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Influence of Probiotics on Broiler Hens' Intestinal Micro Biotas: A Meta-Analysis

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Abstract

Broiler hens' immune systems and food absorption are boosted by probiotics. Probiotics have a beneficial effect on hens, which leads to faster development rates and better health in the long run. Probiotics can enhance intestinal health and performance in broiler chickens, but their reactions vary, making it difficult to anticipate flock-wide effects. The aim of this meta-analysis was to examine the impacts of probiotic enhancement on the log concentrations of cultural gut microbiota in broiler hens using a comprehensive approach. According to the PRISMA criteria, the articles were selected with great care and attention to detail. For the final database, there were fifteen different studies. The findings provide light on the different kinds that effects of lactobacillus, lactobacillus oral administration, growth performance, and impact of probiotics. Our meta-analysis improves lactobacillus knowledge for nutrition, microbiology, and health sciences researchers, practitioners, and policymakers. The results herein emphasize the necessity for focused research to understand the processes and improve lactobacillus-based therapies for growth performance and probiotic effect.

Keywords: Probiotics, lactobacillus, broiler hens', Microbiota, chicken

INTRODUCTION

The complex interaction between probiotics and the microbiotas in broiler hens' intestines has recently attracted a lot of attention. Recent years have seen an evolution in the poultry industry's focus on the gut microbiota as a key component of overall performance and health (1). A expanding subset of the agricultural and veterinary industries is poultry. Producing maximum output with the lowest input is a primary goal in this business, as it is in other parts of the agricultural economy (2). A whopping seventy percent of total chicken output goes on feed, making one of the biggest expenditures in the industry (3). In recent years, poultry producers have seen a decline in their profit margins due to the ever-increasing costs of chicken feed components and compounded feed (4). The ever-increasing demand for protein throughout the world has led to a surge in the production of hen meat (5). Accompanying this increase in use was the continued use of antibiotic growth promoters (AGPs) to boost the efficiency of hen farming in many nations (6). AGPs fuel the expansion of bacteria that are resistant to antibiotics, including extended-spectrum beta-lactamase (ESBL)-producing bacteria in hen (7).The intestinal health and productivity of broiler hens, which are

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mostly reared for pork production, may be compromised by a multitude of difficulties (8). In this context, research on the impact of probiotics on the intestine microbiotas of lying hens has recently come to the fore, providing a potential way to improve the well-being and productivity of these hens by reducing their susceptibility to stress(9).The word probiotics describes living microbes, when given in sufficient doses, can enhance health. By introducing beneficial bacteria into the digestive tract of laying hens, probiotics can help to maintain a healthy microbiome (10). Developing antibodies, protecting the body from harmful intruders, and absorbing nutrients are greatly influenced by the gut microbiota (11). Inadequate development, heightened disease vulnerability and decreased overall production efficiency could come from disturbances to this susceptible ecology. This means to improve the broiler hens' gut microbiotas, researchers and poultry producers are looking at probiotic supplementation in increasing numbers (12). To produce economically viable chicken, quality germplasm is essential, but balanced and efficient feeding is paramount importance. This is because these additives have contributed to the rise of antibiotic-resistant bacteria because they can be detected in eggs and meat (13). Probiotics in broiler chickens' intestinal microbiotas can be ineffective, susceptible to environmental influences, strain-incompatible, and feed-interactive (14). Insufficient bacterial populations during feed preparation, storage and unpredictable bird responses can reduce probiotic supplementation's efficacy (15). This study explores the impact of probiotics on the intestinal microbiota of broiler hens. The information about possible advantages to hen health and production efficiency is valuable.

PROCESS OF SYSTEMATIC REVIEW

The systematic review adhered to the standards outlined in the“preferred reporting items for systematic review and meta-analysis (PRISMA) guidelines”, as depicted in Figure (1).The following sources were discovered from Google Scholar, PubMed, and the Poultry Science Journal (16). The keywords used were: probiotic, microbiotas, and henlactic acidbacteria (LAB). In this research, a comprehensive set of 15 studies was incorporated for analysis. Table (1) provides a summary of the studies (16). The criteria for study inclusion were:

- English peer-reviewed journal publication between 2019 and 2023,
- Controlled-trial experiment,
- Direct experiment on laying hens in vivo, and
- Probiotic concentrations in powder and liquid forms.

