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# Effect of Liquorice (*Glycyrrhiza glabra*) on Growth Performance, Gut Morphometry and Economics of Broilers Production

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**Key words**
***Glycyrrhiza glabra*, Performance, Morphometry, Broilers, Economics**

## ABSTRACT

This study was conducted to examine the effect of liquorice (*Glycyrrhiza glabra*) extract on growth performance, gut morphometry, and economics in broilers. One hundred and twenty days old broiler chicks were used for the experiment and were divided into four groups each with three replicates of ten birds. Group 1 was control with normal water while 1, 1.5, and 2ml/liter of liquorice extract (LE) in drinking water were provided to the remaining three groups. The results showed significantly reduced feed consumption, increased weight gain, and better FCR in 2ml/l of LE group. Similarly, 2ml/l of LE group showed increased ($P<0.05$) villus height, crypt depth, villus width, and villus height to crypt depth ratio. The digestibility of dry matter, ash, crude fiber, crude protein, ether extract, and calcium was also calculated significantly higher in the 2ml/l of LE group. Total cost in the control group while the gross and net return was recorded significantly higher in the group containing 2ml/l of LE. The dressing percentage had a significantly higher value in 1.5, and 2ml/l of LE groups than in the remaining treatment groups. Mortality was recorded significantly higher in 1 ml/l of LE group as compared to all other groups. It was concluded that liquorice extract at 2ml/l water has a useful effect on growth performance, gut morphology, and economics in broilers.

## INTRODUCTION

Medicinal herbs, spices, and aromatic plants play essential roles in making food taste, smell, and look better and also have health benefits for people and animals (Abd-El-Hack and Alagawany, 2015; Abd-el-Hack *et al*., 2018, 2020a, b). Individuals in the livestock industry are becoming more interested in these plants because they have qualities that can improve the quality of the final products from poultry, such as the carcass and meat quality (Abdelnour *et al*., 2018; Alagawany *et al*., 2018a, b; Saeed *et al*., 2018; Velmurugan *et al*., 2018). This article is about *Glycyrrhiza glabra*, a member of the Fabaceae (legume) family. It has been used for over 4,000 years in traditional medicine (Shebl *et al*., 2012). Liquorice has been reported to have immunomodulatory, antihelicobacter, antimicrobial, antioxidative, anti-atherosclerotic, antifungal, anti-inflammatory, estrogen-like, antiviral, antinephritic, anti-infective, and radical scavenging properties (Myandoab and Hosseini, 2012; Alagawany

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*et al*., 2018; Seidavi *et al*., 2021). The main components of liquorice extract (LE), according to phytochemical analysis, are flavonoids (like liquiritin, formononetin, and isoflavonoids), triterpene saponins (like glycyrrhetinic acid, glycyrrhizin, and licorice acid), starch, sugars, amino acids, tannins, ascorbic acid, choline, phytosterols, and coumarins (Shalaby *et al*., 2004). Researchers (Račková *et al*., 2007; Suchitra and Shakunthala, 2014; Parvaiz *et al*., 2014; Alagawany *et al*., 2019a) have found that liquorice and its active ingredients have several pharmacological effects on livestock like immunomodulatory, antioxidant, antiviral and anti-inflammatory activity. Adding liquorice to the diets of chickens has been shown to make them more productive, however, adding liquorice to drinking water is still in its early stages and needs to be investigated more. Therefore, this study was conducted to determine the effect of liquorice (*Glycyrrhiza glabra*) extract on growth performance, gut morphometry, and economics in broilers.

## MATERIALS AND METHODS

*Collection and processing of* Glycyrrhiza glabra

The experiment was carried out at the Department of Poultry Science and samples analysis was performed at the pathology laboratory of the College of Veterinary Science, Faculty of Animal Husbandry and Veterinary Science, the University of Agriculture Peshawar. Liquorice roots were purchased from the local market and identified by the medicinal plant experts in the Department of Botany at the University of Peshawar. The method described by Myandoab and Hosseini (2012) and Hanafy (2022) was followed with a few modifications for the processing. The liquorice roots were dried and ground into powder before being used for extraction. After that, four grams of the final product were suspended in 100ml of sterile distilled water, maintained at 37°C for 24 h, and then incubated for eight h at room temperature while being mixed by a magnetic mixture. In the next step, the suspension was kept at room temperature for 18 h. The finished mixture was filtered through a 0.45µL filter and stored at 4°C until needed (Ghannad *et al*., 2014).

