysis:

A Completely Randomized Design (CRD) was used to study the effect of different treatments on the studied traits. Significant differences between the means were compared by Duncan (1955) multiple range test under a significance level of 0.05. The program SPSS (2018) was used in the statistical analysis.

Results and discussion

Table (1) shows that there are no significant differences in live body weight among all treatments from 1-14 days of chicks age, as for the significant differences from 21-28 days and 28-35 days of birds age, it was significantly superior ($P \leq 0.05$) in T3 and T4 compare with control treatment, while T2 was significantly superior ($P \leq 0.05$) compare with T1 treatment, T1 and T2 treatment outperformed to the control treatment. The reason for the improvement or increase in body weight or growth rate may be due to the probiotics, it promotes the health of the body, by enhancing the action of myosin secretion, increase the exclusion of pathogenic microbes. The probiotics also produce antimicrobial pathogens, like lactic acid and acetic acid, reduce the pH inside the bacterial cells (Al-Gharawi *et al*., 2012; Al-Ahmed and Al-Asadi, 2021). It was also discovered that the addition of the probiotic led to an improvement in the immune system and the growth performance of the birds, by effects on gut function, and resistance to enteric pathogens (Simon *et al*., 2021). Probiotics have a positive effect in improving digestion and absorption and increasing digestion (Wu *et al*., 2022). The reason for the improvement or increase in growth may be due to the probiotic that improves the digestibility and availability of many nutrients, such as fats,

carbohydrates, and some minerals and proteins (Dahiya *et al*., 2022). It may also be due to increased growth, the weight gain required the replacement of soybean meal in the feed provided with fermented soybean meal, due to the decrease of ANFs in the fermented meal, the improvement of gut morphology, and the increase of digestive enzyme (Yan *et al*., 2022). The reason may be due to the superiority of the fourth and fifth treatments due to the existing microorganisms used for fermenting soybean meal (Lo *et al*., 2023).

Table (1) Effect of fermented soybean meal with probiotic and beta-glucan on average live body weight of broiler.

Parameters	Treatments				
	T0	T1	T2	T3	T4
initial body weight (g)	40.00 ^{a} ±0.00	40.00^{a}±0.00	40.00^{a}±0.00	40.00^{a}±0.00	40.00^{a}±0.00
body weight (g)1-14 day	399.66^{a}±10.52	348.33 ^{a}±6.43	355.66^{a} ±5.17	352.33 ^{a}±7.31	385.66 ^{a}±1.85
body weight (g)21 -28 day	1096.66^{d} ±45.09	1163.33^{cd} ±15.27	1200.00±$^{a\,c}$ 50.00	1250.00^{ab}±50.00	1326.66 ^{a}±40.41
body weight (g)28 -35 day	1600.00^{d} ±50.00	1798.33^{b} ±27.53	1821.66 ^{b}±5.77	1861.66 ^{ab}±12.58	1900.00 ^{a}±50.55

Different letters in the same row mean there are significant different at $p \leq 0.05$.

Table (2) did not indicate that there were any significant differences in the amount of feed intake among all treatments in the period from 1-14 days and the period from 21-28 days. In the period from 28-35 days, significant differences ($P \leq 0.05$) in T1, T2 and T3, it was significantly superior ($P \leq 0.05$) to the control treatment. There were no differences among T1, T2, T3 and T4. The reason for the increase in feed intake was the addition of the probiotic and beta-glucan, led to an increase in the activity and stimulation of protease, lipase, and amylase enzymes (Rehman, *at el*., 2022). Amara and Shibl (2015) proved that consuming 5g of probiotics, significantly improves feeding efficiency related to maintaining normal intestinal bacteria, by metabolism, increasing the activity of digestive enzymes, improve the rate of digestion of nutrients and reduce pathogens, probiotics are considered a safe alternative to antibiotics in improving feed consumption.

Table (2) Effect of fermented soybean meal with probiotic and beta-glucan on the amount of feed intake of broiler chickens.

