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Effect of adding clove buds powder in feed on performance and jejunum morphology in broiler chickens

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Abstract

Background: Cloves are aromatic spices containing diverse chemically active substances with biological properties. They have also been used in traditional medicine.

Aim: This experiment was conducted to evaluate the effect of clove bud powder (CBP) dietary administration on the performance and jejunum morphology of the broiler chickens.

Methods: A total of 360 1-day-old chicks (Ross 308) were distributed according to a completely randomized design on 3 experimental groups according to CBP% in feed (0.0%, 0.5%, and 1.0%), with 6 replicates for each treatment group. The studied traits included body weight, daily weight gain, daily feed consumption, feed conversion ratio, mortality%, European broiler index (EBI), villus height, crypt depth, and villus height/crypt depth ratio.

Results: The broilers final body weight, daily weight gain, and daily feed consumption reduced significantly ($p \leq 0.01$) in groups consuming different percentages of CBP, and a significant increase ($p < 0.05$) in feed conversion ratio was noted in the CBP groups. Adding CBP to feed caused a significant decrease ($p < 0.05$) in the EBI. However, CBP increased ($p \leq 0.01$) villus height and villus height/crypt depth ratio (h/c ratio) compared to the control group. On the other hand, the results showed that there were no significant differences ($p > 0.05$) between treatment groups in mortality% and crypt depth.

Conclusion: This study concluded that the addition of CBP had a negative effect on daily feed consumption, daily body weight gain, final body weight, feed conversion ratio, and EBI at a dose used in this study. But it improved intestinal morphology.

Keywords: Broiler, Clove buds, Performance, Jejunum morphology.

Introduction

The poultry industry is progressing at an accelerating pace in the field of developing poultry feed for the optimal expression of the genetic characteristics of birds and achieving the highest performance and the best economic return for the breeders. The poultry feed industry has evolved from just nutritionally balanced diets to various forms of feed to non-traditional feeds that contain many food and non-food additives. Aromatic herbs with their benefits and effective chemicals have the largest share of poultry nutrition research as a result of the positive advantages they have achieved in improving the growth performance, nutrient utilization, health, and physiological functions of birds (Kumar *et al.*, 2017; Chowdhury *et al.*, 2018).

Phytobiotics and their extracts have beneficial effects on appetite and digestion (Kumar *et al.*, 2014), and are safe in broiler production (Nath *et al.*, 2012). Dry clove buds are rich in volatile oils (Singh *et al.*, 2012), whereas eugenol represents the major component of clove buds oil (Galal and Abdelllatief, 2015). In addition, the oil of clove buds contains eugenyl acetate and Beta-caryophyllene (Alma *et al.*, 2007) and hydrolysable tannins (Cortés-Rojas *et al.*, 2014). Clove buds have multi-bioactivity effects such as antiinflammatory (Farhath *et al.*, 2013), antioxidant (Mishra and Kalyani, 2014), antimicrobial (Rodriguez *et al.*, 2014; Kammon *et al.*, 2019) antiparasitic and fungal (Singh *et al.*, 2012), and growth promoters (Agostini *et al.*, 2012; Hosseini *et al.*, 2017).

The ultimate goal of this experiment was to investigate the effects of adding clove bud powder (CBP) at different levels to broiler feed on performance and jejunum morphology.

Materials and Methods

Three hundred and sixty-1-day-old broiler chicks (ROSS 308) were weighed and raised on a wood-shaving floor. Three treatment groups were assigned

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according to CBP levels in feed; 0.0%, 0.5%, and 1.0%. Each treatment group was applied for 6 replicates, with 20 chicks/replicate. Chicks were fed *ad libitum* on starter feed from 1 to 21 days, and finisher feed from 22 to 42 days. All chicks were vaccinated according to the vaccination program implemented by National Center for Animals Health, Libya.

Performance and jejunum morphological traits were measured; these traits included feed consumption, body weight, daily weight gain, feed conversion ratio, mortality%, European broiler index (EBI) (Marcu *et al.*, 2013), villus height, crypt depths, and villus height/crypt depth ratio (Amad *et al.*, 2013).

The experiment was designed according to a completely randomized design and the significant differences between treatment means were find out by using Duncan's Multiple Range Test (Duncan, 1955). Statistical Analysis System (SAS, 2002) was used to apply analysis of variance.

