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Research Article

Influence of clove powder and choline on performance, digestibility and weight of internal organs of Japanese quail

Muhammad Sumair Arain[1], Farman Ali Siyal[1*], Gulfam Ali Mughal[1], Ghulam Murtaza Lochi[2], Muhammad Bilawal[3], Abdul Salam Khoso[4] and Asad ur Rehman[1]

1. Department of Animal Nutrition, Sindh Agriculture University Tandojam, Pakistan
2. Department of Anatomy and Histology, Sindh Agriculture University Tandojam, Pakistan
3. Department of Veterinary Pharmacology, Sindh Agriculture University Tandojam, Pakistan
4. Department of Veterinary Surgery and Obstetrics, Sindh Agriculture University Tandojam, Pakistan

**Corresponding author's email: drfarmansial@gmail.com*

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Abstract

This study aimed to determine the effects of clove powder and choline on the development and digestibility of Japanese quail. For this study, 200-day-old Japanese quail chicks were assigned randomly into four treatments (I, II, III, IV), with each group having five replicates with ten birds each. Group, I treated simply the basal diet, whereas group II treated 0.5% clove powder together with the standard diet, group III treated 0.5% choline along with the standard diet, and group IV was treated with a blend of 0.5% clove powder and 0.5% choline along with the basal diet. The results showed that group I had the highest feed and water consumption, while group IV had the lowest feed consumption and water consumption was lowest in group II with statistically significant differences in all groups. Weekly weight increase was substantially higher in group IV and lower in group I with statistically significant differences in all groups; similarly, ultimate weight gain was significantly higher in group IV than in group I, groups were statistically significant from one another. In comparison to group I, FCR was better in groups IV, II, and III, all groups were statistically different from each other. Carcass weight and dressing percentage were considerably higher in IV, II, and III groups. Heart weight was substantially higher in treated groups, while liver weight was significantly lower in treated groups. Gizzard weight was observed high in treated groups. In terms of digestibility percentage of dry matter, crude protein and crude fat, the maximum efficiency was obtained in group IV, followed by groups II and III, however, there was a significant difference in all groups. On the basis of above mention, the conclusion could be made that supplementing a normal diet with 0.5% clove powder and 0.5% choline improved feed and water intake, weight gain, carcass quantity and dressing percentage, weight of internal organs, FCR, and the digestibility percentage of dry matter, crude protein and fat in Japanese quails.

Keywords: Clove; Choline; Digestibility; Japanese quail; Performance

Introduction

As a supplement to chicken, turkey, and ostrich, quail farming is another business firm that provides important elements and protein at a low-cost. Quail eggs and meat offer protein that might be used to improve food security, particularly in non-industrial nations with poor economic generating networks. They are appealing protein sources because of their high growth rates,

early sexual development, short age spans, and resistance to a variety of harmful illnesses [1].

Quails are small size bird species that belong to the *Phasianidae* family. The Japanese quail (*Coturnix japonica*) is a fast-growing bird with a short breeding interval that is raised for meat or for sale. Quail flesh is regarded to be a delicacy. It is because increasing customer awareness of the importance of high-quality meat has necessitated the development of higher-quality quail meat. It's crucial to choose stocks that have the potential to produce relatively highly nutritious meat and eggs from the start [2].

Antibiotic growth promoters (AGPs) have been used in chicken feeds for a number of years, raising concerns about the development of antibiotic-resistant bacteria and their impact on human health. As a result, several studies are looking for alternative AGPs in broiler chicken feeds, such as probiotics, prebiotics, organic acids, enzymes, plant extracts, herbs, medicinal plants, and spices like cloves [3]. Clove (*Syzygium aromaticum*) is a medicinal herb that is used in many forms and additions to preserve the digestive balance of the current flora. Furthermore, by boosting the production of certain enzymes and exerting antimicrobial actions, they perform a functional role [4]. The nutritionally important components, natural antioxidants, vital fatty acids, and lipid-soluble bioactive substances are all widely distributed. Tocols and phenolics are natural antimicrobials and antioxidants that may directly react with and quench free radicals to prevent lipid peroxidation, therefore enhancing health and avoiding illness. Cloves are high in vitamin A (retinol), beta-carotene, vitamins K, B6, B1, and C. Most notably, cloves contain eugenol, a phenolic molecule that is the primary bioactive component [5, 6].