*Experimental design and diets*

A total of 120 days old broiler chicks were obtained from the local market for the research trial. The birds were split into four groups each with three replicates and ten birds per replicate. Group 1 was control only with normal water without the addition of LE while the other three groups were offered with 1ml/l, 1.5 ml/l, and 2ml/l, respectively, of LE in drinking water. Based on the NRC (1994), the experimental basal diet was made to meet the requirements of broilers. The feed and water were given *ad-libitum* to the experimental birds from days 1 to 35. The light was provided for twenty-four h. The duration of the experiment was five weeks. Biosecurity was maintained for all the animals to prevent the spread of illnesses e.g., visitors were not allowed, wild animal protection, etc.

*Data collection*

Feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) were calculated according to the formula used by Shuaib *et al*. (2022a). Mortality was recorded on daily basis. Post-mortem examinations of dead birds were performed to rule out any disease or lesions. The dressing percentage was calculated with the help of the formula e.g.,

Dressing percentage= dressed weight/live weight x 100

The nutrient digestibility was calculated according to the procedure explained by Shuaib *et al*. (2022a, b) and Hafeez *et al*. (2020). Two chicks from each treatment were collected at five weeks and maintained in a separate cage for feces collection and digestibility testing. Fresh morning faces were collected, weighed, and dried for three days. The dried excreta were analyzed, and then the digestibility was calculated. The following formula was used to determine nutrient digestibility:

Apparent nutrient digestibility (%) = nutrient intake – nutrient output/ nutrient intake × 100.

Gut morphometry was determined according to the method explained by Shuaib *et al*. (2022). A bird from every replicated group was randomly selected on the last day of the experiment and slaughtered. After that, its gastrointestinal tract was removed. A small piece was cut from the ileum portion of the small intestine and was used for the morphological measurement. Input and out costs were worked out to determine the economic parameters.

*Statistical analysis*

A completely randomized design (CRD) was used to assess the experimental data. Analysis of variance (ANOVA) was performed using software statistics 8.1. The Graph Pad Prism 8 software (San Diego, CA, USA) was used to make histograms.

## RESULTS

Results regarding the effect of the addition of liquorice in water on FI, BWG, and FCR are shown in Table I. FI had a significantly higher value in the control group while the BWG and FCR (better) were calculated significantly higher in the 2ml/l of LE group. The effect of LE on-dressing percentage is presented in Figure 1. 1 ml/l of LE group produced a significantly higher dressing percentage, though not significantly different from group containing 2ml/l of LE.

**Table I. Effect of liquorice (*Glycyrrhiza glabra*) in water on feed intake, weight gain and feed conversion ratio in broilers. The values are in Mean±SD.**

| Parameters | Week | Control | Liquorice treatments | | | P value |
|---|---|---|---|---|---|---|
| | | | 1.0 ml/l | 1.5 ml/l | 2 ml/l | |
| Feed intake (g) | 2nd | 395.7±4.04 | 391.6±4.43 | 388.4±4.47 | 384.8±4.97 | 0.103 |
| | 3rd | 645±2.57[a] | 640.4±2.33[ab] | 635.8±2.92[bc] | 631.5±2.37[c] | 0.001 |
| | 4th | 861.4±3.40[a] | 858.4±2.75[ab] | 853.4±2.43[bc] | 849.2±2.91[c] | 0.003 |
| | 5th | 1030±2.87[a] | 1025.1±2.99[a] | 1017±2.83[b] | 1009.7±2.37[c] | 0.000 |
| | Overall | 2932±2.32[a] | 2915.6±2.25[b] | 2894.3±2.69[c] | 2875±2.74[d] | 0.000 |
| Weight gain (g) | 2nd | 283.1±3.00[b] | 284.7 ± 3.42[ab] | 287±2.93[ab] | 289.7±3.50[a] | 0.149 |
| | 3rd | 385.0±2.88[b] | 387.2± 2.83[b] | 389.5±3.33[ab] | 393.5±2.23[a] | 0.031 |
| | 4th | 473.1±2.93[c] | 475.0±2.88[bc] | 479.1±2.96[ab] | 482.1±2.89[a] | 0.021 |
| | 5th | 561.1±2.94[c] | 564.1±2.95[bc] | 568.5±3.40[ab] | 573.2±2.89[a] | 0.006 |
| | Overall | 1701.5±2.99[d] | 1711±2.87[c] | 1723.7±3.39[b] | 1738±3.49[a] | 0.000 |
| FCR | 2nd | 1.39±0.06 | 1.37±0.02 | 1.35±0.03 | 1.32±0.03 | 0.217 |
| | 3rd | 1.67±0.03[a] | 1.65±0.02[a] | 1.63±0.02[ab] | 1.60±0.02[b] | 0.029 |
| | 4th | 1.82±0.02[a] | 1.80±0.03[ab] | 1.78±0.01[bc] | 1.76±0.01[c] | 0.026 |
| | 5th | 1.83±0.03[a] | 1.81±0.03[ab] | 1.78±0.01[bc] | 1.76±1.14[c] | 0.034 |
| | Overall | 1.72±0.01[a] | 1.70±1.13[a] | 1.67± 0.01[b] | 1.65±0.01[b] | 0.002 |

