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RESEARCH ARTICLE

Effect of Dietary Ginger Powder Levels on Growth and Production Performance of Broiler Chickens

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ABSTRACT

The authors have assessed the impact of various concentrations of ginger powder (*Zingiber officinale*) in diets on the growth and production efficiency of broiler chickens. Four dietary treatments were designed, T1 (control, 0% ginger), T2 (0.5% ginger), T3 (1.0% ginger), and T4 (1.5% ginger), were randomly allocated 120 day-old Cobb-500 chicks in total, three replicates of 10 each. The birds were kept at the state of 42 days under normal management conditions. Growth performance parameters like body weight, body weight gain, and average daily gain (ADG) were recorded on weekly basis and production performance parameters like feed intake, feed ratio (FCR) and mortality rate were also recorded. The findings revealed that diet supplementation of ginger powder increased growth and production performance and that, birds fed 1.0% ginger powder (T3) recorded the highest final body weight (2250.8 ± 30.2 g), total body weight gain (2208.6 ± 29.8 g), and optimal FCR (1.70 ± 0.02). Ginger supplemented groups had a minor increase in feed intake and lower mortality than the control. Birds fed more ginger (1.5%) or less (0.5%) were also found to have improvements yet they were not as effective as 1.0% inclusion. To sum up, Ginger 1.0% powder supplementation to the broiler diets improved both growth performance and feed ratio, reduced mortality, which indicates that ginger has the potential to be used as a natural substitute to antibiotic growth promoters in production of broilers.

1. Introduction

One of the fastest expanding industries of poultry across the globe is broiler chicken production that offers a cheap and a good quality source of animal protein to the fast-growing population of humans. The production of broilers requires a lot of efficient feeding on nutrition, sound management as well as feeding with feed additives that are known to stimulate growth and production performance [1]. Historically, the use of antibiotic growth promoters (AGPs) in the poultry diet has been common with an aim of enhancing the feed efficiency, growth and disease control [2]. Nonetheless, with the growing apprehensions regarding antibiotic resistance and contamination of poultry products with the residues, the use of antibiotics as animal feeds has been limited or prohibited in most countries. The use of natural substitutes, particularly herbs, spices, and plant-based feed additives to enhance the performance of poultry, has generated increased interests.

One of these natural additives that have received a significant amount of attention is ginger (*Zingiber officinale*) because of its medicinal and nutritional benefits [3]. Ginger is a familiar medicinal plant, which has various biologically active chemicals, which include *gingerols*, *shogaols* and *Zingiberene* [4]. The compounds have antimicrobial, antioxidant, anti-inflammatory and digestive stimulant effects. Ginger in poultry nutrition was found to promote the activity of digestive enzymes, gut welfare, and the appetite, which can be used to potentially increase growth performance of broiler chicken [1]. Moreover, it is possible that ginger can be used to suppress the number of pathogenic microorganisms that exist in the digestive system, which can increase the availability of nutrients and productivity [2].

The introduction of herbal feed supplements like ginger powder in broiler feed has been proposed as a safe and efficient alternative to feed growth promoters which are synthetic [3]. Past researches have shown that ginger diets can enhance body weight gain, feed intake and feed ratio of broilers. In addition to this, the antioxidant effect of ginger can improve immune systems and decrease oxidative stress in birds and result in their better health and efficiency in production [5]. The use of ginger supplementation should however be effective depending on the level of the supplementation in the diet, the age of the birds, and the management conditions [6]. It is thus significant to find the best amount of dietary ginger powder to optimize its positive effects without impacting on feed palatability or nutrient balance in a negative way [4]. The determination of various levels of inclusion can be used to determine the most efficient dosage of inclusion in enhancing growth and production performance of broiler chicken. Hence, the current experiment aimed at determining the influence of various amounts of ginger powder in diets on the growth performance and production performance of broilers. This study can be used in the establishment of natural and sustainable feeding plans to enhance poultry production and dependence on the antibiotic growth promoters.

2. Materials and Methods

2.1. Experimental Site

This was carried out at Poultry Research Unit on the Gomal University DIKhan. This experiment was conducted under normal management and hygienic environment to test the impact of ginger powder on growth and production of broiler chickens on diet.

