

Research Article

Effect of Dietary Supplementation of Red Pepper and Black Pepper Powder on Feed Intake and Growth Performance of Broiler Chicken

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Abstract

A series of experiments were conducted to investigate the effects of red pepper and black pepper powder supplementation on feed intake, feed conversion ratio, and growth performance in broiler chickens. Two hundred day-old Cobb 500 Strain broiler chickens were randomly divided into five treatments, each replicated four times, with 10 birds per replication from second week. The basal feed was supplemented with ground red pepper and black pepper in varying proportions: T1 (control); T2 (basal diet + 0.02% red pepper); T3 (basal diet + 0.02% black pepper); T4 (basal diet + 0.01% red pepper + 0.01% black pepper); and T5 (basal diet + 0.02% red pepper + 0.02% black pepper). The results indicated that T5 (0.02% red pepper + 0.02% black pepper) showed the best performance ($p < 0.05$) in all growth parameters, including final body weight, weekly feed intake, and feed conversion ratio. The study demonstrated that supplementing broiler chickens with 0.02% red pepper and 0.02% black pepper significantly improved growth performance metrics such as body weight, weight gain rate, and feed efficiency. In conclusion, the inclusion of 0.02% red pepper and 0.02% black pepper powder in the basal feed is a simple and effective strategy to enhance the overall growth performance of broiler chickens.

Keywords: Broiler chickens; Growth performance; Feed conversion ratio; Red pepper; Black pepper; Feed supplementation.

Introduction

Poultry farming has emerged as a significant contributor to Nepal's recent economic progress, becoming one of the nation's primary agricultural sectors (Bhattarai, 2005). According to FAOSTAT (2014), Nepal ranks 92nd globally in chicken meat production, producing an average of 1,170,537 broilers weekly, and holds a similar rank in egg production. The poultry industry contributes 3.5% to the nation's GDP, with investments totalling NRs 22 billion and an annual growth rate of 17–18% (CBS, 2017). The Nepal

Commercial Poultry Survey (CBS, 2017) reports 21,956 commercial poultry farms and 128 hatcheries, producing 110,689,545 kg of broiler meat annually. Broiler production dominates Nepal's commercial meat industry, with 54% of poultry raised professionally in peri-urban areas, while 46% comprises indigenous breeds primarily found in rural regions (Parajuli, 2008). The demand for poultry products has surged in recent years, with the commercial poultry industry tripling in size between 1985 and 2014 (Acharya and Kaphle, 2015).

Feed additives, which include both nutrient and non-nutrient compounds, play a crucial role in enhancing feed utilization and maximizing the value of expensive feed inputs. In poultry farming, antibiotics have traditionally been used to promote growth, prevent diseases, and treat illnesses (Poole and Sheffield, 2013). However, due to growing concerns over antibiotic resistance, natural alternatives such as probiotics, organic acids, and plant extracts have gained attention as effective growth promoters (Windisch *et al.*, 2008). Feed additives, defined as non-nutritive substances, are used to enhance metabolism, improve health, and optimize feed conversion in animals (Church and Pond, 1988). Among these, plant-based additives like red and black pepper have shown promise as natural growth promoters, offering a sustainable alternative to synthetic compounds (Demir *et al.*, 2003).

Red pepper (*Capsicum annuum*) has been widely used as a medicinal herb across various cultures due to its rich bioactive compounds, including retinol, beta-carotene, capsaicin, quercetin, ascorbic acid, folate, and phenolic and flavonoid compounds, which exhibit strong antioxidant properties (Kikuzaki and Nakatani, 1996). Studies have demonstrated its efficacy in reducing gastric lesions by up to 97% (Vincent, 2011). Similarly, black pepper (*Piper nigrum*), a globally recognized spice from the Piperaceae family, is valued for its pungency and spiciness (Hassan *et al.*, 2007; Hosseini, 2011). Research indicates that supplementing broiler diets with these herbal plants can significantly improve body weight and feed efficiency (Greatehead, 1999; Iqbal *et al.*, 2011).

