Review Article

BASRAH JOURNAL OF VETERINARY RESEARCH, 2025, 24(2):1-13.
https://bjvr.uobasrah.edu.iq/

Gut Microbiota's Role in Optimizing the Chicken Digestive System

Ayman A. Alhially , Ahmed N. Flayyih
Department of Pathology and Poultry Diseases, College of Veterinary Medicine,
University of Mosul, Mosul, Iraq.

Corresponding Author Email Address: amoonizzz@uomosul.edu.iq

ORCID ID: https://orcid.org/0000-0002-8186-4489
DOI: https://doi.org/10.23975/bjvr.2025.156143.1184

Received: 25 Dec. 2024 Accepted: 20 March 2025.

Abstract

Chickens' general well-being and productivity depend heavily on their gut health. It describes how well the gastrointestinal system functions and the complex interactions it has with microbial communities. In order to optimize the chicken's digestive tract, this paper examines the importance of gut microbiota, highlighting the ways in which these microbes support performance, health, and resistance to disease. The intricate microbiome found in the gut is important for immunological response, digestion, and nutrient absorption. It is crucial to comprehend gut health since, even in the absence of obvious symptoms of illness, it can have a direct impact on hen performance. This can be accomplished in a number of ways, including by offering a well-balanced diet high in fiber, probiotics, and prebiotics. These elements encourage the development of advantageous bacteria, which enhances the hens' general health and performance. The chicken's digestive system depends on its gut flora. Poultry farmers can improve the well-being and output of their flocks by comprehending its function and putting prevention measures in place to keep the microbiota steady.

Key words: gut microbiota, intestine, chicken.

Introduction:

Gut microbiota function in chicken

Poultry's digestive systems are home to a diverse microbial population known as the gut microbiota. Humans depend on poultry, such as laying hens and broilers, as a source of animal food. The most important organ in the process of poultry nutrition absorption is the gastrointestinal system (1).

The unique design of the avian gut is due to the special feeding species, which gives it the ability to better utilize food and derive more energy and nutrition from it(2). Most of the work has focused on the gut structure, intestinal flora, and its function concerning mammals; Few research has examined the composition and function of the lower gastrointestinal tract, biogas regeneration, or the impact of microbial fermentation in male fowl (3).

Since the gut microbiota is a unique member of the community of microbes, there has been a lot of interest in its significance in maintaining human health (4). A multitude of factors environmental conditions, age, nutrition, and host genetics all affect how the gut microbiota develops and is acquired in chickens. All have an impact on the microbiota composition, which varies significantly among individuals (5). A complicated synergistic link exists between the chicken digestive system and the gut microbiota, and the latter is essential for preserving the homeostasis of the digestive system (6). The gut microbiota can affect the function and appearance of the digestive system as well as the host's growth and development (7).

According to a number of studies, the gut microbiota can support the growth of the chicken's digestive system, enabling it to more easily adjust to various dietary and lifestyle patterns. Additionally, it can encourage the host's healthy growth (8). For instance, antibiotics that disrupt the gut microbiota will impact the growth of hens and cause inflammation and intestinal damage (9). Therefore, during animal production, it is simple to ignore the avian digestive system and its composition and function, which could potentially affect the gut microbiota's makeup. In order to comprehend the ways in which the gut microbiota affects the development of the avian digestive system and support the healthy growth of chickens, this review outlines the relationship between the gut microbiota and the structure and function of the chicken's digestive system at various ages and modes (10,11).

Poultry's general health and well-being are greatly influenced by the condition of their digestive systems. The complex gastrointestinal tract controls poultry digestion, nutrient absorption, and immune response. For the best potential development, performance, and disease resistance in chicken production, gut health must be maintained (12,13). This scientific introduction aims to investigate the significance of poultry gut health, how it affects productivity, and methods for improving gut health. It should be noted that the data shown here is derived from the most recent studies (14).

The ecology of bacteria, viruses, fungi, and protozoa that makeup poultry gut microbiota is diverse. These microbial communities promote the host's immune system growth, digestion, nutrient metabolism, and protection against pathogens by cooperating with it(15). Food, genetics, management practices, Additionally, the gut microbiota's diversity and composition are influenced by environmental variables. Dysbiosis, Poultry performance and gut health may suffer from an imbalance in the microbial community brought on by modifications in the gut microbiota. (16,17). (Figure 1)

It's crucial to keep your gut flora healthy for poultry production. A diverse and balanced microbiome aids in the process of nutritional absorption and digestion, enhancing growth performance and feed efficiency. Besides, the gut flora has a big impact on the immune system's development and maturation (18,19). The microbial population competes with pathogenic microbes for resources and adhesion sites, improves the function of the gut barrier, and promotes the synthesis of antimicrobial peptides. Therefore, improved disease resistance and a decreased need for antibiotics in poultry production are both facilitated by a healthy gut flora (20).