Table (1). Summary of study details (Source: Author)

No	Probiotic types	Probiotic Forms	Dosage of probiotic in g/kg	Time and duration for probiotic	List of Sources
1.	LAB	Powder	0-0.11	16–33	(16)
2.	LAB	Powder	0-0.15	33–46	(17)
3.	Yeast	Powder	0-0.15	15–30	(18)
4.	LAB	Powder	0-0.24	46–52	(19)
5.	Yeast	Powder	0–0.125	32–43	(20)
6.	LAB	fluid	0–0.12	40-42	(21)
7.	LAB	Powder	0-0.41	16-38	(22)
8.	LAB	fluid	0.2-0.63	23-25	(23)
9.	Combination	Powder	0.1-1.3	40-62	(24)
10.	LAB	Powder	0-0.05	27–33	(25)

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11.	Yeast	Powder	0-0.16	56–64	(26)
12.	LAB	Powder	0-0.3	21–35	(27)
13.	LAB	Powder	0-0.22	25–65	(28)
14.	Yeast	Powder	0–2	18–23	(29)
15.	LAB	Powder	0-0.25	22	(30)

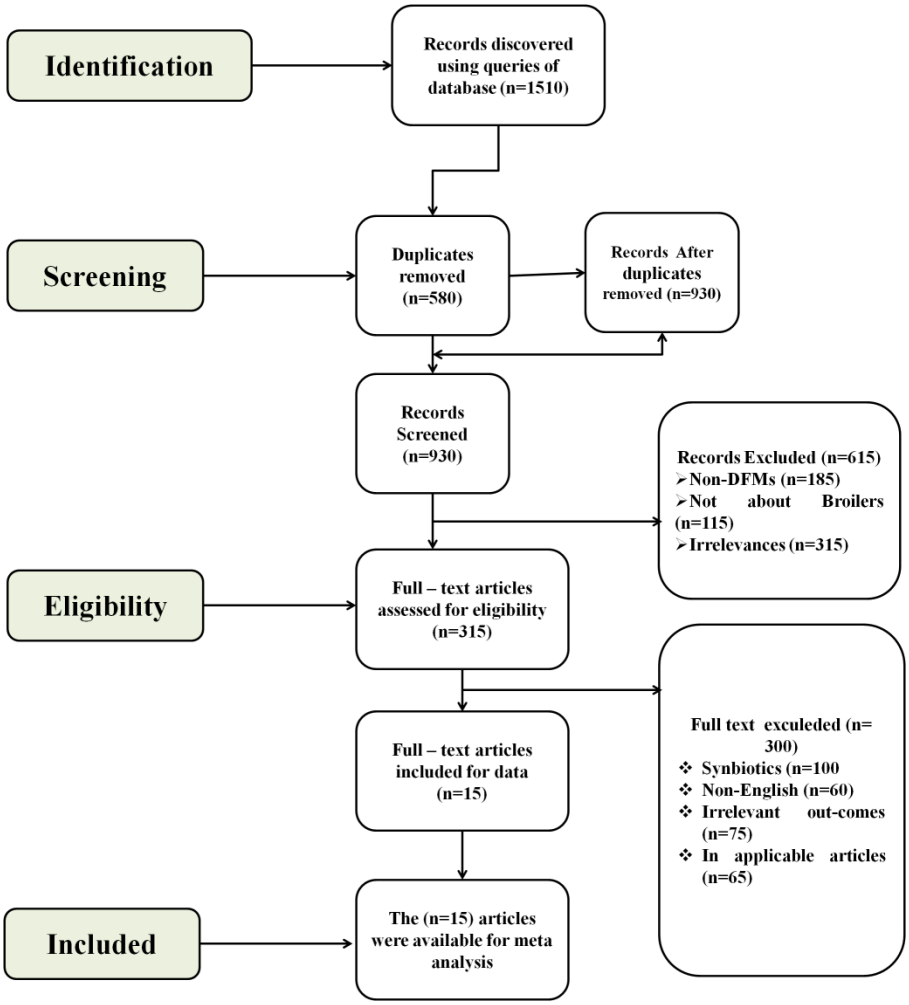

Figure (1). Flow diagram of PRISMA (Source: Author)

Probiotics

Probiotic bacteria are well recognized for their capacity to combat many types of microorganisms, as seen in figure (2). They fight microbes in many different ways, but which is the most prevalent by making bacteriocins, which are peptides that inhibit the growth of bacteria (17). "Researchers found that compared to a bacteriocin-producing strain of Lactobacillus salivarius UCC118 Bac+, non-bacteriocin-producing Lactobacillus salivarius UCC118 Bac- had more significant impact on the gut microbiota and weight gain in diet-induced obese hen (18)".

