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Effect of Nutritious Plant Extracts on Broiler Chicken Development and Bacterial Microorganisms

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Abstract:

This study examined the effects of 10% and 20% ginger and pomegranate peel extract on broiler chicken development and bacterial microbes. The experiment employed one-day-old male broiler chicks. In a totally randomized design, these hens were assigned to five nutrition treatment groups: 1. Control (base diet), 2. Pomegranate peel extract (10%, 20%), 4. Ginger extract (10%), 5. Ginger extract (20%). Each group had unlimited access to its diet for 5 weeks. The College of Agriculture of the esteemed University of Kerbala undertook this experiment. The extracts had antibacterial, antifungal, and antioxidant components, reducing harmful microorganisms and improving animal and human health. Plant extracts also improved development, boosted good bacteria, and decreased harmful bacteria. This implies that poultry diets might benefit from ginger and pomegranate peels.

Keywords: *broiler chicks, plant extracts, growth performance, bacteria.*

Introduction

Antibiotics have long been added to chicken feed with the intention of improving growth performance, reducing the number of certain harmful germs, and boosting beneficial microbes in the gut microbiota. However, it has recently been illegal to use antibiotics as growth promoters in animal diets due to the possibility of antibiotic-resistant human infections emerging (Butaye, et al, 2003). These days, research is being done on the possibility of replacing antibiotics in animal diets with innovative natural additions. Plant extracts are one type of such substitute. Numerous active ingredients may be found in plant extracts, such as essential oils, which have a broad variety of pharmacological effects (Lewis, et al, 2003), (Atallah, 2003). It has been shown that plant extracts lower the ideal pH value while raising the amount of lactic acid bacteria in the broiler chickens' ileum and caecal contents. However, there was a substantial drop in the counts of C. perfringens and coliform in the caecal contents (Vidanarachchi, et al, 2006). In addition to maintaining a balanced gut microbiota, stimulating beneficial bacteria like lactobacilli and bifid bacteria may be the best way to ensure that the immune system remains healthy and that pathogenic microbes are effectively prevented

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(Wang, et al, 2021). The biggest organ in the body, the gut, is in charge of digesting and absorbing food as well as acting as a barrier to selectively let nutrients and liquids into the body while keeping viruses and dangerous chemicals out (Groschwitz & Hogan, 2009). While several plants and their extracts have been suggested to be a viable alternative to antibiotic growth promoters, relatively few of them have been studied and their potential as sustainable and safe feed additives has not been explored. Thus, the goal of the current investigation was to ascertain whether any particular plant extracts would have an impact on gut microbiota, development of the digestive system, performance, and carcass features.

Materials and Methods

Experiment Site

This study was conducted in the poultry field situated within the College of Agriculture at the University of Kerbala during the period spanning from October to December in the year 2023.

Collection of Samples

One hundred and twenty-five day old broiler chicks were randomly allocated to five treatment diets and split into five treatment groups, each consisting of 25 birds. The groups were as follow: 1. Control (basal diet), 2. Pomegranate peel extract (at concentration 10%), 3. Pomegranate peel extract (at concentration 20%), 4. Ginger extract (at concentration 10%), 5. Ginger extract (at concentration 20%). Each group was fed ad libitum its own diet for a period of 5 weeks.

The body weight of the animals was determined individual at the end of the third and fifth weeks. For the purpose of determining the intestinal microflora contents, chickens from each treatment group had been killed at the conclusion of the experiment. Feces samples from the intestinal tract were collected quickly and dissolved with 1:10 deionized water before being subjected to culture studies. During counting, Used Plate count agar for total bacteria, Escherichia coli and Lactobacilli.

Microbiological Analysis of Samples

Following sample collection, two primary evaluations were carried out for bacteriological examination. 225 ml of 0.1% buffered peptone water was first added to a plastic container creating 25 g of chicken sample in order to check the sanitation of the chicken. From there, a homogenized suspension was created. Consequently, a 1:10 dilution of the sample was achieved, and in accordance with the International Organization for Standardization's 1995 guideline, several serial dilutions ranging from 10-2-10-13 were prepared subsequently. Bacteriological examination was performed on each of these samples to determine the total amount of bacteria, Escherichia coli, and lactobacilli. To determine the counts, 0.1 ml of the serial dilution was employed on duplicate plates that had been prepared. Spreading was then done. To transfer 0.1 ml of each tenfold dilution (102 - 1013) onto duplicate agar plates, a sterile micropipette was used for each dilution. Therefore, to determine the total amount of bacteria, Escherichia coli, and Lactobacilli, duplicate agar plates prepared using Nutrient agar (NA), MacConkey agar with crystal violet, as supplied by HIMEDIA® Pvt Ltd., India, were utilized. Using a sterilized glass spreader, the diluted samples were distributed as soon as possible throughout the plate's surface. For every plate, there was one sterile spreader utilized. Completing the counting, the plates were incubated for 24 hours at 37°C. The plates were classified as having too few (less than 30), too many (more than 300), or neither. To get the total count, the overall amount of colonies in each of the dilutions in each plate of agar was times multiplied by the dilution. The number of colony forming units (cfu) per gram of materials was used to express the overall bacterial count findings. After that, the bacterial counts were converted and shown as log 10 cfu/g of the sample (Harrigan & McCance, 2014).