Antibiotics' Effect on Chicken Gut Health

Gut health in poultry is essential for their growth and overall well-being, but several challenges can disrupt it. The use of antibiotics as growth promoters in chicken production is one significant problem. Antibiotics have been widely used to increase bird development rates and prevent infections for a long time (21). However, bacteria that are resistant to these antibiotics have emerged as a result of their overuse and abuse (22) Both the health of the bird and human health are seriously threatened by the spread of these resistant germs through the environment and food chain. In response to this growing worry, laws have limited the use of antibiotics in animal agriculture. (23,24). Consequently, the poultry industry is now exploring alternative methods to support gut health, such as probiotics and improved nutrition, to ensure both the safety of the animals and the health of consumers (25).

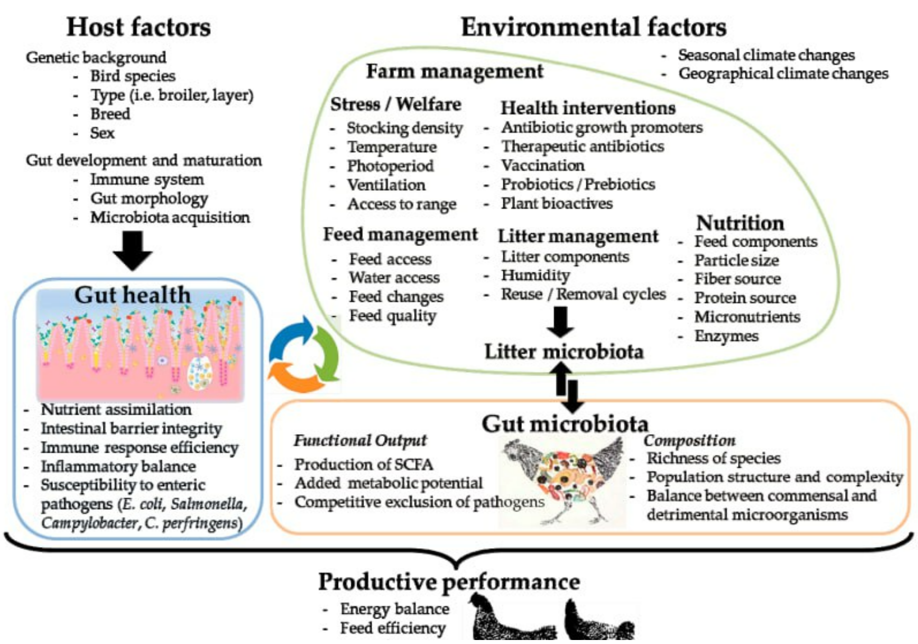

Figure (1) Environmental factors for production of Chicken Gut Microbiota(17)

Antibiotic substitutes for the gut health of chickens

Probiotics, prebiotics, and organic acids have gained attention as viable alternatives to antibiotics for enhancing gut health in poultry. When given in enough amounts, probiotics which are defined as live microorganisms benefit the host's health (26,27). These advantageous bacteria enhance gut health by competing with harmful microorganisms, modulating the immune response, and synthesizing antimicrobial substances (28). On the other hand, prebiotics are indigestible food ingredients that specifically encourage the development and activity of good gut flora. They facilitate the colonization and functional activity of particular bacterial populations in the gastrointestinal tract by acting as substrates for their growth. (29,30). Maintaining intestinal health in chickens requires dietary interventions in addition to the use of chemicals. The gut microbiota and general gut health are greatly impacted by the diet's quality and composition (31). Incorporating prebiotics, probiotics, and various feed additives into the diet can positively influence gut microbial populations, resulting in improved gut health and performance (32). Moreover, utilizing feed additives that enhance gut health can diminish the dependency on antibiotics, thereby promoting sustainable and environmentally friendly practices in poultry production (33). (figure 2)

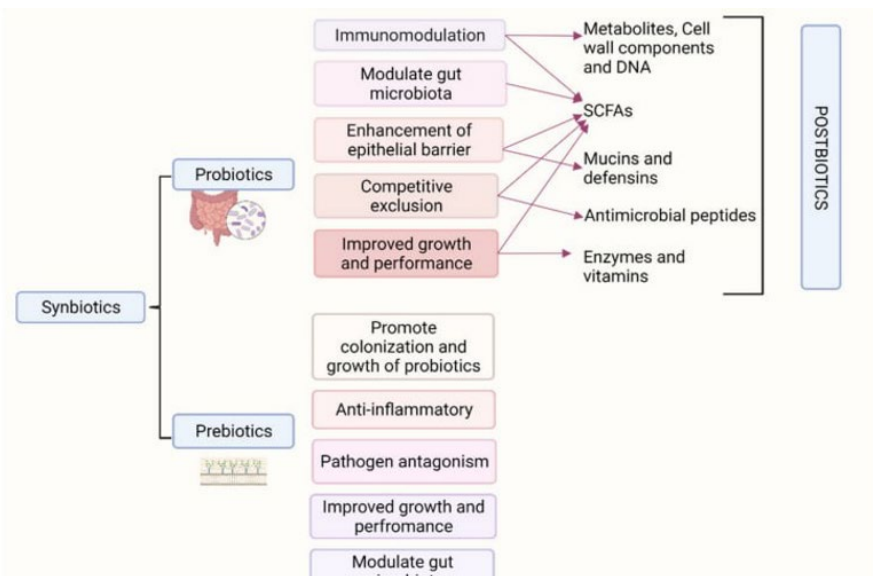

Figure (2) probiotic and prebiotic stable population in chicken gut host gut (17)