Given the potential of red and black pepper as natural feed additives, this study aimed to investigate their effects on the growth performance and health parameters of broiler chickens. The experiment evaluated the impact of supplementing broiler diets with varying proportions of red and black pepper powder on feed intake, feed conversion ratio, and overall growth performance. The findings provide valuable insights into the use of these herbal additives as sustainable alternatives to synthetic growth promoters in poultry farming.

Materials and Methods

The study was carried out at Lumbini Poultry Farm, Bhairahawa, Nepal. A total of 200-day-old Cobb 500 broiler chicks were obtained from Rapti Hatchery Pvt. Ltd., Dang and randomly divided into five treatment groups starting from seven days of age, following a Completely Randomized Design (CRD) in a deep litter system. Each treatment group included four replicates, with 10 chicks per replicate, ensuring an even distribution of body weight among all groups.

The basal diet used in the experiment was designed to align with the nutritional guidelines established by the National Research Council (NRC, 1994). The specific composition of the feed ingredients and the calculated nutrient content are provided in Table 1. The chicks were provided with a starter ration from days 0 to 14, followed by a grower ration from days 15 to 29, and a finisher ration from days 30 to 42.

Table 1: Ingredients used to prepare the basal diet used in the experiment and their proximate analysis

Ingredients (%)	Starter (0-14 days)	Grower (15-29 days)	Finisher (30-42 days)
Maize	56	59	59.8
Hipro Soya	31	28	25
Mustard DOC	1.5	2	3
Rice Polish	4	4	4
Oil Soya	1.2	1.8	2.5
Salt	0.35	0.35	0.35
DCP	1.8	1.5	1.3
Phytase	0.02	0.02	0.02
Lime stone Powder	0.8	1	1.5
Phytase	0.02	0.02	0.02
Lime stone Powder	0.8	1	1.5
Soda	0.1	0.1	0.15
Broken rice	1.8	2.2	1
DL methionine	0.4	30.5	0.4
Lysine	0.3	0.3	0.25
Threonine	0.04	0.04	0.04
Vitamin premix	0.04	0.04	0.04
Toxin binder	0.1	0.1	0.1
Organic trace minerals	0.1	0.1	0.1
Livertonic	0.1	0.1	0.1
Cocciostat	0.05	0.05	0.05
Growth promoter	0.02	0.02	0.02

Table 1: Ingredients used to prepare the basal diet used in the experiment and their proximate analysis (Contd.)

Ingredients (%)	Starter (0-14 days)	Grower (15-29 days)	Finisher (30-42 days)
Acidifier	0.05	0.05	0.05
Enzyme	0.05	0.05	0.05
Turmeric oil	0.1	0.1	0.1
Total	100	100	100
DM	88.58	88.44	88.21
CP%	23	21.5	20
CF%	5	5	5
Ether extract %	9	8	7.8
NFE	51.5	54.2	55.3
Ash	2.1	2	1.9

The required quantities of red pepper and black pepper were prepared by finely grinding the spices and passing them through a 1 mm sieve. The ground red pepper and black pepper were then mixed into the basal feed to create the following treatment groups:

T1: Control diet (basal diet only)

T2: Basal diet + 0.02% red pepper

T3: Basal diet + 0.02% black pepper

T4: Basal diet + 0.01% red pepper + 0.01% black pepper

T5: Basal diet + 0.02% red pepper + 0.02% black pepper

Feed mixing was done manually, and the experimental diets were provided to the chicks starting from one week of age. Cumulative feed intake, cumulative weight gain, and feed conversion ratio (FCR) were recorded weekly. The collected data were analyzed using one-way analysis of variance (ANOVA), and differences between treatment groups were determined using the Least Significant Difference (LSD) test.

Results and Discussion

Feed Intake

The mean weekly cumulative feed consumption of Cobb 500 broilers fed diets supplemented with varying levels of red pepper and black pepper is presented in Table 2. The supplementation of red pepper and black pepper, particularly in combination (T5), had a significant effect ($p < 0.05$) on feed intake during the 5th week of rearing. The lowest feed intake was observed in T5 (0.02% red pepper + 0.02% black pepper), which differed significantly from the other treatments. This reduction in feed intake aligns with findings by Alcicek *et al.* (2004), who reported a similar trend when essential oils were added to broiler diets. Several studies, including those by Mohamed *et al.* (2012), Valiollahi *et al.* (2013), and Barazesh *et al.* (2013), have also documented reduced feed intake in broilers fed diets containing herbal extracts. This phenomenon may be attributed to the bioactive compounds in red and black pepper, which can influence feed palatability and digestion.