2.2 Management and Experimental Birds

The broiler chicks (Cobb-500) that were obtained in this study were 120 day-old and purchased at a commercial hatchery. At the start of the experiment, the chicks were weighed each and divided into four groups of dietary treatments each having three replicas consisting of 10 birds each.

The birds were reared in a well-ventilated poultry house where there was a similarity in environmental and management conditions. During the experiment period, feed and clean drinking water was offered at will. Normal vaccination and health management procedures were adhered to as per the recommended poultry management practices. The trial took a period of 42 days.

2.3 Diets and Treatments that are Experimental

A diet was designed based on the nutrient needs of broiler chicken as per the standard poultry feeding (Table 1). The ginger rhizomes were dried, ground to a fine powder and added to the basal diet at varying rates. The birds were allocated to the following diets: T1 (Control): Basal diet that is not added with ginger powder; T2: Basal diet + 0.5% ginger powder; T3: Basal diet + 1.0% ginger powder; T4: Basal diet + 1.5% ginger powder.

Table 1. Composition of Basal Diet for Broiler Chickens

S. No	Ingredients	Starter Diet (%) (Day 0–21)	Finisher Diet (%) (Day 22–42)
1.	Maize	54.00	58.00
2.	Soybean Meal	36.00	32.00
3.	Fish Meal	4.00	3.00
4.	Vegetable Oil	3.00	3.50
5.	Dicalcium Phosphate	1.50	1.50
6.	Limestone	1.00	0.90
7.	Salt (NaCl)	0.30	0.30
8.	Vitamin & Mineral Premix*	0.20	0.20
9.	Methionine	0.30	0.30
10.	Lysine	0.20	0.20
11.	**Total**	100	100

**Vitamin and mineral premix supplied per kg of diet: Vitamin A 12,000 IU, Vitamin D3 3,000 IU, Vitamin E 20 mg, Vitamin K3 2 mg, Vitamin B1 2 mg, Vitamin B2 6 mg, Vitamin B6 4 mg, Vitamin B12 0.01 mg, Folic Acid 1 mg, Niacin 20 mg, Biotin 0.05 mg, Choline 500 mg, Fe 80 mg, Zn 70 mg, Mn 80 mg, Cu 8 mg, I 1 mg, Se 0.3 mg.*

2.4 Body Weight

At the start of the experiment the initial body weight of each and every chick was measured by the use of a digital weighing scale. Subsequently, the weight of the birds was recorded weekly at the end of every replicate (day 42). At the end of the trial, the final body weight was taken. Based on these records, the body weight increase of each group of treatment was determined by calculating the difference between the starting body weight and the final body weight.

2.5 Feed Intake

The quantity of feed that was supplied to each replicate group was weighed on a daily basis and the remaining feed was weighed the next day. The quantity of feed fed upon minus the quantity of feed refused was the calculus of the amount of feed intake. The mean feed intake per bird was then calculated by dividing the total feeds intake by the number of birds per replicate.

2.6 Feed Conversion Ratio (FCR)

The ratio of feed to conversion was computed to identify efficiency with which the birds used the feed to gain body weight. The following formula was used to calculate it:

FCR = total feed intake(g)/ total body weight gain (g).

The lesser the FCR values, the higher the efficiency of feeding and production.

2.7 Mortality Rate

Daily monitoring of birds was done during the experimental period. Any mortality was noted instantly and mortality percentage of each treatment group was computed at the conclusion of the experiment.

2.8 Average Daily Gain (ADG)

To ascertain the rate of growth of the birds on a daily basis, average daily gain was computed. It was calculated by taking the total body weight gain divided by the days of the experiment.

ADG =kg/gain of body weight/ number of experimental days.

All the data collected were well noted and tabulated to be analyzed further statistically to establish the impact of dietary ginger powder on the growth and production performance of broiler chicken.

2.4 Data Collection

The growth and production performance of broiler chicken data was recorded during the experimental period to determine the impact of the various levels of ginger powder in dietary content. The measures were taken weekly according to the standard poultry research methods.

3. Results

3.1 Growth Performance

Body weight of broiler chickens rose gradually every week in all the treatment groups (Table 2). Birds that received 1.0% ginger powder (T3), were always found to have the highest body weight at every time interval. Finally, body weight (2250.8 30.2 g) of T3 as compared to that of T1 (control 2050.4 25.1 g), T2 (2145.6 28.3 g), and T4 (2195.5 27.4 g) was found to be greater at the end of week 6. In line with this, T3 recorded the highest weekly and total body weight gain thus showing that moderate ginger powder supplementation promoted growth performance (Table 4 and Figure 1).