The Gut Tract's Function in Chicken Immunity

The Gut tract can be regarded as part of the external environment. Since the GI tract provides a place for the colonization and invasion of many harmful microorganisms, one of the gut's primary roles is to act as a barrier between the internal and exterior environments (34,35). The GI tract contributes significantly to the immune system of birds through this and a number of other functions. (36). In order for the gut immune systems of birds to develop, the post-hatching period is crucial. During this time, the immune system must distinguish between harmful infections, beneficial microbes, and food. Maintaining gut health requires this differentiation because a protracted immune response might result in problems like villus atrophy. In the first weeks after hatching, Research has documented the successive emergence of multiple stages of gastrointestinal immunity in chickens raised for meat, including (a) immune cell influx and innate development; (b) immune specialization and specialty; and (c) immunological regulation and maturation (37, 38).

Immunity-gut microbiota communication in chickens

Additionally, there are opportunistic microorganisms that can be found in the microbiota. have the ability to "bloom," which can greatly exacerbate barrier surface illnesses by triggering inflammatory immune responses. Furthermore, The opportunistic bacteria that can "bloom," which can trigger inflammation immune responses and considerably exacerbate barrier surface disorders, may be found in the microbiota (39). Several host functions in chickens are dependent on cues from the microbiota because they have evolved in the setting of microbial colonization. (40).

Through the expression of metabolites produced by enzymes, foreign antigens, and microbe-associated molecular patterns, which can directly sense the microbiota. (41). As a result, the immune system depends on the microbiota to defend it from invasive pathogens. However, this intimate relationship has a serious risk because it can cause disease if it is disrupted. A diverse GI microbial community, comprising numerous different types of bacteria along with up to 1011 CFU per gram of gut contents, is what poultry have evolved to live with. A few benefits of this microbial community, sometimes referred to as the GI microbiome, include promoting the development of the gastrointestinal mucus layer, epithelium monolayer, and lamina propria (42).

In order to allow the host to tolerate both viral and noninfectious stimuli, the gastrointestinal tract, sometimes referred to as the "gut," regulates the homeostasis of the body's physiological in nature, microbiological, and physical processes (43,44). With more immune cells located there than any other part of the host, the gut is an active immune organ due to its constant exposure to both infectious and non-infectious stimuli. This is because it has the greatest area of surface between the lumen that is exposed to the environment and the interior subepithelial tissue. The gut mucosal immune system, a highly regulated structure that includes innate and acquired components, has the remarkable ability to respond and adjust to these extraordinarily diverse events (45).

The host controls the growth and anatomical placement of the microbiota by producing nonspecific antimicrobial peptides including defensins (46), IgA, and miRNAs that control bacterial transcription and growth. (47).

Commensal pathogens in the gastrointestinal tract employ their sense of the surrounding environment to initiate biochemical pathways that promote bacterial metabolism in order to evade, alter, as well as survive host adaptive immune destruction. Furthermore, certain compounds derived from microbes can encourage particular commensal processes that are advantageous to both the host and the microbe. Similar to this, the host recognizes the microorganisms by their generation of certain molecules or parts with distinctive chemical patterns, which triggers both innate and learned immune responses. When microbial pathogens (as well as viruses and fungi) modify to survive in the host's intestine, the result is a mutually advantageous coexistence between the microbial community and the host during homeostasis. (47,48). The host and microbiota's interdependent interaction clearly impacts the immunological response of the host, causing it to develop immunological tolerance to commensal microorganisms while simultaneously remaining susceptible to invasive infections. (49). The disruption of this immune balance caused by changes to the gut microbial communities leads to immunological dysregulation and increased vulnerability to illnesses.

Immune homeostasis of Chicken Gut microbiota:

A status of immune competency is the immune interactome's homeostasis of the microbiota of the gut (47) (figure 3) that is made up of two complementing elements. microbiota-nourishing immunity, a distinct immune response, and the conventional anti-infective immunity that provides protection (50). In a state of health or equilibrium, the microbiome can efficiently stop invasive bacteria, such as illnesses, from colonizing and proliferating. This characteristic, referred to dubbed "colonization resistance," is linked to both a controlled lack of inflammation and a steady and varied microbiota. It covers particular interactions between the microbiota and the mucosal immune system (51).