Choline is a water-soluble micronutrient that is often associated with different vitamins. Choline has gained a lot of attention in recent years due to its ability to prevent liver obesity, support brain growth, and play a role in neuronal conduction. Choline is required for the production of phosphatidylcholine and beta-lipoproteins. It makes fat absorption and breakdown faster because it has an anti-fatty liver effect. Choline deficiency in experimental mice resulted in liver fattening and hepatocyte loss, atherosclerosis in heart disease, growth, bone development abnormalities, and kidney function impairment [7]. Dietary supplementation with commercially available herbal and synthetic choline-containing lipotropic feed additives may affect chicken growth rate, nutrient digestibility, and certain carcass composition [8].

Quails have recently been discovered to exhibit numerous characteristics, including infection tolerance, adaptability to severe environmental conditions, early sexual maturity, and rapid growth patterns [9]. However, there is no previous research on choline-rich quail meat in the literature. The objective of this study was to determine the clove powder and choline (alone and in combination) impact on the performance, digestibility, and weight of internal organs with Japanese quail

Materials and Methods

Experimental design

A total of two hundred (200) day-old quail chicks were purchased from birds market of district Hyderabad and scattered into four groups. Group, I as a control, fed a basal diet only, Group II, fed was a basal diet with 0.5% Clove powder, group III fed was a basal diet with 0.5 choline, and group IV was fed with a basal diet with 0.5% clove powder and 0.5% choline. Each group was divided into 05 replicates and each replicate had 10 birds and was reared for 30 days at Animal Nutrition Department, Sindh Agricultural University (SAU), Tandojam.

Housing management

Five Japanese quail chicks were given one square foot of room and kept in cages for five weeks. Using disinfectant combined with fresh water, the cage was thoroughly

cleaned and free of germs. Rice husk was provided as litter for each group of birds, up to a depth of 2-4 inches. Litter rotation was performed on a regular basis to minimize gas emissions. Paper sheets were applied to cover the litter during the first week of brooding [10]. It was routine to feed the birds twice a day. The birds were also given free access to fresh and clean water *ad libitum*. The following ingredient values are used to compose the feed/diet (Table 1).

Table 1. Feed formulation on dry matter (DM) basis

Ingredients	Starter (0-15 days)	Grower (16-30 days)
Ground corn	56.90	63.10
Soybean meal	27.90	21.55
Fish meal	4.00	5.00
Canola meal	5.05	2.50
Guar meal	2.00	2.50
Soybean oil	-	1.79
Limestone	1.29	1.00
Calcium carbonate	1.09	0.76
DL-methionine	0.31	0.27
Lysine	0.57	0.49
L-threonine	0.18	0.12
Sodium Carbonate	0.23	0.22
Vitamin premix	0.05	0.05
Trace mineral premix	0.05	0.05
Neomycin	0.01	0.02
Supplement	0.37	0.60
Chemical analysis		
Moisture (%)	12.02	11.73
Dry Matter (%)	87.98	88.27
Crude protein (%)	20.93	18.40
Crude fat (%)	3.01	5.00
Crude Fiber (%)	3.89	3.55
Ash (%)	2.11	2.15

Composition of clove powder

The nutritive composition of clove powder is presented in (Table 2) was performed at the laboratory of the Animal Nutrition department, SAU, Tandojam.

Table 2. Nutritive value of clove powder

S. No.	Clove powder composition /100g	
1.	Soluble sugar	32.1%
2.	Moisture	28.89%
3.	Crude fibre (CF)	14.87%
4.	Crude protein (CP)	6.87%
5.	Crude fat (CF)	5.81%
6.	Ash	5.49%

Analysis of samples of feed and droppings

Samples of diet and droppings were brought to the laboratory of Animal Nutrition to determine moisture, DM, CP, EE, CF, and Ash percentage using standard

methods [11]. Similarly, the digestibility of different nutrients was determined by following formula was used;

$$\text{Nutrient digestibility (\%)} = \frac{\text{Nutrient intake} - \text{Nutrient in feces}}{\text{Nutrient intake}} \times 100$$

Body weight (g/b)

The initial and weekly live body weights of 5 birds from different replicates per group were recorded using an electric weighing machine.