Figure 1. Weekly Body Weight Gain (g/bird) of Broiler Chickens Fed Different Levels of Ginger Powder

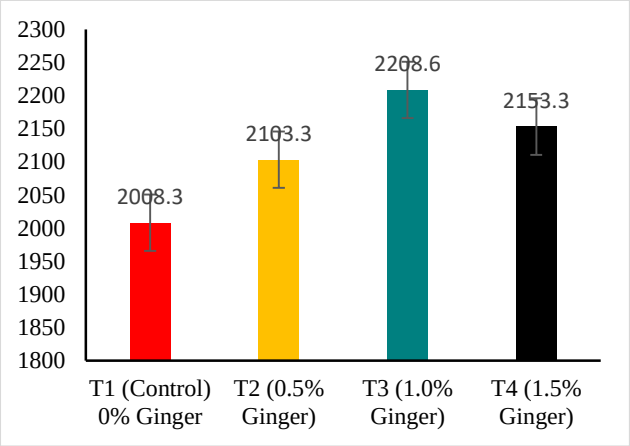


Figure 2. Weekly Feed Intake (g/bird) of Broiler Chickens Fed Different Levels of Ginger Powder

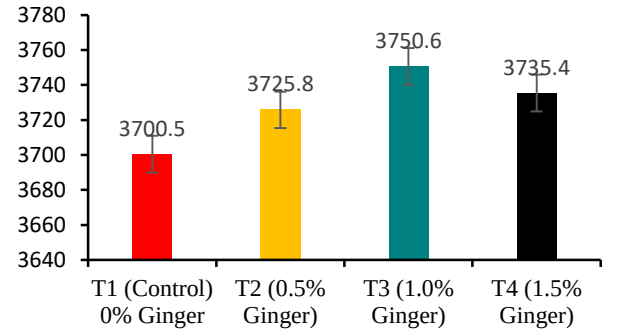
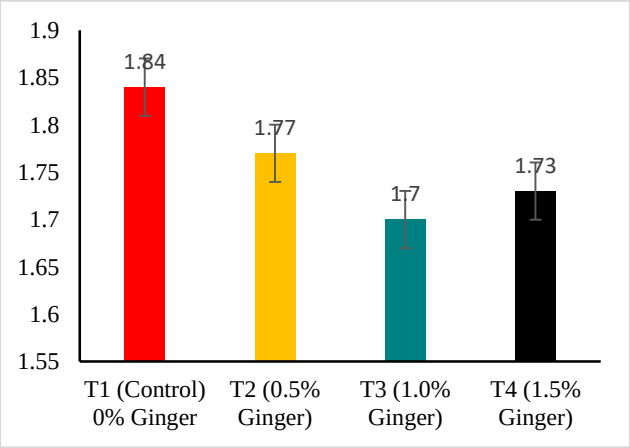


Figure 3. Weekly Feed Conversion Ratio (FCR) of Broiler Chickens Fed Different Levels of Ginger Powder

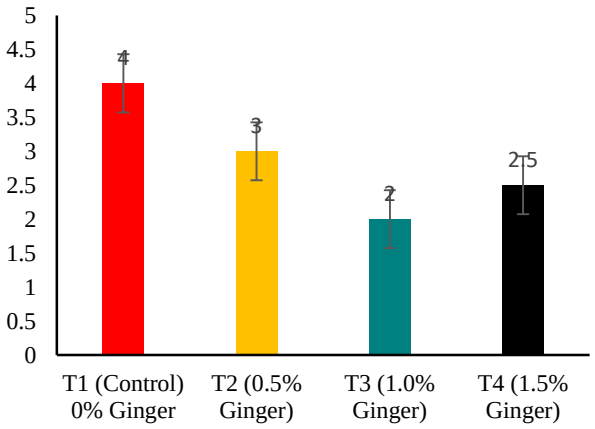


3.2 Feed Intake

There was an age-related rise in the intake of feed in all groups (Table 3 and Figure 2). Birds fed the GER diets (T2, T3, T4) had a somewhat higher feed consumption than the control group with T3 having the highest total feed intake

(3750.6 +40.5 g/bird). This indicates that ginger powder could have increased appetite and feed palatability.