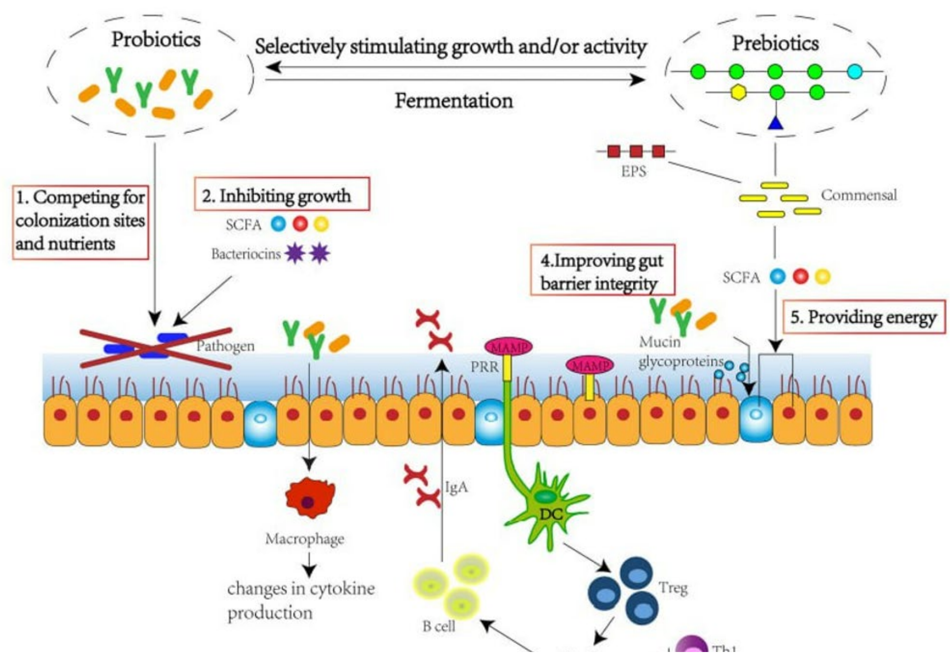

Figure (3) gut microbiota immune interactome's homeostasis (47)

Intestinal immunity to prevent infections, the initial line of defense is the microbiota that supports immunity. By keeping the gut microbiota in balance, it makes it possible to start colonization resistance. Microbiota-nourishing immunity has to enhance both protection of the "microbial organ" within the human intestinal organ through direct (microbiota source) and indirect (the host origin) colonization resistant qualities (52). The traditional anti-infective defense stops the pathogen from colonizing and growing by generating peptide antibiotics, triggering inflammasomes, and creating Traditional anti-infective immunity, the second part of the intestinal immune response, stops pathogen colonization and proliferation by producing antimicrobial peptides, activating inflammasomes, and producing and expressing IL-17, IL-10, & IL-22 (53,54).

Chicken immune dysfunction and gut microbiome dysbiosis

A physiologic opening that pathogens can take advantage of to colonize is created when dysbiosis occurs, which is a breakdown of immunity nourished by the microbiota that impairs colonization resistance. In a healthy microbiome, commensal microbes provide resistance to colonization by possible pathogens in the gut. Resistance to colonization is eliminated when commensals are disturbed (by antibiotics or dietary modifications). Because they may utilize more physiological and nutritional resources, pathogens like Clostridium perfringens and S. typhimurium have the opportunity to proliferate (55) (figure 4). Therefore, infections change the pitch by causing diarrhea and other physiological alterations, such as inflammation, that affect the intestinal environment and encourage their own proliferation. In chickens, intestinal inflammation also leads to dysbiosis (56), However, it is unclear if the inflammation is the cause or if it is a result of modifications in the gut flora.(57). In chickens, intestinal inflammation also contributes to disintegration, albeit it is unclear whether this is the cause or a result of gut dysregulation. (58).

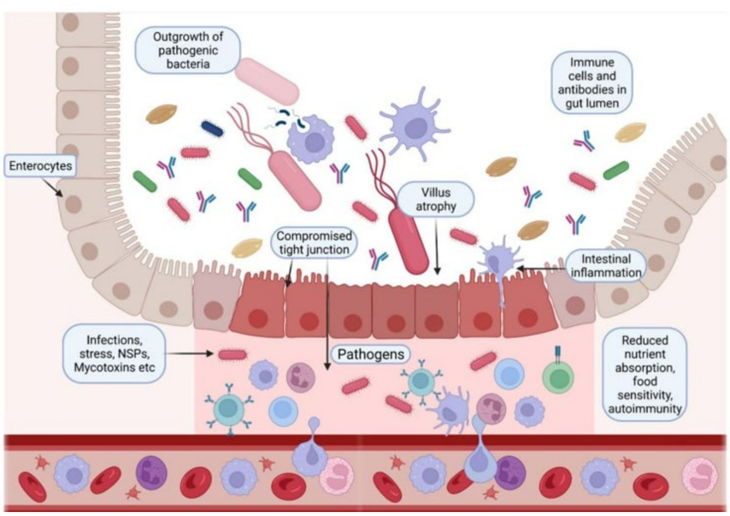

Figure (4) Dysbiosis of Gut microbiota in Chicken (55)

Therapeutic approaches such as targeted dietary intervention, and bioactive compounds that include direct-fed microbials (DFMs) as well as pro/prebiotics, may help to ameliorate gut dysbiosis and its associated loss of colonization resistance (59). The primary goal of many of the microbe-targeted treatments currently on the market, such as nutritional supplements containing prebiotics, probiotics, enzymes, and DFM, is to improve performance (better feed conversion rate, increased production of breast meat and eggs, and improved nutrient utilization of the diet), not to improve cell immunomodulation. However, in certain instances, commercial feed additives, like as b-mannanase, have been observed to boost immunity or lessen intestinal inflammation. (60).