Feed intake (g)

The rejection was assessed and recorded the next day after the feed was administered twice a day (morning and evening). To calculate feed intake, use the following formula;

$$\text{Feed intake (g/b/d)} = \frac{\text{Total diet offered (g)} - \text{Total diet refused (g/group/d)}}{\text{Total no. of birds}}$$

Water intake (ml)

Water was offered twice a day (morning and evening) and refusal was measured and recorded on the next day. To calculate water intake, use the following formula;

$$\text{Water intake(ml/b/d)} = \frac{\text{Total water offered(ml)} - \text{Total water refused(ml/group/d)}}{\text{Total no. of birds}}$$

Feed conversion ratio (FCR)

Total feed intake was divided by weight gain to arrive the figure.

$$\text{FCR} = \frac{\text{Feed intake}}{\text{Weight gain}}$$

Carcass weight (g/b) and dressing percentage (%)

Following the experimental trail, five birds from each group were chosen at random, weighed, and slaughtered. Then carcass was weighed using an electric weighing machine after that dressing % was calculated using the formula below.

$$\text{Dressing \%} = \frac{\text{Carcass weight}}{\text{Live body weight}} \times 100$$

Weight of internal organs

After slaughtering from each group, heart, liver, and gizzard were removed with the help of a scalpel and scissors from each quail bird and weighed by using an electric balance separately.

Statistical analysis

Software Statistics 8.1 version was used for data analysis. For significant differences in averages at the level of significance ($P<0.05$), LSD was used.

Results

Total feed and water intake

Results specified that significantly highest total feed intake and total water intake were recorded (Table 3) in group I while minimum feed intake was observed in group 3, and minimum water intake was observed in group II. Statistically it was declared that there was a statistical difference between all groups of feed intake and water intake ($P<0.01$). Total feed and water intake in each group I, II, III and IV were 429.80g and 927.61ml, 412.70g and 845.70ml, 421.04g and 885.15ml, 404.98g and 905.30ml respectively.

Table 3. Total feed and water intake

Parameters	Group I (BD only)	Group II BD + 0.5% C. P	Group III BD + 0.5% C	Group IV BD + 0.5% C.P + 0.5% C	LSD (0.05)	SEM
Total feed intake (g)	429.80[a]	412.70[c]	421.04[b]	404.98[d]	±6.8957	3.2528
Total water intake (ml)	927.61[a]	845.70[d]	885.15[c]	905.30[b]	±5.2922	2.4964

BD= Basal diet* CP= Clove powder* C= Choline

[abcd] Significantly different was marked by these superscripts. (P. value 0.01)

Weekly and final weight gain

Weekly final weight gain (Table 5) was seen as highest in group 5 while lowest in group I, and statistically all the groups were significantly different (P<0.012). Weekly weight gains for each groups I, II, III and IV, were 33.04g, 36.26g, 34.77g, and 37.85g and final weight gains were 141.60g, 155.40g, 149.00g and 162.20g respectively.

Table 5. Weekly weight gain (g) for different groups

Parameters	Group I (BD only)	Group II BD + 0.5% C.P	Group III BD + 0.5% C	Group IV BD + 0.5% C.P+ 0.5% C	LSD (0.05)	SEM
Weekly weight gain (g)	33.04[d]	36.26[b]	34.77[c]	37.85[a]	±0.7627	0.3598
Final weight gain (g)	141.60[d]	155.40[b]	149.00[c]	162.20[a]	±3.2704	1.5427

BD= Basal diet* CP= Clove powder* C= Choline
[abcd] Significantly different was marked by these superscripts. (P value 0.012)

FCR

FCR was calculated at the end as shown in (Table 6), group I had the highest FCR, whereas groups II, III, and IV had the lowest computed FCR. Whereas the best FCR is considered for group IV. All Groups were statistically different from one another, according to statistical differences (P<0.01).

Table 6. FCR recorded for different groups

Parameters	Group I (BD only)	Group II BD + 0.5% C.P	Group III BD + 0.5% C	Group IV BD + 0.5% C.P+ 0.5% C	LSD (0.05)	SEM
FCR	3.04[a]	2.65[c]	2.82[b]	2.5[d]	±0.0777	0.0366

BD= Basal diet* CP= Clove powder* C= Choline
[abcd] Significantly different was marked by these superscripts. (P value 0.01)

Carcass weight and dressing percentage

Groups fed with supplementation of clove powder and choline individually and in combination show a positive effect on weight of carcass and its dressing percentage which were presented in (Table 7). The results for carcass weight and dressing percentage were noticed in groups IV followed by II, III and I. According to the statistical tool, a statistical difference (P<0.02) was found in each group.