Results

Table (1) displays the influence of supplemental plant extracts on the body weight of broiler chicks throughout weeks three and five of the experiment. At third week experiment, plant extract which did influence body weight efficiency of all treatment while in the fifth week experiment the plant extract which did influence only at 20% concentration of treatments. These results agree with results reported by (Botsoglou, et al, 2002), (Hernandez, et al, 2004).

Table 1. Effect of Dietary Plant Extracts on Body Weight of Broiler Chicks on Third and Fifth Week

Groups	Body weight (g) Mein / Standard error	
	At third week	At fifth week
Control	648 g / 15	2073 g / 5
Ginger extract 10%	858 g / 157.8 *	2273 g / 81.3
Ginger extract 20%	826 g / 145.7 *	2320 g / 57.2 *
Pomegranate peel extract 10%	784 g / 38.8 *	2178 g / 99.6
Pomegranate peel extract 20%	875 g / 6.6 *	2559 g / 220.5 *

Note: * Refer to a significant ($p \leq 0.05$) differences between treatments with control.

Among the numerous Lactobacillus species, the chicken-isolated L. salivarius exhibited superior in vitro antagonistic activity against a range of poultry pathogens, such as Salmonella spp. and E. coli (Aazami, et al, 2014), (AL-Abedy, et al, 2021). Table No. 2 shows some bacterial genera extracted from the intestines of broiler chickens. This shows that the treatments have reduced or prevented the appearance of some bacterial genera as a result of the antibacterial role that the plant extracts possess.

Table 2. Main Bacteria Isolated from the Small Intestinal of Chickens

Group	Genus and species
Control	Escherichia coli Salmonella enterica Enterobacter cloacae Citrobacter freundii Lactobacillus salivarius Pantoea spp
Ginger extract 10%	Pantoea spp Lactobacillus salivarius L. paracasei Escherichia coli
Ginger extract 20%	Lactobacillus salivarius Escherichia coli Citrobacter freundii
Pomegranate peel extract 10%	L. paracasei Lactobacillus salivarius Escherichia coli Citrobacter freundii
Pomegranate peel extract 20%	Lactobacillus salivarius Escherichia coli

Table 3. Concentrations of Microorganisms in Small intestine of Chickens at Fifth Week of Age (mean & SD).

Groups	Number of bacteria (CFU)		
	Total bacteria	Escherichia coli	*Lactobacilli*
Control	$76*10^6$	$86*10^4$	$64*10^4$
Ginger extract 10%	$63*10^5$ **	$15*10^4$ **	$37*10^5$ **
Ginger extract 20%	$42*10^4$ **	$32*10^3$ **	$12*10^6$ **
Pomegranate peel extract 10%	$86*10^5$ *	$24*10^4$ *	$39*10^5$ **
Pomegranate peel extract 20%	$71*10^5$ **	$42*10^4$ **	$17*10^5$ **

Note: * refer to a significant ($p \leq 0.05$) or** refer to a significant ($p \leq 0.01$) differences between treatments with control.

Discussion

The infectious dose of salmonellosis is approximately 103 to 105 bacilli by ingestion (Bronze & Greenfield, 2005). The research study presented here used an infectious dosage of E. coli of around 6 × 103 CFU (Cornick & Helgerson, 2005). The total count of bacteria, E. coli, and lactobacilli in the intestinal tract of 5-week-old broiler chicks are displayed in Table 3. The total number of bacteria, E. coli bacteria, and lactobacilli varied significantly between all addition and control treatment levels. In comparison to the control treatment, which recorded the greatest number of total bacteria and E. coli bacteria, the statistical analysis findings showed a substantial drop ($P < 0.01$) in the number of total bacteria and E. coli in all levels of addition. The treatments with the ginger extract (20%) and followed by the treatments with the ginger extract (10%) had the lowest concentrations of this bacteria. However, as compared to the control, the number of Lactobacilli bacteria rose considerably ($P<0.01$) in all additional treatments. The treatments showing the greatest increase in the number of bacteria were those that included ginger extract (20%) and pomegranate peel extract (10%). It is possible that the presence of inhibitory and other killing compounds in plant extracts, which work against numerous dangerous and insignificant bacteria, is the cause of microbial alterations in the small intestine's intestinal environment (Ghorbani, et al, 2013).

Numerous anti-bacterial, anti-fungal, and antioxidant compounds are present in ginger extract (Rahmani & Aly, 2014). Yadufashije et al. (2020) claim that because ginger extract prevents germs from growing in the human digestive system, it can be utilized to cure illnesses. These findings are consistent with those of Dosu et al. (2023), wherein at 5 weeks of age, the number of Lactobacilli bacteria significantly increased in the intestines of broilers fed feeds containing watercress leaves at levels (10 and 20%)% relative to the control, while the number of coliform bacteria (E. coli) decreased significantly ($P<0.05$). The amount of coliform bacteria (E. coli) in the broiler's gut was significantly reduced ($P <0.05$) by pomegranate peel extract, whereas the quantity of Lactobacilli bacteria increased significantly (Xu, et al, 2024).

Conclusion

It was determined that plant extracts used as nutritional supplements, particularly the peels of ginger and pomegranates, enhanced growth performance and the quantity of good bacteria while decreasing dangerous bacteria. It can be speculated that ginger and pomegranate peels could be valuable for supplementary nutritional use with traditional food in poultry diet.

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Conflict of Interests

No conflict of interest.

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