Conclusion

The health of the chicken gut is a complex interplay of various factors, including diet, environment, and microbial balance. By optimizing gut microbiota, poultry producers can enhance the digestive health of their chickens, leading to improved growth performance and resistance to diseases. Understanding these relationships is critical for advancing practices in poultry management and ensuring animal welfare.

Conflict of interest

The paper's content was not improperly influenced by any personal or financial relationships the author may have had with other people or organizations.

References

1. Liu, Y., Wang, J., & Wu, C. (2022). Modulation of gut microbiota and immune system by probiotics, pre-biotics, and post-biotics. *Frontiers in nutrition, 8*, 634-897.DOI.10.3389/fnut.2021.634897
2. Zhang, X., Akhtar, M., Chen, Y., Ma, Z., Liang, Y., Shi, D., ... & Liu, H. (2022). Chicken jejunal microbiota improves growth performance by mitigating intestinal inflammation. *Microbiome, 10(1)*, 107-112. DOI.10.1186/s40168-022-01299-8
3. Fathima, S., Shanmugasundaram, R., Adams, D., & Selvaraj, R. K. (2022). Gastrointestinal microbiota and their manipulation for improved growth and performance in chickens. *Foods, 11(10)*, 14-01. DOI.10.3390/foods11101401
4. Stanley, D., & Bajagai, Y. S. (2022). Feed safety and the development of poultry intestinal microbiota. *Animals, 12(20)*, 28-90. DOI.10.3390/ani12202890
5. Yin, H. C., Liu, Z. D., Zhang, W. W., Yang, Q. Z., Yu, T. F., & Jiang, X. J. (2022). Chicken intestinal microbiota modulation of resistance to nephropathogenic infectious bronchitis virus infection through IFN-I. *Microbiome, 10(1)*, 162-172.DOI.10.1186/s40168-022-01348-2
6. Diaz Carrasco, J. M., Casanova, N. A., & Fernández Miyakawa, M. E. (2019). Microbiota, gut health and chicken productivity: what is the connection. *Microorganisms, 7(10)*,

374-384.DOI.10.3390/microorganisms7100374

7. Sood, U., Gupta, V., Kumar, R., Lal, S., Fawcett, D., Rattan, S., ... & Lal, R. (2020). Chicken gut microbiome and human health: past scenarios, current perspectives, and futuristic applications. *Indian journal of microbiology, (60)*, 2-11. DOI.10.1007/s12088-019-00785-2
8. Chen, B., Li, D., Leng, D., Kui, H., Bai, X., & Wang, T. (2022). Gut microbiota and meat quality. *Frontiers in microbiology, (13),* 951-726. DOI.10.3389/fmicb.2022.951726
9. Bindari, Y. R., & Gerber, P. F. (2022). Centennial Review: Factors affecting the chicken gastrointestinal microbial composition and their association with gut health and productive performance. *Poultry Science, 101(1)*, 101-612.DOI.10.1016/j.psj.2021.101612
10. Lei, J., Dong, Y., Hou, Q., He, Y., Lai, Y., Liao, C., ... & Zhang, B. (2022). Intestinal microbiota regulate certain meat quality parameters in chicken. *Frontiers in nutrition, (9)*, 747-705.10.3389/fnut.2022.747705
11. Wang, Y., Sun, J., Zhong, H., Li, N., Xu, H., Zhu, Q., & Liu, Y. (2017). Effect of probiotics on the meat flavour and gut microbiota of chicken. *Scientific Reports, 7(1)*, 64-76.DOI.10.1038/s41598-017-06677-z
12. Shang, Y., Kumar, S., Oakley, B., & Kim, W. K. (2018). Chicken gut microbiota: importance and detection technology. Frontiers in veterinary science, 5, 254-260.DOI.10.3389/fvets.2018.00254
13. Clavijo, V., Morales, T., Vives-Flores, M. J., & Reyes Muñoz, A. (2022). The gut microbiota of chickens in a commercial farm treated with a Salmonella phage cocktail. *Scientific reports, 12(1)*, 991-202. DOI.10.1038/s41598-021-04679-6
14. Hubert, S. M., Al-Ajeeli, M., Bailey, C. A., & Athrey, G. (2019). The role of housing environment and dietary protein source on the gut microbiota of chicken. *Animals, 9(12)*, 1085-1098. DOI.10.3390/ani9121085
15. Akinyemi, F. T., Ding, J., Zhou, H., Xu, K., He, C., Han, C., ... & Meng, H. (2020). Dynamic distribution of gut microbiota during embryonic development in chicken. *Poultry science, 99(10)*, 5079-5090. DOI.10.1016/j.psj.2020.06.016
16. Kers, J. G., Velkers, F. C., Fischer, E. A., Hermes, G. D., Stegeman, J. A., & Smidt, H. (2018). Host and environmental factors affecting the intestinal microbiota in chickens. *Frontiers in microbiology,(9),* 235-246.DOI.10.3389/fmicb.2018.00235
17. Iqbal, Y., Cottrell, J. J., Suleria, H. A., & Dunshea, F. R. (2020). Gut microbiota-polyphenol interactions in chicken: A review. Animals, 10(8), 1391-1403.DOI.10.3390/ani10081391
18. Diaz Carrasco, J. M., Casanova, N. A., & Fernández Miyakawa, M. E. (2019). Microbiota, gut health and chicken productivity: what is the connection. *Microorganisms, 7(10)*,