Table 7. Carcass weight (g) and dressing percentage (%)

Parameters	Group I (BD only)	Group II BD + 0.5% C.P	Group III BD + 0.5% C	Group IV BD + 0.5% C.P+ 0.5% C	LSD (0.05)	SEM
Carcass weight (g)	97.44[d]	115.22[b]	108.63[c]	126.44[a]	±3.3186	1.5654
Dressing percentage (%)	68.86[d]	74.15[b]	72.92[c]	77.96[a]	±2.8725	1.3550

BD= Basal diet* CP= Clove powder* C= Choline
[abcd] Significantly different was marked by these superscripts.(P value 0.02)

Weight of internal organs

Supplementation of clove powder and choline individually and in combination shows effects on weights of heart, liver and gizzard, which were calculated after the slaughtering and presented in (Table 8). All of the groups were statistically difference (P<0.012) in case of heart and liver. While in case of gizzard group III had a non-significant difference with II and III while

I, II, and IV were found significantly different from each other.

Table 8. Heart, liver and gizzard weight (g) for different groups

Parameters	Group I (BD only)	Group II BD + 0.5% C.P	Group III BD + 0.5% C	Group IV BD + 0.5% C.P + 0.5% C	LSD (0.05)	SEM
Heart weight (g)	1.48^{d}	1.62^{b}	1.56^{c}	1.65^{a}	±0.0398	0.000191
Liver weight (g)	6.51^{a}	5.70^{b}	5.22^{c}	3.83^{d}	±0.2722	0.1303
Gizzard weight (g)	3.62^{c}	3.99^{b}	3.95^{b}	4.66^{a}	±0.3567	0.1711

BD= Basal diet* CP= Clove powder* C= Choline
^{abcd} Significantly different was marked by these superscripts. (P value 0.012)

Digestibility of nutrients

Average results for fecal samples examined for digestibility of dry matter (%) were presented in (Table 9). Supplementation of clove powder and choline individually and in combination shows more nutrient digestibility in treated groups, but best nutrients digestibility was observed in group IV, followed by I, II and III. Statistically, it was revealed that All of the groups were statistically different (P<0.01).

Table 9. Nutrients digestibility (DM%, CP% & EE%).

Parameters	Group I (BD only)	Group II BD + 0.5% C.P	Group III BD + 0.5% C	Group IV BD + 0.5% C.P + 0.5% C	LSD (0.05)	SEM
DM Digestibility(%)	68.05^{d}	74.00^{b}	70.99^{c}	77.97^{a}	±1.9039	0.8256
CP Digestibility(%)	73.87^{d}	78.27^{b}	76.15^{c}	82.97^{a}	±1.4957	0.6486
EE Digestibility(%)	70.34^{d}	75.02^{b}	72.60^{c}	77.72^{a}	±1.2091	0.5243

BD= Basal diet* CP= Clove powder* C= Choline DM= Dry matter* CP= Crude protein* EE= Ether extract*
^{abcd} Significantly different was marked by these superscripts. (P value 0.01)

Discussion

Total feed intake and water intake

Findings for feed intake indicated that lowest feed intake was observed in the control group in contrast to birds given clove powder and their blend. These findings in comparison to this gain might be attributed to the attractive effect of active components in clove essential oil (such as carvacrol, thymol, eugenol, and anethole). This is also in accordance with the findings of Abudabos *et al.* [12], who found that animals require choline in their diet to regulate bodily growth and development. The application of cloves as an additive in broiler feed can lower feed intake.

According to Al-Mufarrej *et al.* [6] adding Clove leaf essential oil to the diet had a very significant (P<0.01) influence on body weight growth, using it at a concentration of 0.5-1.5 percent tended to enhance body weight gain quantitatively. In the 0.5 and 1.5 percent usage of eugenol from clove leaf essential oil, an increase in body weight growth was inversely linked to feed intake. The presence of 0.5 percent and 1% eugenol in clove leaf essential oil increased feed digestibility in this situation. As a result, nutritional needs for growth were met, despite a reduction in feed consumption. Moreover, Kamel [13] stated that herbs, spices, and other plant extracts have been shown to have appetite and digestion-stimulating qualities, and antibacterial capabilities. Clove extract

contains a variety of compounds (most notably eugenol) with bioactive properties in animal physiology and metabolism.