Parameters	Treatments				
	T0	T1	T2	T3	T4
feed intake (g/bird) 1-14 day	198.63 ±10.11[a]	200.66±6 .41[a]	200.16±5. 19[a]	199.00±6.8 0[a]	205.50±2.0 2[a]
feed intake (g/bird)21-28 day	800.00 ±28.8[a]	836.66±2 3.33[a]	372.66±11 .84[ab]	800.00±5.7 7[a]	850.00±28. 86[a]
feed intake (g/bird) 28-35 day	503.33 ±29.05[b]	635.00±2 4.66[a]	621.66±29 .05[a]	611.66±32. 44[a]	573.33±6.6 6[ab]

Different letters in the same row mean there are significant different at $p \leq 0.05$.

Table (3) shows that there were significant differences (P≤0.05) on the rate of weight gain in T1, T2 and T3 treatment, where T1, T2 and T3 treatment were significantly superior (P≤0.05) compare with the control treatment. As for the feed conversion efficiency, the results showed that T1 significantly improved (P≤0.05) compare with T2, T3 and T4 treatments, T1 significantly improved (P≤0.05) compare with T3 and T4 treatment. As for the production index, T4 significant outperformed (P≤0.05) compare with T0, T1, T2 and T3 treatments, T3 significant outperformed (P≤0.05) compare with T0, T1 and T2 treatments, T2 significant outperformed (P≤0.05) compare with T0 and T1, T1 outperformed on T0. The reason may be due to the improvement in the rate of weight gain, feed intake efficiency and production index. Probiotics The synergistic effect of probiotics and beta-glucans, leads to an increase in beneficial microorganisms that eliminate harmful microorganisms, improved forage utilization within the digestive tract (Markowiak and Slizewska, 2017). Probiotics also produce lactic and acetic acid, they act as antimicrobial substances as they reduce the pH inside bacterial cells (Plaza-Diaz *et al*., 2019), increase the length of the villi, it increases the digestion and absorption of nutrients and thus improves the above-mentioned qualities (Gurram *et al*., 2022).

Table (3) Effect of fermented soybean meal with probiotic and beta-glucan on weight gain rate, feed conversion efficiency, and live broiler production index.

Parameters	Treatments				
	T0	T1	T2	T3	T4
Body weight gain(g)	941.66 ±63.32[b]	1150.00± 52.04[a]	1108.33±4 6.39[a]	1033.33±44 .09[a]	930.00±15. 27[ab]
Feed efficiency (g/g)	1.87±0. 037[a]	1.80±0.0 17[ab]	1.77±0.02 3[b]	1.68±0.176[c]	1.61±0.008[c]
Production index	729.52 ±17.09[e]	821.56±8 .84[d]	868.78±13 .92[c]	931.40±7.6 9[b]	990.08±16. 816[a]

Different letters in the same row mean there are significant different at $p \leq 0.05$.

Table (4) shows that there was a significant superiority in the treatments treated with probiotic and beta-glucan, where T1, T2 and T3 treatments were significantly superior (P≤0.05) compare with control treatment. As for breast weight, T1, T2, T3 and T4 treatments were significantly superior (P≤0.05) compare with control treatment, the results showed that T3 and T4 treatments were significantly superior (P≤0.05) on T0 and T1 treatments, T2 was outperformed compare with control treatment. In breast weight, all the probiotic and beta-glucan treatments significantly superior (P≤0.05) compare with control treatment. As for the thigh weight, T3 and T4 treatments were significantly superior (P≤0.05) to T0 and T1 treatments. As for the dressing percentage, we do not notice any significant differences among treatments. There was a direct correlation with live body weight with carcass weight, we notice the increase in the weight of the carcass in the treatments treated with probiotics and probiotics, the reason is due to the increased feed consumption and the palatability of the probiotic-fermented feed, eliminate harmful microorganisms and increase the activity of digestive enzymes, in addition, the increase in the length of the villi, all together, leads to an increase in the weight of the carcass and the weight of the pieces (Sun *et al*., 2022).