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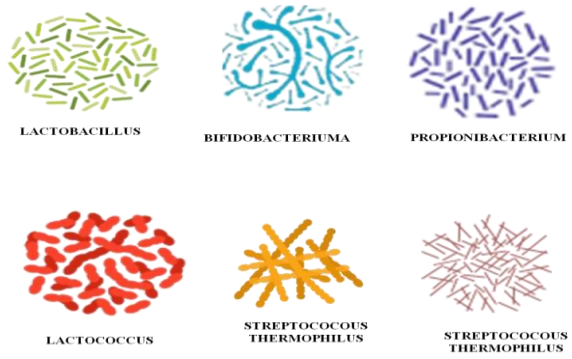

Figure (2). Probiotics (Source-https://bridgechiro.com/wp-content/uploads/2020/11/probiotics1.jpg)

Egg production and egg quality are two areas where birds that consume diets treated with probiotics seem to improve. By restoring harmony to several bacteria species, probiotics enhance the gut environment in multiple ways (19). By the way of illustration, Bacillus subtilis enhanced the bifidobacteria and milk bacteria counts while decreasing the parasites and coliforms, according to a quantification technique based on cultures (20). The utilization of probiotic and synbiotic supplements proved instrumental in restoring the disrupted gut ecology caused by Salmonella Typhimurium, concurrently augmenting the synthesis of butyrate (21). Reducing cholesterol levels in the yolk of eggs and enhancing the mineralization of tibial bone were both achieved by a Pedicoccus acidilactici strain (22). Increased egg quality and decreased blood cholesterol in hens were the results of a combination of fructo-oligosaccharides and an Enterococcus faecium strain (23). There is evidence that some probiotics candevelop the balance of the intestine microbiota (24).

Influence of probiotics

Probiotics influence the host immune system in many ways as shown in figure (3). In vitro, research has shown that, when Lactobacillus reuteri and Lactobacillus casei attach to CD209, it can enhance hen mature dendritic cells and IL-10 production. In the course of these interactions, bacteria create SCFAs, alter their redox capacity, manufacture antibacterial chemicals, compete with one another for epithelium receptors, use sensing of quorum, and ultimately create environments that are unfit for disease colonization (25).

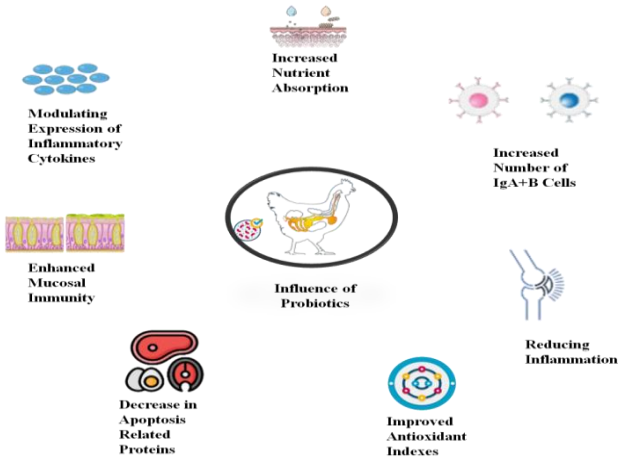

Figure (3). Intestinal microbiota (Source:https://www.researchgate.net/figure/Effects-of-probiotics-on-intestinal-health-of-chickens_fig1_339935309)

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Probiotic-producing bacterial strains encompass cell walls containing a combination of capsule carbohydrates, amino acids, teichoic chemicals, and lipids. Intestinal epithelium pattern-recognition receptors (PRRs) on certain hostsidentify these molecular components as microbe-associated molecular patterns (MAMPs), which set the stage for the immune system to control infections (26).The synthesis of lipoteichoic acid, comprising two-acyl or three-acyl glycolipids, is known to elicit signaling through Toll-like receptors (TLRs) in various probiotics, includingLactobacillus plantarum WCFS1,L. rhamnosus GG,andLactobacillus acidophilus NCFM. Upon interaction with host cells, probiotics typically initiate a series of events. These events involve the generation of both natural and antigen-specific antibodies, activation of Toll-like receptors for signaling cascades, and the modulation of cytokines and T cells. In a controlled vitro researchinvolving cecal tonsil cellsandhen splenic, L.Salivarius was observed to induce anti-inflammatory cytokine responses, while L. acidophilus specifically stimulated the production of Th1 antibodies, among other discernible outcomes (27).

