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Effect of Neem (*Azadirachta indica*) Leaves Powder and Cinnamon (*Cinnamomum zeylanicum*) Oil on Growth Performance of Broiler Chickens

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ABSTRACT

Background: This study was conducted to assess the effect of neem (*Azadirachta indica*) leaves powder (NLP) and cinnamon (*Cinnamomum zeylanicum*) oil (CNO) on the growth performance of broiler chickens.

Methods: Four hundred twenty day old commercial Vencobb 400 broiler chicks were randomly distributed into 6 groups of 7 replicates each. Dietary treatments were; T0 (control: basal diet), T1 (basal diet + 2 g NLP/kg), T2 (basal diet + 4 g NLP/kg), T3 (basal diet + 100 mg CNO/kg), T4 (basal diet + 200 mg CNO/kg) and T5 (basal diet + 2 g NLP/kg + 100 mg CNO/kg).

Result: Birds of supplemented groups showed improved average daily gain (ADG), better FCR and broiler performance efficiency index. Overall ADG was significantly high in T3 than other groups. The FCR of T3 and T5 groups, which were fed CNO 100 mg/kg and a combination of CNO (100 mg/kg) and NLP (2 g/kg), respectively, were better than control as well as other groups. It can be concluded that dietary supplementation of cinnamon oil (100 mg/kg) along with neem leaves powder (2 g/kg) has the potential to improve growth performance of broiler chickens. However, 100 mg/kg CNO can be recommended in the diet of broiler chickens as an alternative growth promoter for better production and optimum health status.

Key words: Broiler chickens, Cinnamon oil, Growth, Neem leaves powder.

INTRODUCTION

India has achieved a significant development in terms of broiler production because of successful broiler farming, which has gained much fame recently. Total poultry population in our country is 851.81 million (Commercial Poultry-534.74 million) in 2019 (20th Livestock Census), increased by 16.8% over previous census in 2012 (Singh, 2020). Meat production from poultry is 4.47 million tonnes, contributing about 50.84% of total meat production (BAHS, 2021). Broiler meat is a salubrious source of high-quality proteins, minerals and vitamins. Broilers are given a variety of synthetic medications and growth boosters, which are costly, unpleasantly affect bird health and have long-term residual properties (Thi Huong-Anh *et al.,* 2020). Growth Promoters are added to chicken feed for better appetite, improved feed conversion, stimulation of immune system, regulation of intestinal microflora and so forth. Pros and cons have been experienced with usage of antibiotics during last 50 years, directing research back to natural antimicrobial agents as indispensable resources. As a result, poultry researchers are refocusing their efforts on our traditional medicinal system to uncover beneficial plants and their extracts that may be safely used to boost productivity (Obikaonu *et al.,* 2012).

Different herbs like garlic, ginger, cloves, turmeric, moringa, neem, gooseberry, sage, thyme, mustard and fenugreek are used in both humans and animals, for being digestive enhancers, antidiarrheal, antiseptic, anti-inflammatory and antiparasitic (Eevuri and Putturu, 2013). These herbal agents could serve as safer alternatives to antibiotic growth promoters due to their lower cost of production, reduced risks of toxicity and minimum health hazards. Neem (*Azadirachta indica*) is known for its useful medicinal properties like antibacterial, antiviral, antifungal, antiprotozoal, anticancerous, hepatoprotective, immuno modulator and various other properties without showing any adverse effects (Alzohairy, 2016). Recent biological trials on broilers with neem formulations have shown encouraging results, such as, improved weight gain, feed efficiency, lowered mortality, increased immunity and increased

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livability (Deka *et al.,* 2019; Ubua, *et al.,* 2019). Due to their antibacterial, hypocholesterolaemic, antioxidant, analgesic, antiulcer and anticandidial activities numerous plant extracts from cinnamon oils and their constituents (cinnamaldehyde and eugenol) are also employed as feed additives in poultry sector (Lin *et al.,* 2003; Debasish and Nath, 2020).

Based on the aforementioned information, the current study was conducted to assess the growth performance of broiler chickens supplemented with neem leaf powder (NLP), cinnamon oil (CNO) and their combination at different levels to observe if there is any synergistic effect.