Table (4) Effect of fermented soybean meal with probiotic and beta-glucan on carcass weight, breast weight, thigh weight and dressing percentage of broiler.

Parameters	Treatments				
	T0	T1	T2	T3	T4
Carcass weight (g)	354.945±354.02^{b}	1155.333±13.13^{a}	1204.000±21.70^{a}	1204.333±17.94^{a}	1229.333±2.90^{a}
Breast weight	318.333±11.66^{b}	398.333±14.51^{a}	412.666±25.78^{a}	456.000±23.86^{a}	454.666±20.82^{a}
Thigh weight	146.000±4.93^{c}	164.000±2.88^{bc}	171.333±3.17^{ab}	191.333±8.98^{a}	188.333±9.02^{a}
Dressing Percentage	167.100±13.38^{a}	155.700±2.02^{a}	151.433±2.97^{a}	154.666±2.80^{a}	154.566±2.71^{a}

Different letters in the same row mean there are significant different at $p \leq 0.05$.

References

Al-Ahmed, D.A. and M.H. Al-Asadi. 2021. Use of different transport methods of propionic acid treated broiler carcasses and it impact on some microbial properties. Plant Archives 21 (Supplement 1): 1882-1886.

Al-Fayyad, H.A., S.A. Naji and N.N. Abdel-Hago. 2011. Poultry Products Technology. Second Edition. Directorate of Higher Education Press, Baghdad - Iraq.

Al-Gharawi, J.K.M., A.H. Al-Helali and I.F. Al-Zamili. 2018. Effect of using different ways to provide the Iraqi probiotics on some productive traits of broiler. Plant Archives Vol. 18(1): 1102-1108.

Al-Hmedawy, N. K. ., Al-Asadi, M. H. ., & Al-Hilphy, A. R. . (2019). Destruction of bacteria using electric stimulation of old Duck and Chicken carcasses. *Basrah Journal of Agricultural Sciences*, *31*(2), 31–35. https://doi.org/10.37077/25200860.2018.97

Al-Mhsenawi, Z.K., M.H. Alasadi and Q.J. Al khfaji. 2021. Effect of Different Levels of Local Concentrated Protein Manufactured from Slaughterhouse Wastes on some Carcasses Traits of Broiler. Basrah Journal of Agricultural Sciences, 34(1): 60-66.

Al-Zubaidi, S.S.A. 1986. Poultry management, 1st edition, Basra University Press.

Amara, A.A. and A. Shibl. 2015. Role of Probiotics in health improvement, infection control and disease treatment and management. Saudi pharmaceutical journal : SPJ : the official publication of the Saudi Pharmaceutical Society, 23(2): 107-114.

Castro, F.L.S., L. Chai, J. Arango, C.M. Owens, P.A. Smith, S. Reichelt C. DuBois, and A. Menconi. 2023. Poultry industry paradigms: connecting the dots,Journal of Applied Poultry Research, 32(1): 262-271.

Dahiya, D. and P.S. Nigam. 2022. Probiotics, Prebiotics, Synbiotics, and Fermented Foods as Potential Biotics in Nutrition Improving Health via Microbiome-Gut-Brain Axis. Fermentation., 8(7): 303.

Duncan, D.B. 1955 . Multiple ranges test and Multiple F-test . Biometrics . 11: 1-42.

Grzinic, G., A. Piotrowicz-Cieslak, A. Klimkowicz-Pawlas, R.L. Górny, A. Ławniczek-Wałczyk, L. Piechowicz, E. Olkowska, M. Potrykus, M. Tankiewicz, M. Krupka, G. Siebielec and L. Wolska. 2023. Intensive poultry farming: A review of the impact on the environment and human health, Science of The Tota Environment, 858(3): 844-853.