Figure 4. Mortality Rate (%) of Broiler Chickens Fed Different Levels of Ginger Powder



3.3 Feed Conversion Ratio (FCR)

The values of weekly and total FCR (Table 5 and Figure 3) reveal that supplementation with ginger enhanced feed efficiency. The lowest overall FCR (1.70 + 0.02) was recorded by birds in T3, with a better feeding to body weight conversion. T1 (control) recorded the highest FCR (1.84 ± 0.03), which means an inefficient use of feed. These findings confirm that the use of ginger powder in the diet improves nutrient intake and growth productivity.

3.4 Mortality

There was no difference in mortality in all of the treatment groups during the experiment (Table 6 and Figure 4). The overall mortality rate was the highest in T3 (2.0%), and a little bit in T1 (4.0%). The decreased death rates in ginger-enriched groups could be attributed to the antimicrobial and immune- boosting effect of ginger, which led to the improved health and survival of the birds.

Table 2. Weekly Body Weight (g) of Broiler Chickens Fed Different Levels of Ginger Powder

Week	T1 (Control) 0% Ginger	T2 (0.5% Ginger)	T3 (1.0% Ginger)
Week 1	165.4 ± 3.2	168.7 ± 3.5	170.2 ± 3.1
Week 2	420.6 ± 8.5	435.2 ± 9.1	448.8 ± 8.7
Week 3	825.7 ± 15.4	860.3 ± 16.2	895.6 ± 17.0
Week 4	1250.8 ± 22.6	1315.5 ± 24.3	1380.2 ± 25.1
Week 5	1685.3 ± 28.7	1765.8 ± 30.2	1855.4 ± 32.6

Table 3. Weekly Feed Intake (g/bird) of Broiler Chickens Fed Different Levels of Ginger Powder

Week	T1 (Control) 0% Ginger	T2 (0.5% Ginger)	T3 (1.0% Ginger)	T4 (1.5% Ginger)
Week 1	155.4 ± 4.1	158.6 ± 4.3	160.2 ± 4.5	159.3 ± 4.2
Week 2	365.7 ± 8.2	372.4 ± 8.5	378.6 ± 8.7	375.5 ± 8.4
Week 3	610.3 ± 12.6	620.8 ± 13.1	630.5 ± 13.4	625.2 ± 13.0
Week 4	815.6 ± 16.3	828.7 ± 17.0	840.4 ± 17.5	835.1 ± 17.2
Week 5	965.2 ± 18.8	978.5 ± 19.4	990.7 ± 19.9	985.3 ± 19.5
Week 6	788.3 ± 15.2	802.6 ± 15.8	810.2 ± 16.1	805.4 ± 15.9

Table 4. Weekly Body Weight Gain (g/bird) of Broiler Chickens Fed Different Levels of Ginger Powder

Week	T1 (Control) 0% Ginger	T2 (0.5% Ginger)	T3 (1.0% Ginger)	T4 (1.5% Ginger)
Week 1	123.3 ± 3.1	126.4 ± 3.2	128.0 ± 3.0	127.3 ± 3.1
Week 2	255.2 ± 6.0	266.5 ± 6.3	278.6 ± 6.5	271.0 ± 6.2
Week 3	405.1 ± 8.4	425.1 ± 8.9	446.8 ± 9.3	434.9 ± 9.0
Week 4	425.1 ± 9.2	455.2 ± 9.8	484.6 ± 10.1	470.2 ± 9.6
Week 5	434.5 ± 9.6	450.3 ± 10.2	475.2 ± 10.5	460.1 ± 10.1
Week 6	365.1 ± 8.5	379.8 ± 8.9	395.4 ± 9.1	389.8 ± 8.8

Table 5. Weekly Feed Conversion Ratio (FCR) of Broiler Chickens Fed Different Levels of Ginger Powder