The values in the same row that don't have the same superscript differ (P<0.05).

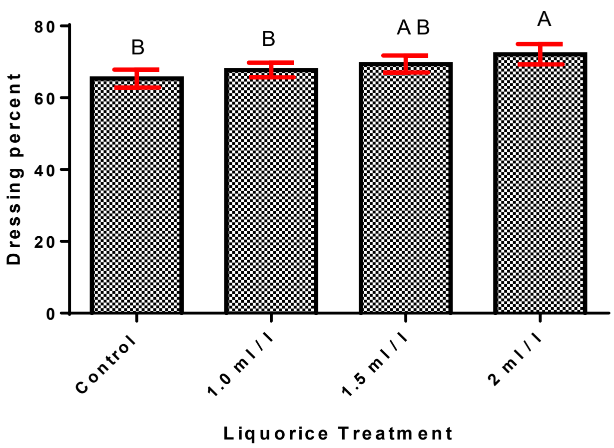


Fig. 1. Effect of liquorice (*Glycyrrhiza glabra*) in water on percentage of dressing in broilers.

Similarly, there was no significant difference between the yield of control and 1.5ml/l of LE group, even though control group yield was lower than all the other groups. The impact of adding liquorice in water on nutrient digestibility is presented in Table II. The digestibility of dry matter, ash, crude fiber, crude protein, ether extract, and calcium was calculated significantly higher in 2ml/l of LE group. The results related to the intestinal histomorphology and economics are indicated in Table III. The results show that birds' intestinal ileum morphology is affected significantly by the administration of liquorice water. 2ml/l of LE group showed increased (P<0.05) villus height, crypt depth, villus width, and villus height to crypt depth ratio than the remaining groups. Gross return and net return per chick were calculated significantly higher for group containing 2ml/l of LE. Results regarding the bird's mortality are shown in Figure 2. The highest significant mortality of the birds was calculated in 1ml/liter of LE group as compared to all other groups.

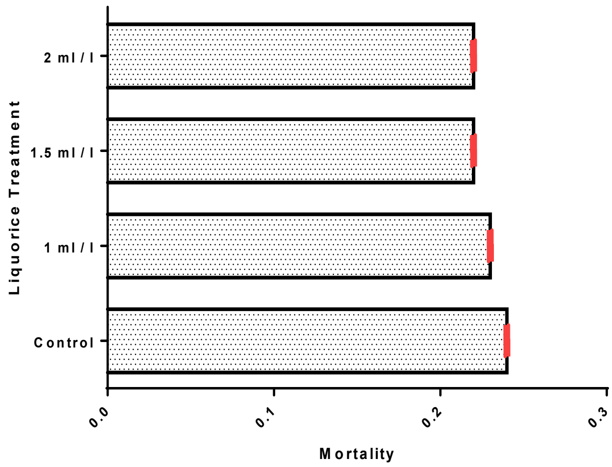


Fig. 2. Effect of liquorice (*Glycyrrhiza glabra*) in water on broilers mortality.