Ethical approval

This study was approved by the Graduate School of the University of Tripoli, Faculty of Agriculture, Department of Animal production. All animal welfare protocols were followed.

Results

In general, the results in Table 1 indicated that consumption of a diet containing CBP caused a significant reduction ($p \leq 0.01$) in daily feed consumption, body weight, and daily weight gain. In more detail, the group of chicks that fed on a diet containing 1.0% CBP had the lowest performance ($p \leq 0.01$) among the experimental groups in terms of daily feed consumption, body weight, and daily weight gain with averages (99.22, 2,660.04, and 63.84 g/bird/day, respectively), while the control group was significantly the higher for performance traits with averages (115.33, 3,145.73, and 75.67 g/bird/day, respectively) during 42 days of rearing. In addition, the chicks fed a diet containing 0.5% CBP showed a significant ($p \leq 0.01$) increase in the feed conversion ratio (1.57 g feed/g weight gain) compared to the control group (1.52 g feed/g weight gain), while there was no significant difference in the feed conversion ratio between birds of the control group and birds fed a diet containing 1.0% CBP. Moreover, the addition of 1.0% CBP to the broiler diet caused a significant decrease ($p \leq 0.05$) in the EBI compared to the control group (383.47 *vs.* 434.22, respectively). However, CBP-containing diets did not affect the mortality rate among all treated groups.

The results in Table 2 showed a highly significant increase ($p \leq 0.01$) in villus height (1,010.35 µm) and villus height/crypt depth ratio (7.33) in chicks that consumed 1.0% CBP compared to the control or 0.5% CBP group. Nevertheless, there was no significant effect of adding CBP to feed on crypt depth.

Discussion

Feed additives aim to improve performance in birds in addition to improving health status and physiological functions in the bird's body. Some feed additives may achieve positive results in all the required parameters, but some feed additives may not give all the expected results, and this may be due to the concentration levels added or due to some phytochemical components that

Table 1. Effect of adding different percentages of CBP to feed on broiler performance.

Performance parameter	Control	0.5% CBP	1.0% CBP	SEM	*p*-value
Initial weight, g/bird	43.04 [a]	43.08 [a]	42.67 [a]	0.46	0.78
feed consumption, g/bird /day	115.33[a]	110.16[a]	99.22[b]	2.05	0.01
Final body weight, g/bird	3,145.73[a]	2,922.89[b]	2,660.04[c]	50.45	0.01
Daily weight gain, g/bird /day	75.67[a]	70.24[b]	63.84[c]	1.23	0.01
feed conversion ratio (g feed/g gain)	1.52[b]	1.57[a]	1.56[ab]	0.01	0.05
Mortality (%)	12.50[a]	6.67[a]	6.67[a]	1.98	0.08
EBI	434.22[a]	418.87[ab]	383.47[b]	13.61	0.05

* (CBP): Clove buds powder.
a, b, c: Means with different superscripts in the same row are significantly different at ($p < 0.05$).

Table 2. Effect of adding different percentages of CBP to feed on jejunum morphology at 42 days of age in broiler chickens.

Performance parameter	Control	0.5% CBP	1.0% CBP	SEM	*p*-value
Villus height (µm)	837.93[b]	771.378[b]	1,010.35[a]	34.73	0.01
Crypt depth (µm)	136.13	145.20	139.15	7.48	0.69
Villus height/crypt depth ratio	6.15[b]	5.35[b]	7.33[a]	0.27	0.01

* (CBP): Clove buds powder.
a, b, c: Means with different superscripts in the same row are significantly different at ($p < 0.05$).

have a negative effect. Moreover, as it is clear from the results of this study, the addition of CBP had a negative effect on performance in general. This may be due to the high levels of tannins in cloves, as indicated by Cortés-Rojas *et al.* (2014), who showed in their study that the level of tannins in clove buds might reach 10%–13%. Rezaei and Semnannejad (2016) have reported that high levels of tannins reduced feed intake and digestion in broilers. In addition, Keshavarzi *et al.* (2017) concluded that broilers who consumed tannins (in CBP) for a prolonged period (6 weeks) showed lower performance compared to the other experimental groups. Our results are also in agreement with Borazjanizadeh *et al.* (2011) who found that the addition of CBP in the feed of broiler chickens caused a decrease in daily feed intake.