Week	T1 (Control) 0% Ginger	T2 (0.5% Ginger)	T3 (1.0% Ginger)	T4 (1.5% Ginger)
Week 1	1.26 ± 0.03	1.25 ± 0.03	1.25 ± 0.02	1.25 ± 0.03
Week 2	1.43 ± 0.04	1.40 ± 0.04	1.36 ± 0.03	1.38 ± 0.03
Week 3	1.51 ± 0.05	1.46 ± 0.04	1.41 ± 0.04	1.44 ± 0.04
Week 4	1.92 ± 0.06	1.82 ± 0.05	1.73 ± 0.05	1.77 ± 0.05
Week 5	2.22 ± 0.07	2.17 ± 0.06	2.08 ± 0.06	2.14 ± 0.06
Week 6	2.16 ± 0.06	2.11 ± 0.06	2.05 ± 0.05	2.07 ± 0.05

Table 6. Mortality Rate (%) of Broiler Chickens Fed Different Levels of Ginger Powder

Week	T1 (Control) 0% Ginger	T2 (0.5% Ginger)	T3 (1.0% Ginger)	T4 (1.5% Ginger)
Week 1	0.0	0.0	0.0	0.0
Week 2	0.0	0.0	0.0	0.0
Week 3	1.0	0.0	0.0	0.0
Week 4	1.0	0.0	0.0	0.5
Week 5	1.0	1.0	0.5	0.5
Week 6	1.0	2.0	1.5	1.5

4. Discussion

This current research article has revealed that ginger powder dietary supplementation has a positive effect on the growth and production performance of broiler chicken. The findings indicated that birds receiving diets that were supplemented with 1.0 ginger powder (T3) recorded the highest body weight, body weight gain as well as feed efficiency and also recorded low mortality rates than the control group. The high growth of final body weight as well as body weight gain in ginger-supplemented groups is in line with other published reports that indicated an increase in the growth of broilers fed with herbal additives. Gingerol, shogaols, and zingibene are some of the biologically active compounds found in ginger that are said to stimulate the activity of digestive enzymes, improve nutrient absorption, and promote the health of the gut. It is probable that these mechanisms led to the higher growth in T3 birds. The same results were also obtained by Al-Shuwaili, [7] and Ojo et al. [8], where moderate amounts of dietary ginger enhanced weight gain in broiler chickens.

The reduced growth performance of T4 (1.5% ginger powder) in comparison with T3 could have been caused by exorbitant supplementation that can also decrease the palatability of feed or disrupt nutrient balance. The implication of this is that the inclusion level of ginger powder is optimal at 1.0 percent in this study. The level of feed was slightly increased in ginger-supplemented groups, specifically T3, which could be explained by the palatability of ginger. Ginger has been demonstrated to increase secretions of the digestive system and increase feed intake. But, the changes in the feed intake were not as significant as the changes in the weight gain, which suggests that the significant impact of ginger was on nutrient use instead of having to increase the feed intake [9].

The increased FCR in T3 means that the birds had an opportunity to change the feed to body weight more effectively. This is attributable to the digestive and metabolic stimulating properties of ginger such as enhancement of enzymes, gut motility and antimicrobial properties. Less FCR values are more cost effective to future broiler production since they indicate a superior feed efficiency. These findings are in line with the past reports that herbal additives such as ginger are capable of improving FCR in the poultry diets [10]. All groups had low mortality rates, but in all groups birds in ginger-supplemented diets had a slightly lower mortality rate than controls. This can be attributed to the antimicrobial and antioxidant effects of ginger which has the capacity of diminishing cases of gut infections and oxidative stress among broilers [11]. Such health promoting benefits lead to enhanced survivability and production performance in general. The results of this experiment reflect that moderate dietary supplementation of ginger powder (1.0 percent) may improve the growth rate and production efficiency in the broiler chicken [12]. Ginger is able to take the place of growth promoting antibiotics, which will enable the production of poultry to be sustainable. But, inclusion higher than the optimum might not be beneficial, and, on the contrary, might lower feed efficiency or palatability [10].

5. Conclusion

Supplementation of ginger powder in the diet of broiler chicken had a positive effect on their growth and production performance. Inclusion of 1.0% ginger powder in the diet led to the greatest body weight, body weight gain and feed efficiency and also marginally lowering mortality. The results are indicative that ginger powder can be utilized as a natural feed additive to enhance the growth performance

and the overall productivity of broiler chickens, and is a viable alternative to antibiotic growth promoters.

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Declaration of Conflict Of Interest

All authors hereby declared that, there were no conflict of interest was so ever.

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