**Table II. Effect of liquorice (*Glycyrrhiza glabra*) in water on nutrient digestibility in broilers. The values are in Mean±SD.**

| Parameters | Control | Liquorice treatments | | | P value |
|---|---|---|---|---|---|
| | | 1.0 ml/l | 1.5 ml/l | 2 ml/l | |
| DM | 62.34±3.39$^{c}$ | 66.36±3.49$^{bc}$ | 71.40±3.42$^{ab}$ | 75.39±3.48$^{a}$ | 0.012 |
| Ash | 43.40±3.44$^{b}$ | 45.37±4.48$^{b}$ | 49.33±3.44$^{ab}$ | 53.49±3.29$^{a}$ | 0.042 |
| CP | 56.33±3.39$^{b}$ | 59.65±4.08$^{ab}$ | 61.45±3.34$^{ab}$ | 65.44±3.48$^{a}$ | 0.145 |
| CF | 62.51±2.49$^{b}$ | 65.40± 3.29$^{b}$ | 67.35±2.45$^{ab}$ | 72.47$^{a}$±3.38 | 0.018 |
| EE | 53.37±3.49$^{b}$ | 57.48±3.43$^{ab}$ | 59.34±2.43$^{a}$ | 61.97±2.94$^{a}$ | 0.049 |
| Ca | 28.71±3.99$^{b}$ | 32.75±3.69$^{ab}$ | 33.37±2.39$^{ab}$ | 37.35±4.12$^{a}$ | 0.073 |

The values in the same row that don't have the same superscript differ (P<0.05). DM, dry matter; CP, crude protein; CF, crude fibre; EE, ether extract; Ca, calcium.

**Table III. Effect of liquorice (*Glycyrrhiza glabra*) in water on intestinal morphology (ileum) and economic in broilers. The values are in Mean±SD.**

| Parameters | Control | Liquorice treatments | | | P value |
|---|---|---|---|---|---|
| | | 1.0 ml/l | 1.5 ml/l | 2 ml/l | |
| Villus height (µm) | 1275.4±1.4$^{d}$ | 1297.3±1.40$^{c}$ | 1311.3±1.40$^{b}$ | 1325.4±1.40$^{a}$ | 0.001 |
| Crypt depth (µm) | 212.3±6.41$^{c}$ | 204.3±5.03$^{b}$ | 195.67±5.42$^{ab}$ | 183.34±5.03$^{a}$ | 0.001 |
| Villus width (µm) | 168.0±5.54$^{b}$ | 177±6.48$^{b}$ | 189.40±6.48$^{a}$ | 199.7±5.93$^{a}$ | 0.001 |
| Villus height: Crypt depth | 6.31±1.41$^{b}$ | 7.52±1.30$^{b}$ | 8.34±1.36$^{ab}$ | 10.41±1.41$^{a}$ | 0.035 |
| Cost (Pak Rs) | 345.49±2.43$^{a}$ | 339.40±2.43$^{b}$ | 333.54±2.37$^{c}$ | 327.4±329$^{d}$ | 0.001 |
| Gross return (Pak Rs) | 370.18±2.09$^{c}$ | 374.85±1.38$^{b}$ | 379.20±1.94$^{a}$ | 381.5±1.55$^{a}$ | 0.001 |
| Net return (Pak Rs) | 24.60±2.43$^{d}$ | 35.46±2.41$^{c}$ | 45.58±2.39$^{b}$ | 54.42±2.26$^{a}$ | 0.002 |

The values in the same row that don't have the same superscript differ (P<0.05).