374-385.DOI.10.3390/microorganisms7100374

19. Choi, K. Y., Lee, T. K., & Sul, W. J. (2015). Metagenomic analysis of chicken gut microbiota for improving metabolism and health of chickens—a review. *Asian-Australasian journal of animal sciences, 28(9)*, 1217-1225. DOI.10.5713/ajas.15.0026
20. Shi, D., Bai, L., Qu, Q., Zhou, S., Yang, M., Guo, S., ... & Liu, C. (2019). Impact of gut microbiota structure in heat-stressed broilers. Poultry science, 98(6), 2405-2413.DOI.10.3382/ps/pez026
21. Juricova, H., Matiasovicova, J., Kubasova, T., Cejkova, D., & Rychlik, I. (2021). The distribution of antibiotic resistance genes in chicken gut microbiota commensals. *Scientific reports, 11(1)*, 3290-3298.DOI.10.1038/s41598-021-82640-3
22. Hubert, S. M., Al-Ajeeli, M., Bailey, C. A., & Athrey, G. (2019). The role of housing environment and dietary protein source on the gut microbiota of chicken. *Animals, 9(12)*, 1085-1098.DOI.10.3390/ani9121085
23. Iqbal, Y., Cottrell, J. J., Suleria, H. A., & Dunshea, F. R. (2020). Gut microbiota-polyphenol interactions in chicken: A review. Animals, 10(8), 1391-1399.DOI.10.3390/ani10081391
24. Stanley, D., & Bajagai, Y. S. (2022). Feed safety and the development of poultry intestinal microbiota. *Animals, 12(20),* 2890-2896.DOI.10.3390/ani12202890
25. Sood, U., Gupta, V., Kumar, R., Lal, S., Fawcett, D., Rattan, S., ... & Lal, R. (2020). Chicken gut microbiome and human health: past scenarios, current perspectives, and futuristic applications. *Indian journal of microbiology, (60),* 2-11. DOI.10.1007/s12088-019-00785-2
26. Utkarsh Sood, U. S., Vipin Gupta, V. G., Roshan Kumar, R. K., Sukanya Lal, S. L., Fawcett, D., Supriya Rattan, S. R., ... & Rup Lal, R. L. (2020). Chicken gut microbiome and human health: past scenarios, *current perspectives, and futuristic applications*.ISSN (Electronic): 0973-7715
27. Fathima, S., Shanmugasundaram, R., Adams, D., & Selvaraj, R. K. (2022). Gastrointestinal microbiota and their manipulation for improved growth and performance in chickens. *Foods, 11(10),* 1401-1412.DOI.10.3390/foods11101401
28. Shang, Y., Kumar, S., Oakley, B., & Kim, W. K. (2018). Chicken gut microbiota: importance and detection technology. *Frontiers in veterinary science,(5)*, 254.DOI.10.3389/fvets.2018.00254
29. Zhang, X., Akhtar, M., Chen, Y., Ma, Z., Liang, Y., Shi, D., ... & Liu, H. (2022). Chicken jejunal microbiota improves growth performance by mitigating intestinal inflammation. *Microbiome, 10(1),* 107.DOI.10.1186/s40168-022-01299-8
30. Yin, H. C., Liu, Z. D., Zhang, W. W., Yang, Q. Z., Yu, T. F., & Jiang, X. J. (2022). Chicken intestinal microbiota modulation of resistance to nephropathogenic infectious bronchitis virus infection through IFN-I.