Gurram, S., V.C. Preetam, K.V. Lakshmi, M.V. Raju, M.L.N. Venkateswarlu and S. Bora. 2022. Synergistic effect of probiotic, chicory root powder and coriander seed powder on growth

performance, antioxidant activity and gut health of broiler chickens. PloS one, 17(6), e0270231.

Irawan, A., A. Ratriyanto, A.N. Respati, N. Ningsih, R. Fitriastuti, W.P.S. Suprayogi, R.F. Hadi, W. Setyono, N. Akhirini and A. Jayanegara. 2022. Effect of feeding fermented soybean meal on broiler chickens' performance: a meta-analysis. Animal bioscience, 35(12), 1881–1891.

Lo, W., P. Ong, Y. Lee, Y. Hsu and K. Chen. 2023. "Effect of Fermented Meat and Bone Meal–Soybean Meal Product on Growth Performance in Broilers" Fermentation 9(1): 24.

Markowiak, P. and K. Slizewska. 2017. Effects of Probiotics, Prebiotics, and Synbiotics on Human Health. Nutrients, 9(9): 1021.

Plaza-Diaz, J., F.J. Ruiz-Ojeda, M. Gil-Campos and A. Gil. 2019. Mechanisms of Action of Probiotics. Advances in nutrition (Bethesda, Md.), 10(suppl_1): S49-S66.

Rehman, A., M. Arif, N. Sajjad, M.Q. Al-Ghadi, M. Alagawany, M.E. Abd El-Hack, A.R. Alhimaidi, S.S. Elnesr, B.O. Almutairi, R.A. Amran, E.O.S. Hussein and A.A. Swelum. 2020. Dietary effect of probiotics and prebiotics on broiler performance, carcass, and immunity. Poultry science, 99(12), 6946-6953.

Simon, R., F. Docando, N. Nuñez-Ortiz, C. Tafalla and P. Díaz-Rosales. 2021. Mechanisms Used by Probiotics to Confer Pathogen Resistance to Teleost Fish. Front Immunol., 12:653025.

Soumeh, E.A., H. Mohebodini, M. Toghyani, A. Shabani, A. Ashayerizadeh and V. Jazi. 2019. Synergistic effects of fermented soybean meal and mannan-oligosaccharide on growth performance, digestive functions, and hepatic gene expression in broiler chickens, Poultry Science, 98(12): 6797-6807.

SPSS. 2018. SPSS users guide. Statistics version 26. Statistical Package Solution Service.

Sun, H., D. Chen, H. Cai, W. Chang, Z. Wang, G. Liu, X. Deng and Z. Chen. 2022. Effects of Fermenting the Plant Fraction of a Complete Feed on the Growth Performance, Nutrient Utilization, Antioxidant Functions, Meat Quality, and Intestinal Microbiota of Broilers. Animals., 12(20):2870.

Sun, W., M.H. Shahrajabian and M. Lin. 2022. Research Progress of Fermented Functional Foods and Protein Factory-Microbial Fermentation Technology. Fermentation. 8(12):688.

Wu, T., Wang, G., Xiong, Z., Xia, Y., Song, X., Zhang, H., Wu, Y., & Ai, L. (2022). Probiotics Interact With Lipids Metabolism and Affect Gut Health. Frontiers in nutrition, 9, 917043.

Yan, H., J.Q. Jin, P. Yang, B. Yu, J. He, X.B. Mao, J. Yu and D.W. Chen. 2022. Fermented soybean meal increases nutrient digestibility via the improvement of intestinal function, anti-

oxidative capacity and immune function of weaned pigs. Animal : an international journal of animal bioscience, 16(6): 100557.

Zhang, Y., M. Ishikawa, S. Koshio, S. Yokoyama, S. Dossou, W. Wang, X. Zhang, R.S. Shadrack, K. Mzengereza, K. Zhu and S. Seo. 2021. Optimization of Soybean Meal Fermentation for Aqua-Feed with Bacillus subtilis natto Using the Response Surface Methodology. Fermentation. 7(4):306.