## DISCUSSIONS

The current study indicated significantly improved feed intake, body weight gain, and FCR in the liquorice-supplemented groups. On the other hand, the feed intake and corresponding weight gain were significantly decreased in the control group. Indeed, due to its chemical components, liquorice acts as an immunomodulator (due to its low molecular weight exhibit anticancer and immunomodulatory activities by suppressing tumor growth) and maintains the correct gastrointestinal status, increasing the animal's immune system (Alagawany *et al.*, 2019a, b), thus improving growth performance of birds. Therefore, the beneficial effects of phytogenic extracts on poultry growth in this study may be due to the ability of liquorice to improve digestibility, gut microflora, and digestive enzyme secretion. Similarly, Grieve (2013) reported that liquorice stimulates appetite and digestion and improves blood flow through gut mucous membranes, boosting nutrient absorption. Hosny *et al.* (2020) in quail, and Hassan and Lashin (2017) in chicken found that the body weight of the study animal improved as the quantity of licorice in its diet went up, compared to the control group. Also, Al-Daraji (2012) found that adding LE to drinking water at a level of 450 mg/l increased body weight gain and total body weight by a lot. Furthermore, Al-Daraji (2012) found that adding different amounts of licorice powder to the diets of broilers led to much more weight gain than in the control group. On the other hand, some research showed that the body weight of birds that used licorice or drank water with licorice did not change much compared to the body weight of untreated birds (Moradi *et al.*, 2014; Naser *et al.*, 2017). In the current study, the highest feed conversion ratio value and the dressing percentage, was observed in the group with 2ml/l liquorice in water and this may be because the liquorice root powder supplement in the water made the water taste better the animals, which probably increased the activity of microorganisms in the chicken's digestive tract. This, in turn, made it easier for the animals to eat dry matter in the experiment, which made the beneficial bacteria work more effectively (Meng *et al.*, 2006). The food conversion efficiency indicated that it is the active substance in this plant, which led to increased animal feed and body weight utilization and, therefore, feed conversion (Muhammad and Oloyede, 2010). This is in agreement with Towaje *et al*. (2020) who showed that using 7.5% raw liquorice powder improved chicken's feed ratio and dressing percentage and the same author also found that the licorice powder improved the chemical analysis of meat by more moisture and less fat. Al-Daraji study illustrated that Fawbro broiler chicks receiving drinking water with 450mg/l liquorice extract significantly increased the dressing percentage when measured with or without giblets.

Similarly, Alagawany *et al*. (2019) found that due to the presence of active molecules, particularly those of the isoflavonoid class of chemicals, liquorice may be able to enhance the function of the immune system. In the current study, ash content, dry matter, and crude fiber were found significantly higher as compared to the control group. The only justification for this improvement may be that liquorice supplemented in animal rations may stimulate cellulose-degrading bacteria, thus, increasing crude fiber digestibility. This result is consistent with the previous findings (Hassanat *et al*., 2017; Benchaar *et al*., 2007; Hassan and Abdel-Raheem, 2013; Wei *et al*., 2016), who reported improved crude fiber digestibility in their studies. Additionally, Akanmu and Hassen (2017) determined that plant extracts improved the digestibility of fat and overall dry matter. The glycyrrhizin found in *Glycyrrhiza glabra* is considered to stimulate mechanisms of peripheral sensory innervation in the cavities of the nose and mouth. It stimulates the gastrointestinal tract (GIT) to receive the feed and motility of the GIT and secretions of the stomach for better digestion of diet ingredients (Kheravii *et al*., 2018). From these data, it could be observed that the beneficial impact of liquorice in improving feed efficiency and digestion could be through providing a better environment for the absorption of nutrients, thus, the improvement of dry matter, ash content. Regarding the economic part, the supplementation of *Glycyrrhiza glabra* in drinking water was found to be beneficial for the group who received it in the current study. This positive effect may be attributed to the significant positive effects on daily weight gain and feed conversion ratio throughout the growing period. Indeed, the chicken industry's biggest concern is epidemiological diseases, which mostly affect the respiratory, digestive, and immunological systems cause diseases in them and increase the cost per chick by controlling the disorders (Hafez and Attia, 2020). Flavonoids and glycyrrhizin are two bioactive components that are effective in treating disorders such as the liver, immune system, and lungs (Alagawany *et al*., 2019b). Hence controlling the diseases using liquorice (*Glycyrrhiza glabra*) in the water reduces the cost and increases the net return (Saeed *et al*., 2019).

## CONCLUSION AND RECOMMENDATION

It is concluded from the current study that liquorice extract at 2ml/l drinking water reduced feed consumption, increased weight gain, improve FCR, and enhanced ileum morphology and was also feasible economically. Therefore, liquorice extract at 2ml/l in drinking water is recommended for broiler production.

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*IRB approval*

The experimental work was approved by the board of studies (September 2022) conducted at the Department of Poultry Science, Faculty of Animal Husbandry and Veterinary Sciences (FAHVS), The University of Agriculture Peshawar, KP, Pakistan.

*Ethical statement*

The experiment was approved by the ethical committee of the Faculty of Animal Husbandry and Veterinary Sciences (FAHVS), The University of Agriculture Peshawar before practical execution of this experiment.

*Statement of conflict of interest*

The authors have declared no conflict of interest.

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