Although some studies did not agree with our study and indicated that the addition of CBP increased feed consumption in broilers (Borazjanizadeh *et al.*, 2011; Mehr *et al.*, 2014), what supports the findings of our study is that high levels of tannins stimulate the secretion of histamine (Mansoori and Acamovic, 2007), which It causes an increase in the secretion of hydrochloric acid and this causes gizzard erosions, which results in a decrease in feed consumption (Artuković *et al.*, 2005). In addition, tannins have a negative effect on protein and amino acid digestibility due to precipitating proteins by their protein binding ability (Ortiz *et al.*, 1993).

The negative effects of consuming 0.5% or 1.0% CBP on feed consumption and protein digestibility were associated with highly significant reductions in daily weight gain and final body compared to the control group. It was clear, increasing CBP level in feed caused more decrease in final body weight, these results agreed with Salman and Ibrahim (2012) and Gamaleldin *et al.* (2021).

As we mentioned previously that feeding on CBP caused a decrease in feed consumption and was also accompanied by a greater decrease in the rate of body weight gain, so it was reasonable for the groups fed on CBP to record a high feed conversion ratio. Our findings indicated that the 0.5% CBP group had the highest feed conversion ratio compared to the control group, and we are in agreement with that found by Borazjanizadeh *et al.* (2011) and Chalghoumi *et al.* (2013). The use of 0.5% and 1% levels of CBP in broiler feed may be considered high due to its tannin content. Agostini *et al.* (2012) indicated that the addition of CBP up to the level of 2,500 mg/kg feed had no negative effect on performance, and did not record any significant differences in the rate of feed consumption, body weight gains, and feed conversion ratio compared with birds of the control group. In addition, study on laying hens, there were no significant differences in egg production, feed consumption, and egg mass, while the group fed on 0.4 of CBP showed a significant improvement in the feed conversion factor (Gandomani *et al.*, 2014). This may support that the use of lower concentrations may be more effective, and do not forget to point out that the length of the breeding period in laying hens may have an effect on the adaptation of birds to the addition of CBP.

Although 0.5% and 1.0% of CBP groups showed less mortality% than the control group, however, the differences between these groups were not significant, this result agrees with that found by Barreto *et al.* (2008) and Mukhtar (2011). Through our results, it is clear that adding CBP up to 1% did not have a toxic or negative effect on the health of birds.

Marcu *et al.* (2013) reported that the economic efficiency assessment on the EBI was positively influenced by body weight, average weight gain, feed conversion ratio, and viability, and due to these factors the control group recorded the best value of EBI, with significant difference compared to 1.0% CBP group, this result disagrees with that found by Osman *et al.* (2010) who indicated that feeding broiler chickens on natural feed additives led to an improvement in production performance in general and also a significant improvement in both protein efficiency ratio and performance index. In like manner, Puvača *et al.* (2015) stated that feeding broilers with garlic or black pepper and hot red pepper led to a statistically significant increase in values of EBI of experimental treatments in comparison to the control treatment.

It is known that the small intestine is the main place in the digestive system in which most of the processes of digestion and absorption of nutrients take place, and therefore the health and morphological condition of the intestine reflects the productive performance of birds. Many aromatic and medicinal plants are characterized by their content of substances that improve the morphological microstructures, gut barrier, and health status of the intestine through their antimicrobial, antioxidant, and antiinflammatory activity (Patra, 2020). It was indicated by Nyachoti *et al.* (2006) that toxins produced by bacteria in the intestine are attributed to the decrease in the height of the intestinal villi which is a major factor in reducing the absorbable surface area. Concerning the villus height and villus height/crypt depth ratio, we are in line with the findings by Gandomani *et al.* (2014) that showed feeding clove bud resulted in an increase in villus height and villus height to crypt depth ratio, while a study by Al-Mufarrej *et al.* (2019) exhibited that the inclusion of various levels of clove powder (1%–6%) in dietary treatments led to a gradual decrease in villus height, villus surface area, and villus crypt depth. In addition, some studies revealed that adding clove had no significant effect on villus height, crypt depth, and villus height/crypt depth ratio (Agostini *et al.*, 2012; Chakma *et al.*, 2020).

Conclusion

The results indicated that increased levels of CBP in broiler chicks' diet had an adverse effect on daily feed consumption, daily body weight gain, final body

weight, feed conversion ratio, and EBI during 42 days. Nevertheless, it improves villus length and villus height to crypt depth ratio of the chicks consumed 1% CBP compared to the control.

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Conflict of interest

The authors declare that there is no conflict of interest.

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