Broiler hens' intestinal microbiotas

Microbiotarefers to the communities of microbes, virus, and fungi that inhabit certain bodily systems, such as the breathing, intimate, intestinal, and epidermal tracts as shown in Figure (4). Host tissue growth, nutrition intake, digestion, and immunological system development are a few of the many biological activities that rely on the microbiota (28). The relevance of the intestinal microbiota to the happiness, good health, and production of humans, hens, and other animals is well-documented. There are more commensal elements in the intestine ecology that are associated with organisms that provide food, and these components affect the proliferation of typical intestinal microbes (29).

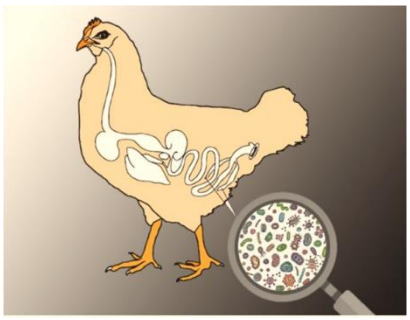

Figure (4). Intestinal microbiota (Source: https://www.asian-agribiz.com/2022/03/16/the-importance-of-gut-microbiota/)

The gastrointestinal tract (GIT) ecosystem consists of intestinal epithelial cells, the immune system, and a group of microbes. Maintaining proper immunity relies on the interplay between microbiota and hosts (30). Microbiota governs immune cell proliferation, the synthesis of antibodies, the production of host defense peptides (HDP), and the morphology of intestinal walls. The microbiota in the gut helps the host to absorb nutrients, defend against viruses, and build a healthy immune system (31). Due to irregular microbiota development, gut microbial colonization can alternate, leading to sensitivity, diabetes, obesity, diabetes, and aberrant immune reactions. Because of variances in the maturation of microbiota in the intestines, challenges and illnesses in freshly born hens can elicit diverse reactions (32). Even more importantly, in the animal world, the first few days after hatching are crucial for the formation of a healthy gut microbiota, which impacts health and subsequent growth. Normal microbial community development is dependent on the first few days of a hen's life after hatching (33). Hens have the highest evolved stable microbiome before hatching. Within the first week after hatching, GIT develops quicker than other organs, making it essential for chickens to reach their genetic potential (34). Hen microbiotacan be modified by host

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secretions, dietary nutrients, and systemic reactions. These microbes interact with each other and the host to control gut physiological metabolisms (35).

RESULTS

In this part, we discussed for influence of probiotics on broiler hens intestinal micro biotas to calculate, such as the effect of lactobacillus, lactobacillus oral administration, growth performance, and impact of probiotics.

Effect of Lactobacillus

A probiotic strain called Lactobacillus hen, which has been found to improve gut microbiota, can also improve the general health of broiler chickens. Research has shown that feeding broilers Lactobacillus hen has a beneficial impact on the variety and makeup of their gut microbiota, resulting in a harmonious microbial community (36). The chicken sector seeks sustainable and effective ways to increase animal health and production, and Lactobacillus hen's function in altering broiler chickens' gut microbiota shows promise for future poultry management strategies. Figure (5) and Table (2) demonstrate the way broiler breeders' egg weights changed after taking a Lactobacillus supplement. From 56 to 62 weeks of age, there was no significant impact of supplementing the diet of broiler breeders with Lactobacillus on egg weight.

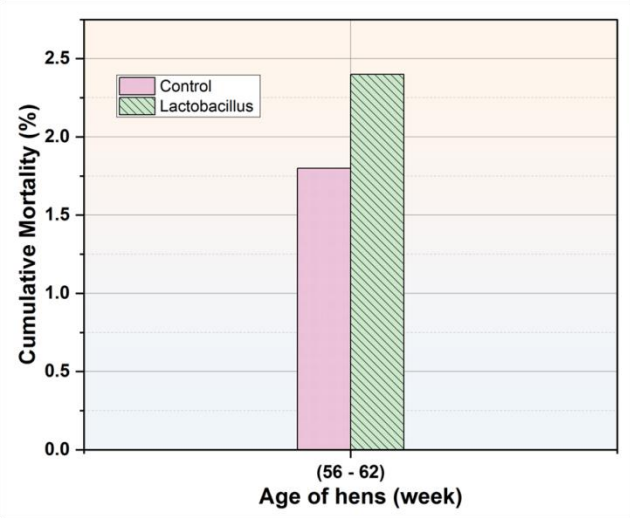

Figure (5). Percentage of cumulative mortality (Source: Author)

Table (2). Numerical result of cumulative mortality (Source: Author)

Age of hens (week)	Cumulative Mortality (%)	
	Control	Lactobacillus
(56 - 62)	1.8	2.4

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Lactobacillus Oral Administration

Hen resistance as a result of using liquid lactobacillus cultures orally once a day (37). The caecum included three of the used lactobacillus species: L. reuteri, L. salivarius, and L. casei. There was no indication of L. reuteri in the caecum, even after daily treatment. Since L. salivarius was found in both the experimental and control hen caecas, This was true even when lactobacillus were given daily for the entire 12 days of the experiment Figure (6) and Table (3) show the percentage of total microbiotas.