Table 2: Feed intake of Cobb 500 birds (kg/bird/week) fed diet (mean±SD) containing different levels of red pepper and black pepper.

Treatments	Feed intake by Cobb 500 birds (kg/bird/week) in various weeks (mean±SD)				
	1 st week	2 nd week	3 rd week	4 th week	5 th week
T ₁	0.425±0.002 ^a	1.046±0.011 ^a	2.05±0.012 ^a	3.3123±0.015 ^a	4.580±0.018 ^a
T ₂	0.424±0.004 ^a	1.040±0.009 ^a	2.02±0.010 ^a	3.3234±0.013 ^a	4.570±0.015 ^a
T ₃	0.420±0.008 ^a	1.032±0.0015 ^a	2.05±0.016 ^a	3.2313±0.020 ^a	4.552±0.017 ^a
T ₄	0.419±0.006 ^a	1.040±0.009 ^a	1.941±0.013 ^a	3.2375±0.014 ^a	4.509±0.021 ^a
T ₅	0.430±0.003 ^a	1.032±0.011 ^a	1.925±0.013 ^a	3.2354±0.016 ^a	4.401±0.019 ^b
Grand Mean	0.427	1.041	1.999	3.284	4.531
F value	0.25	0.49	1.77	2.15	5.58
Probability	0.905	0.742	0.188	0.125	0.005
CV%	3.595	1.99	1.68	1.99	1.07

Means in a column with different superscripts differ significantly at ($p < 0.05$), where CV= Coefficient of Variation; SEM= Standard error of the mean; and LSD= Least significant difference ($p = 0.05$)

Body Weight Gain (BW)

The weekly weight gain across treatment groups is presented in Table 3. Supplementation with red pepper and black pepper, either alone or in combination, did not significantly affect body weight during the 1st week. However, by the end of the trial, the mean cumulative live weight gain was 369.3 g/bird/week. The lowest body weight gain was observed in T1 (control), which was statistically different ($p < 0.05$) from the other treatments. Notably, T2 (0.02% red pepper) and T3 (0.02% black pepper) showed similar weight gains, as did T3 and T4 (0.01% red pepper + 0.01% black pepper).

The significantly higher body weight in birds fed red pepper and black pepper may be linked to the bioactive phytochemicals present in these spices. Piperine, piperidine, and volatile oils in black pepper have demonstrated antibacterial properties, enhancing nutrient absorption and gut health (Khalaf et al., 2008; Hosseini, 2011). Similarly, red pepper contains antioxidants, phenolic compounds, and capsaicin, which improve digestion and nutrient utilization

(Akoachere et al., 2002). These findings are consistent with studies by Safa (2014), Valiollahi et al. (2014), and Onu (2010), who reported improved weight gain in broilers fed diets supplemented with red pepper and black pepper.

Feed Conversion Ratio (FCR)

The average weekly feed conversion ratio (FCR) across treatment groups is presented in Table 4. Supplementation with red pepper and black pepper did not significantly affect FCR during the 1st week ($p = 0.1$). However, by the 3rd week, the highest FCR was observed in T1 (control), which was statistically similar to T3 (0.02% black pepper). In contrast, T2 (0.02% red pepper), T4 (0.01% red pepper + 0.01% black pepper), and T5 (0.02% red pepper + 0.02% black pepper) showed significantly lower FCR values ($p < 0.05$). By the 5th week, the lowest FCR was recorded in T5, which was statistically similar to T4. This improvement in FCR can be attributed to the antibacterial and digestive properties of red and black pepper, which enhance nutrient absorption and gut health (Hassan et al., 2007).

Table 3: Mean weekly cumulative live body weight (mean±SD) (g/bird/week) of Cobb 500 broilers fed diet supplemented with different levels of black pepper and red pepper.