Microbiome, 10(1), 162.DOI.10.1186/s40168-022-01348-2
31. Wickramasuriya, S. S., Park, I., Lee, K., Lee, Y., Kim, W. H., Nam, H., & Lillehoj, H. S. (2022). Role of physiology, immunity, microbiota, and infectious diseases in the gut health of poultry. *Vaccines, 10(2),* 172-184.DOI.10.3390/vaccines10020172
32. Staudacher, H. M., & Loughman, A. (2021). Gut health: definitions and determinants. *The Lancet Gastroenterology & Hepatology, 6(4)*, 269-275. DOI: 10.1016/S2468-1253(21)00071-6
33. Rowland, I., Gibson, G., Heinken, A., Scott, K., Swann, J., Thiele, I., & Tuohy, K. (2018). Gut microbiota functions: metabolism of nutrients and other food components. *European journal of nutrition, (57),* 1-24.DOI.10.1007/s00394-017-1445-8
34. Kers, J. G., Velkers, F. C., Fischer, E. A., Hermes, G. D., Stegeman, J. A., & Smidt, H. (2018). Host and environmental factors affecting the intestinal microbiota in chickens. *Frontiers in microbiology,(9)*, 235-242.DOI.10.3389/fmicb.2018.00235
35. Broom, L. J., & Kogut, M. H. (2018). The role of the gut microbiome in shaping the immune system of chickens. *Veterinary immunology and immunopathology*, (*204),* 44-51. DOI.10.1016/j.vetimm.2018.10.002
36. Belkaid, Y., & Harrison, O. J. (2017). *Homeostatic immunity and the microbiota. Immunity, 46(4),* 562-576. DOI.10.1016/j.immuni.2017.04.008
37. Shakouri, M. D., Iji, P. A., Mikkelsen, L. L., & Cowieson, A. J. (2009). Intestinal function and gut microflora of broiler chickens as influenced by cereal grains and microbial enzyme supplementation. *Journal of animal physiology and animal nutrition, 93(5),* 647-658. DOI.10.1111/j.1439-0396.2008.00852.x
38. Sassone-Corsi, M., & Raffatellu, M. (2015). No vacancy: how beneficial microbes cooperate with immunity to provide colonization resistance to pathogens. *The Journal of Immunology, 194(9),* 4081-4087. DOI.10.4049/jimmunol.1403169
39. Crhanova, M., Hradecka, H., Faldynova, M., Matulova, M., Havlickova, H., Sisak, F., & Rychlik, I. (2011). Immune response of chicken gut to natural colonization by gut microflora and to Salmonella enterica serovar enteritidis infection. *Infection and immunity, 79(7),* 2755-2763. DOI.10.1128/iai.01375-10
40. Quinteiro-Filho, W. M., Rodrigues, M. V., Ribeiro, A., Ferraz-de-Paula, V., Pinheiro, M. L., Sá, L. R. M. D., ... & Palermo-Neto, J. (2012). Acute heat stress impairs performance parameters and induces mild intestinal enteritis in broiler chickens: role of acute hypothalamic-pituitary-adrenal axis activation. Journal of animal science, 90(6), 1986-1994. DOI.10.2527/jas.2011-3949
41. Thaiss, C. A., Zmora, N., Levy, M., & Elinav, E. (2016). *The microbiome and innate immunity. Nature, 535(7610)*, 65-74. DOI.10.1038/nature18847

42. Honda, K., & Littman, D. R. (2016). The microbiota in adaptive immune homeostasis and disease. *Nature, 535*(7610), 75-84. DOI.10.1038/nature18848
43. Bommineni, Y. R., Pham, G. H., Sunkara, L. T., Achanta, M., & Zhang, G. (2014). Immune regulatory activities of fowlicidin-1, a cathelicidin host defense peptide. *Molecular immunology*, *59*(1), 55-63. DOI.10.1016/j.molimm.2014.01.004
44. Den Hartog, G., De Vries-Reilingh, G., Wehrmaker, A. M., Savelkoul, H. F. J., Parmentier, H. K., & Lammers, A. (2016). Intestinal immune maturation is accompanied by temporal changes in the composition of the microbiota. *Beneficial microbes, 7*(5), 677-685. DOI.10.3920/BM2016.0047
45. Liu, S., Da Cunha, A. P., Rezende, R. M., Cialic, R., Wei, Z., Bry, L., ... & Weiner, H. L. (2016). The host shapes the gut microbiota via fecal microRNA. *Cell host & microbe, 19*(1), 32-43. DOI.10.1016/j.chom.2015.12.005
46. Kogut, M. H., & Arsenault, R. J. (2017). Immunometabolic phenotype alterations associated with the induction of disease tolerance and persistent asymptomatic infection of Salmonella in the chicken intestine. *Frontiers in immunology,(8)*, 372-380. DOI.10.3389/fimmu.2017.00372
47. Bene, K., Varga, Z., Petrov, V. O., Boyko, N., & Rajnavolgyi, E. (2017). Gut microbiota species can provoke both inflammatory and tolerogenic immune responses in human dendritic cells mediated by retinoic acid receptor alpha ligation. Frontiers in Immunology, 8, 427-435. DOI.10.3389/fimmu.2017.00427
48. Guo, C. J., Chang, F. Y., Wyche, T. P., Backus, K. M., Acker, T. M., Funabashi, M., ... & Fischbach, M. A. (2017). Discovery of reactive microbiota-derived metabolites that inhibit host proteases. *Cell*, *168*(3), 517-526. DOI.10.1016/j.cell.2016.12.021
49. Shi, N., Li, N., Duan, X., & Niu, H. (2017). Interaction between the gut microbiome and mucosal immune system. *Military Medical Research*, *4*, 1-7. DOI.10.1186/s40779-017-0122-9
50. Byndloss, M. X., Litvak, Y., & Bäumler, A. J. (2019). Microbiota-nourishing immunity and its relevance for ulcerative colitis. *Inflammatory bowel diseases*, *25*(5), 811-815. DOI.10.1093/ibd/izz004
51. Litvak, Y., & Bäumler, A. J. (2019). Microbiota-nourishing immunity: a guide to understanding our microbial self. *Immunity*, *51*(2), 214-224.DOI.10.1016/j.immuni.2019.08.003
52. Buffie, C. G., & Pamer, E. G. (2013). Microbiota-mediated colonization resistance against intestinal pathogens. *Nature Reviews Immunology, 13*(11), 790-801. DOI.10.1038/nri3535
53. Belkaid, Y., & Hand, T. W. (2014). Role of the microbiota in immunity and inflammation. *Cell*, *157*(1), 121-141.DOI.10.1016/j.cell.2014.03.011
54. Sassone-Corsi, M., & Raffatellu, M. (2015). No vacancy: how beneficial microbes cooperate with immunity to provide colonization resistance to pathogens. *The Journal of*