MATERIALS AND METHODS

Experimental design

The feeding trial was conducted in the Poultry Farm Complex of Odisha University of Agriculture and Technology (OUAT), Bhubaneswar, Odisha during the month of April and May 2022 with an average temperature ranging from 25 to 38°C and relative humidity from 66 to 72 per cent. Four hundred twenty (N=420) day old commercial Vencobb 400 broiler chicks (37.92±0.22 g/bird) were procured from Venkateshwara Hatcheries Pvt. Ltd., Nayapalli, Bhubaneswar. Chicks were wing banded for identification and kept in brooder by maintaining optimum brooder temperature (33.9 to 35°C) for three days. *Ad libitum* pre-starter crumbles (22% crude protein and 3000 kcal ME/kg) were offered to chicks for first 7 days of age. Chicks were vaccinated against Marek's Disease, Ranikhet Disease and Infectious Bursal Disease as per standard schedule. All biosecurity measures were adopted during the experimental period.

On d 7, chicks were weighed individually and randomly distributed into 6 treatment groups *i.e.,* T0, T1, T2, T3, T4 and T5 having 70 chicks in each group with 7 replicates of 10 chicks each by following randomized block design (RBD). Experimental diets (Table 1) were formulated for starter and finisher phases to meet the nutrient requirement (ICAR, 2013). T0 (control) group was fed with basal diet; whereas, the treatment groups were fed basal diet supplemented with neem leaves powder (NLP) @ 2 g/kg feed (T1), NLP @ 4 g/kg feed (T2), cinnamon oil (CNO) @ 100 mg/kg feed (T3), CNO @ 200 mg/kg feed (T4) and NLP @ 2 g/kg feed + CNO @ 100 mg/kg feed (T5), respectively during starter and finisher phases.

Performance of broiler chickens during starter, finisher phases and overall period of experiment was calculated for body weight, average daily gain, average daily feed intake and feed conversion ratio. Broiler performance efficiency index was also calculated as described by Martins *et al.* (2016). Data generated in the experimental period were analyzed by using SPSS statistical software (IBM SPSS version 21, Chicago, Illinois, USA) with one way ANOVA. Means were compared by using post hoc test (Duncan multiple range test) at 5% level of significance.

Source and preparation of feed additives

Neem leaves powder was procured from Bhubaneswar, Odisha and cinnamon oil from Allinpro Industries Pvt. Ltd., Noida, Uttar Pradesh.

Fresh neem leaves were harvested manually from neem trees and were sundried for d 8-10 on polythene sheets until they become crispy while retaining the greenish colouration. The dried leaves were then ground properly in willy grinder to obtain fine particles (5 mm size). The powder was stored in a plastic container at room temperature for future use in the proposed experiment.

RESULTS AND DISCUSSION

There was significant effect (P<0.05) of supplementation on average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR) during d 7-21, 22-42 and 0-42 (Table 2). During d 7-21, T2, T3 and T5 groups showed higher ADG (P<0.05) when compared to other groups. T3 group showed highest ADG from d 22-42 of experimental period. T3 group had significantly higher final BW than other supplemented groups and control. Similar observations were found by Zanu *et al*. (2011), Ansari *et al.* (2012) and Shihab *et al*. (2017) who reported that NLP supplementation improved final BW of broiler chickens.

Table 1: Ingredient and chemical composition of the basal diet (% DM basis) during starter and finisher phase.

Ingredients	Starter (d 7-21)	Finisher (d 22-42)
Maize	45.3	51
Rice polish	10	10
GNC	18.5	16.4
Soyabean meal	20.5	17
Premix*	1.5	1.5
Salt	0.5	0.5
Vegetable oil	3.5	3.5
Lysine	0.067	0.06
Methionine	0.133	0.10
Total	100	100
Chemical composition		
CP (%)	21.21	19.37
ME (Kcal/Kg)	3042.55	3109.3
DM	90.48	90.06
EE	4.50	4.10
CF	4.35	5.25
Ca	1.43	1.53
P	0.57	0.51
Available P	0.45	0.45
Lysine	1.2	0.99
Methionine	0.5	0.4

*Each Kg contains: - Vitamin A: 8,00,000 IU, Vitamin D3: 80,000 IU, Vitamin E: 400 mg, Nicotinamide: 1200 mg, Cobalt: 200 mg, Copper: 1500 mg, Iodine: 500 mg, Iron: 2000 mg, Manganese: 2000 mg, Sodium: 10 mg, Sulphur: 9.5 g, Zinc: 10000 mg, Calcium: 300 g, Phosphorus: 150 g.