Treatments	Cumulative live body weight (g/bird/week) of Cobb 500 in various week (mean±SD)				
	1 st week	2 nd week	3 rd week	4 th week	5 th week
T ₁	350.2±2.1 ^a	717±4.3 ^a	1241.54±8.2 ^a	1638.9±9.9 ^a	2151.21±13.2 ^a
T ₂	364±2.8 ^a	761.92±4.9 ^b	1331.93±6.3 ^b	1718.74±9.4 ^a	2425.72±12.7 ^b
T ₃	379.4±3.2 ^a	789.09±4.5 ^b	1308.2±9.2 ^b	1725.72±12.1 ^a	2452.39±14.2 ^{bc}
T ₄	370.01±2.6 ^a	779.05±5.1 ^b	1299.23±7.8 ^b	1801.02±10.6 ^b	2560.21±16.4 ^{cd}
T ₅	375.41±3.2 ^a	783.73±5.2 ^b	1328.21±10.2 ^b	1811.01±12.5 ^b	2615.01±16.1 ^d
Grand Mean	369.3	770.4	1302.8	1725.5	2443.4
F value	2.02	4.14	7.48	5.57	17.44
Probability	0.142	0.018	<0.0016	<0.006	<.0001
CV %	4.550	3.65	2.052	3.41	3.49
SEM	16.57	27.8	26.6	19382.7	85.03

Means in a column with different superscript differ significantly by LSD ($P < 0.05$), where CV= Coefficient of Variation, SEM= Standard error of the mean, LSD= Least significant difference

Table 4: Mean±SD weekly feed conversion ratio of Cobb 500 broilers fed diet supplemented with different levels of red pepper and black pepper.

Treatments	Feed conversion ratio of Cobb 500 (mean±SD) in Weeks of observation				
	1 st week	2 nd week	3 rd week	4 th week	5 th week
T ₁	1.213±0.002 ^a	1.458±0.006 ^a	1.651±0.007 ^a	2.021±0.003 ^a	2.129±0.005 ^a
T ₂	1.164±0.004 ^a	1.364±0.005 ^a	1.516±0.002 ^b	1.933±0.005 ^{ab}	1.883±0.003 ^a
T ₃	1.107±0.006 ^a	1.307±0.005 ^b	1.567±0.003 ^a	1.872±0.004 ^{bc}	1.856±0.007 ^{ab}
T ₄	1.132±0.005 ^a	1.334±0.007 ^b	1.493±0.003 ^b	1.797±0.005 ^c	1.761±0.004 ^{bc}
T ₅	1.145±0.003 ^a	1.316±0.002 ^b	1.449±0.005 ^b	1.786±0.007 ^c	1.682±0.006 ^c
Grand Mean	1.11	1.35	1.54	1.89	1.92
F value	2.31	3.22	9.60	7.34	21.79
Probability	0.10	<0.04	<0.0005	<0.0018	<.0001
CV %	4.69	5.04	9.48	3.8	3.788

Means in a column with different superscript differ significantly by LSD ($P < 0.05$), where CV= Coefficient of Variation, SEM= Standard error of the mean, LSD= Least significant difference

Conclusion

The inclusion of 0.02% red pepper and 0.02% black pepper in broiler diets significantly improved growth performance, as evidenced by higher body weight gain and better FCR. The bioactive compounds in these spices, such as piperine, capsaicin, and phenolic compounds, likely contributed to enhanced digestion, nutrient absorption, and gut health. These findings are supported by numerous studies (Valiollahi et al., 2014; Safa, 2014), which highlight the potential of herbal additives as sustainable alternatives to synthetic growth promoters. In conclusion, supplementing broiler diets with 0.02% red pepper and 0.02% black pepper is a simple and effective strategy to improve overall growth performance, including body weight gain and feed efficiency.

Authors' Contribution

All authors contributed to the study's conception and design. Rabin Acharya: Writing original draft, editing, methodology, investigation, data curation, and supervision. Manish Gautam: Conceptualization, writing review and editing, data curation, and analysis. Tek Pandey: Literature review, methodology, and investigation. Bishnu Prasad Adhikari: Investigation and editing. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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