Immunology, *194*(9), 4081-4087. DOI.10.4049/jimmunol.1403169
55. Ducatelle, R., Goossens, E., De Meyer, F., Eeckhaut, V., Antonissen, G., Haesebrouck, F., & Van Immerseel, F. (2018). Biomarkers for monitoring intestinal health in poultry: present status and future perspectives. *Veterinary research*, *49*, 1-9. DOI.10.1186/s13567-018-0538-6
56. Hughes, E. R., Winter, M. G., Duerkop, B. A., Spiga, L., de Carvalho, T. F., Zhu, W., ... & Winter, S. E. (2017). Microbial respiration and formate oxidation as metabolic signatures of inflammation-associated dysbiosis. *Cell host & microbe*, *21*(2), 208-219. DOI.10.1016/j.chom.2017.01.005
57. Sommer, F., Anderson, J. M., Bharti, R., Raes, J., & Rosenstiel, P. (2017). The resilience of the intestinal microbiota influences health and disease. *Nature Reviews Microbiology*, *15*(10), 630-638. DOI.10.1038/nrmicro.2017.58
58. Zeng, M. Y., Inohara, N., & Nuñez, G. (2017). Mechanisms of inflammation-driven bacterial dysbiosis in the gut. *Mucosal immunology*, *10*(1), 18-26. DOI.10.1038/mi.2016.75
59. Arsenault, R. J., Lee, J. T., Latham, R., Carter, B., & Kogut, M. H. (2017). Changes in immune and metabolic gut response in broilers fed β-mannanase in β-mannan-containing diets. *Poultry Science*, *96*(12), 4307-4316. DOI.10.3382/ps/pex246
60. Scapini, L. B., de Cristo, A. B., Schmidt, J. M., Buzim, R., Nogueira, L. K., Palma, S. C., & Fernandes, J. I. M. (2019). Effect of β-Mannanase Supplementation in Conventional Diets on the Performance, Immune Competence and Intestinal Quality of Broilers Challenged With Eimeria sp. *Journal of Applied Poultry Research*, *28*(4), 1048-1057. DOI.10.3382/japr/pfz066

دور ميكروبات الأمعاء في تحسين الجهاز الهضمي للدجاج

ايمن عبدالله علي ,احمد نوزد توفيق
فرع الامراض وامراض الدواجن،كلية الطب البيطري ,جامعة الموصل ,العراق .

الخلاصة

تعتمد صحة الدجاج العامة وإنتاجيته بشكل كبير على صحة أمعائه. ويصف مدى جودة عمل الجهاز الهضمي والتفاعلات المعقدة التي لديه مع المجتمعات الميكروبية. من أجل تحسين الجهاز الهضمي للدجاج، يبحث هذا البحث في أهمية ميكروبات الأمعاء، مع تسليط الضوء على الطرق التي تدعم بها هذه الميكروبات الأداء والصحة ومقاومة الأمراض. الميكروبيوم المعقد الموجود في الأمعاء مهم للاستجابة المناعية والهضم وامتصاص العناصر الغذائية. من الأهمية بمكان فهم صحة الامعاء لأنه حتى في غياب أعراض المرض الواضحة، يمكن أن يكون لها تأثير مباشر على أداء الدجاج. يمكن تحقيق ذلك بعدد من الطرق، بما في ذلك تقديم نظام غذائي متوازن غني بالألياف والبروبيوتيك والبريبايوتيك. تشجع هذه العناصر نمو البكتيريا المفيدة، مما يعزز الصحة العامة والأداء للدجاج. يعتمد الجهاز الهضمي للدجاج على فلورا الأمعاء. يمكن لمربي الدواجن تحسين صحة وإنتاجية قطعانهم من خلال فهم وظيفتها ووضع تدابير وقائية للحفاظ على استقرار ميكروبات المزرعة.

الكلمات المفتاحية: صحة الأمعاء ,ميكروبات الأمعاء ,دجاج