Weight gain and FCR

In comparison to the control and antibiotic groups, daily live weight growth and feed conversion ratio were higher in groups supplemented with essential clove oil. These variations might be related to active ingredients in cloves, such as eugenol, which has digestive-stimulating properties [14]. Furthermore, eugenol had an effect on pathogen microorganisms in the digestive tract, resulting in enhanced live weight gain and feed conversion ratio. Essential oils produced from oregano and clove have been shown to have antibacterial properties [6].

Furthermore, Ansari *et al.* [15] discovered that the total FCR of poultry birds treated with clove powder was considerably higher than the control group. However, Nidaullah *et al.* [16] found that adding clove powder to chicken rations did not enhance ration efficiency considerably.

Carcass weight and dressing percentage

When the percentages of clove powder, choline treated, and control groups were compared to a mixture of clove powder and choline treated groups, there was very little change. The overall carcass weight and dressing percentage were significantly improved by a mixture of 0.5% clove powder and 0.5% choline, The findings of this study matched those of Mohammadi *et al.* [17], who reported on the growth performance of broiler chicks fed various doses of clove. Abudabos *et al.* [12] found that giving Japanese quails a choline-rich feed had no effect on carcass features or organoleptic tests, and that giving them 0.5 to 0.10% choline had no significant difference in body weight compared to birds given 0.5-0.15% choline. According to Alagawany *et al.* [8], choline supplementation resulted in increased dressing yields in choline supplemented Japanese quail. Chickens given clove showed a rise in dressing % and breast weight, according to Tariq *et al.* [18]. The high amount of clove seed inclusion used in our investigation might account for this difference. Furthermore, Dalkilic and Guler [19] reported that carcass characteristics in Japanese quails given the clove oil–enriched diet were better than those in the control group. The discrepancy might be due to a change in clove supplementation form. This research backed up findings that feed regimens enriched with up to 0.04 percent clove extract may be used as an efficient broiler growth enhancer instead of antibiotics.

Weight of internal organs (heart, liver and gizzard)

In comparison to the control group, dietary clove powder boosted growth and development and weight of inner organs, but the fact that a lot of their weight with carcass characteristics had also been reduced, which could be due to the fact that dressing percentage and organ weight did not grow in a directly proportional ratio. If the weight of an organ increased by one gram while the rest of the body grew by ten grams, the total weight ratio of organs was lower than the dressing percentage. When compared to control birds, Tarhyela *et al.* [20] found that weight gain was significantly higher in all carcass weights except liver, heart, and gizzard weights. Ragab [21] examined that weights of the liver, gizzard, and heart of Japanese quail, they found these weights were higher than control line birds', but that their proportion along with weight was unaffected. The different amounts of choline employed in this study had no detrimental effects on the internal organs tested (liver, gizzard and heart). The prevention of unwanted fat build up in hepatocytes or the formation of fatty liver is one of the advantages of choline in chicken production [16].

Digestibility of nutrients

When Japanese quail chicks were fed with clove powder and choline, the percentage of crude protein and ether extract digestibility was substantially different across all groups (I, II, III, IV), but not statistically different in the case of dry

matter (DM). Group IV, which was supplemented with a mixture of 0.5 percent clove powder and choline, had the highest percentage of nutrients digestibility, followed by groups II, III, and IV, and these findings were linked to those of Krishan and Narang [22]. Alemayehu *et al.* [23], found that when rations are supplemented with fragrant spices like clove, the proportion of nutrients digestible and overall performance, including economy, improves. Similarly, according to Chowdhury *et al.* [3], clove oil stimulates the proteolytic process in the stomach, improving amino acid and protein digestibility. Furthermore, Jiwuba and Kadurumba [24] found that chicks fed a choline extract-enriched feed had higher CP and EE digestibility.

Conclusion

In Japanese quails, an addition of 0.5% clove powder and 0.5% choline, combined with a normal diet supplemented, improved total feed and water intake, weight gain, carcass quantity, dressing percentage, weight of internal organs, FCR, digestibility percentage of crude protein, dry matter and fat. Whereas the supplementation of 0.5% clove powder and 0.5% choline individually, also improved total feed and water intake, weight gain, carcass quantity, dressing percentage, weight of internal organs, FCR, digestibility percentage of crude protein, dry matter and fat. But was not good enough as in combination.

Authors' contributions

Conceived and designed the experiments: MS Arain, FA Siyal & GA Mughal, Performed the experiments: MS Arain & A Rehman, Analyzed the data: MS Arain, GM Lochi & AS Khoso

Wrote the paper: FA Siyal & MB Arain.

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