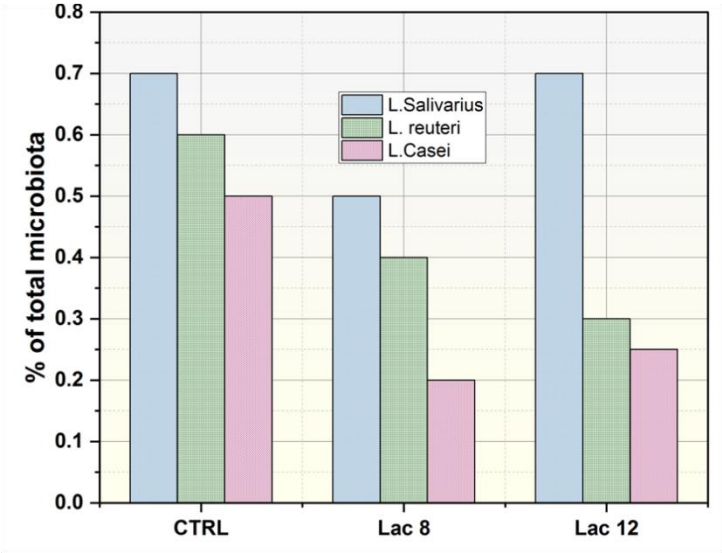

Figure (6). Comparisons percentage of totalmicrobiota(Source: Author)

Table (3). Numerical result of totalmicrobiota (Source: Author)

Total microbiota (%)			
Species	**L.Salivarius**	**L. reuteri**	**L.Casei**
CTRL	0.7	0.6	0.5
Lac 8	0.5	0.4	0.2
Lac 12	0.7	0.3	0.25

Growth performance

The productivity and economic feasibility of hen farming are directly impacted by the growing performance of hens. Metrics including feed conversion efficiency and body weight increase all part of this complex indicator (38). If the husbandry system is well-managed and the diet is balanced, the growth performance can be optimal. Hereditary factors, dietary composition, environmental factors, and illness management are those factors that impact hen growth Figure (7) and Table (4) shows the comparisons of probiotic. It was necessary to determine the initial weight of each hen, thus each one was weighed separately when they arrived. The subsequent step was to measure

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the body weight (BW) in grams every week until the infant reached six weeks of age. Utilizing feed intake (FI) and BW, it was possible to ascertain the amount of each duplicate in each treatment.

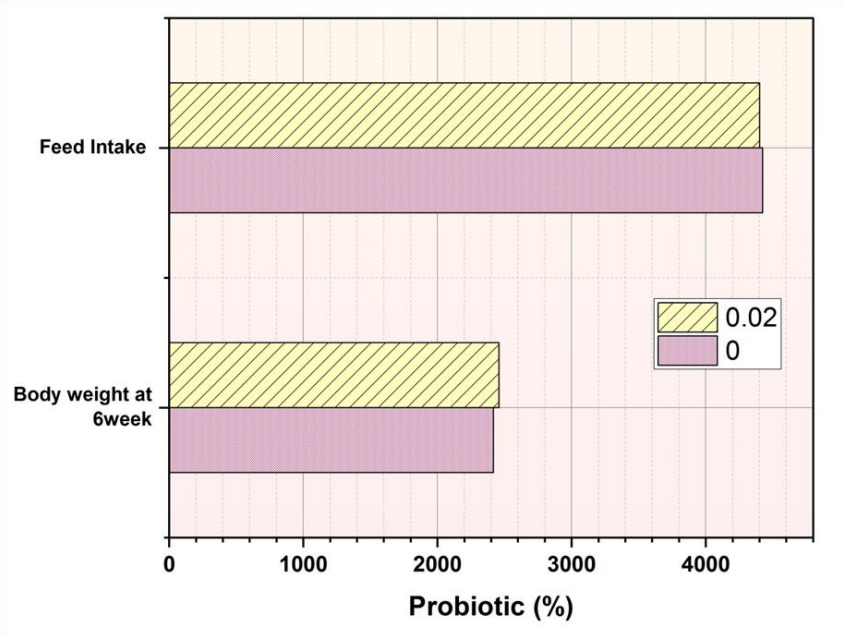

Figure (7). Comparisons of Probiotic (Source: Author)

Table (4). Numerical Outcomes of Probiotic (Source: Author)

Item	Probiotic (%)	
	0	**0.02**
Body weight at 6 week	2417.5	2458.2
Feed Intake	4425	4403.2

Impact of Probiotics

The influence that probiotics have on hens is a developing field of study that has important repercussions for the health of poultry as well as the production of poultry (39). The ability of probiotics, which are helpful living microorganisms, to have a good effect on the microbiota of the intestine of broiler hens is becoming more and more acknowledged regularly (40). There is a correlation between enhanced nutritional absorption, regulation of the immune system, and general intestinal health in hens. Additionally, probiotics have the potential to reduce the negative impact that stresses, infections, and inadequate environmental circumstances have on chickens. The probiotic group had a pre-treatment level of 10 ng/ml before treatment, while the conventional diet group had a pre-treatment level that was lower, coming at 7 ng/ml. The post-treatment concentration in the probiotic group dropped to 8 ng/ml after the treatment period, which indicates a moderate reduction in the previous concentration. The group

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that followed a typical diet had a post-treatment concentration of 5 ng/ml, which demonstrated a greater reduction. Figure (8) and Table (5) show the comparisons of the hen diet.

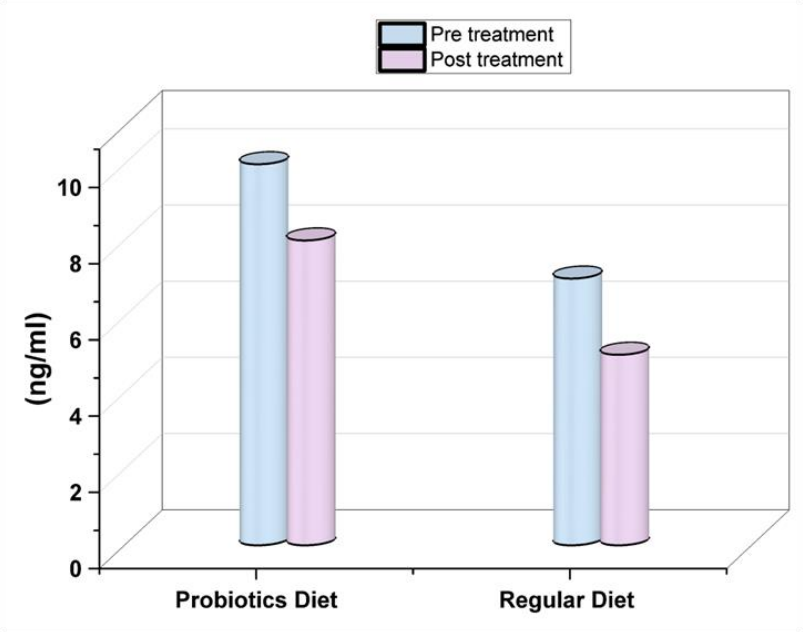

Figure (8). Comparisons of the hen diet (Source: Author)

Table (5). Numerical Outcomes of the Hen Diet (Source: Author)

(ng/ml)	Pre-treatment	Post-treatment
Probiotics Diet	10	8
Regular Diet	7	5

CONCLUSION

This comprehensive review highlights the promise of probiotics for improving broiler chickens' gut health and productivity. Researchers and practitioners may benefit from our methodology, which clarifies the log concentrations of cultured gut microbiota in grill chickens, notwithstanding the observed diversity in reactivity. We extensively selected fifteen papers for our final database using the PRISMA principles. While the synthesized results add to our knowledge of the benefits of lactobacillus, oral administration of lactobacillus, growth performance, and probiotics in general, they also highlight the need for further targeted studies. The findings of this study have important consequences for the fields of nutrition, microbiology, and health sciences. They provide a basis for optimizing the efficacy of treatments based on lactobacillus and can assist legislators in promoting probiotic policies that enhance the health and growing performance of hens. Probiotics have been shown to have a consistent and unambiguous effect on grill chickens, although there is little data to support that assertion. To ensure the long-term

viability of the poultry industry, researchers are investigating the miraculous effects of probiotics on the health and productivity of broiler hens.

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