Table 2: Average daily gain (ADG; g/d), body weight (BW), average daily feed intake (ADFI; g/d), feed conversion ratio (FCR) and broiler performance efficiency index (BPEI) of broiler chickens (d 0-42).

Attributes	Dietary treatments*						SEM	P-value
	T0	T1	T2	T3	T4	T5		
ADG (g)								
d 0-6	110.07^{b}	109.33^{b}	117.85^{a}	114.32^{ab}	113.43^{ab}	113.25^{ab}	2.85	0.041
d 7-21	582.6^{b}	589.6^{b}	633.75^{a}	655.47^{a}	579.35^{b}	640.1^{a}	13.92	<0.001
d 22-42	1033.13^{d}	1149.87^{b}	1078.92^{cd}	1206.60^{a}	1130.30^{bc}	1129.13^{bc}	26.52	<0.001
d 0-42	1725.80^{c}	1848.80^{b}	1830.52^{b}	1976.38^{a}	1823.08^{b}	1882.48^{b}	31.00	<0.001
Final BW (g)	1762.72^{c}	1887.07^{b}	1868.10^{b}	2014.87^{a}	1861.23^{b}	1920.62^{b}	31.02	<0.001
ADFI (g)								
d 0-6	141.08	141.30	141.53	140.68	140.83	141.67	0.47	0.258
d 7-21	978.19^{a}	882.12^{bc}	865.00^{c}	892.85^{bc}	889.03^{bc}	903.60^{b}	15.85	<0.001
d 22-42	2352.49^{ab}	2370.48^{a}	2274.72^{c}	2318.69^{bc}	2278.41^{c}	2207.85^{d}	21.22	<0.001
d 0-42	3471.76^{a}	3393.90^{b}	3281.26^{d}	3352.22^{bc}	3308.27^{cd}	3253.11^{d}	31.64	<0.001
FCR								
d 0-6	1.31	1.32	1.22	1.25	1.26	1.28	0.04	0.069
d 7-21	1.71^{a}	1.55^{b}	1.38^{c}	1.38^{c}	1.58^{b}	1.43^{c}	0.05	<0.001
d 22-42	2.36^{a}	2.08^{bc}	2.14^{b}	2.00^{c}	2.05^{bc}	1.98^{c}	0.05	<0.001
d 0-42	1.98^{a}	1.81^{b}	1.77^{b}	1.69^{c}	1.79^{b}	1.71^{c}	0.03	<0.001
BPEI	145.83^{c}	171.37^{b}	164.90^{b}	213.57^{a}	172.16^{b}	220.79^{a}	9.17	<0.001

*T0= Control (basal diet), T1= Basal diet + NLP (2 g/kg), T2= Basal diet + NLP (4 g/kg), T3= Basal diet + CNO (100 mg/kg), T4= Basal diet + CNO (200 mg/kg), T5= Basal diet + NLP (2 g/kg) + CNO (100 mg/kg).

^{abcd}Means bearing different superscripts in a row differ significantly (P<0.05).

Contrary to the present findings, Bonsu *et al*. (2012) and Nayaka *et al*. (2013) reported that BW was not affected by NLP supplementation in broilers. Results of present study are in agreement with that of Saied *et al*. (2022) who reported that CNO (500, 1000, 1500 mg/kg) supplementation significantly increased chickens' BW in comparison with control and antibiotic groups; however 500 mg/kg CNO level gave more salient results. Ahmed *et al*. (2019) found that BW of quail chicks significantly increased when supplemented with ginger or CNO than antibiotic. Mehdipour and Afsharmanesh (2018) also observed that adding 200 mg/kg CNO in quail feed improved BW and FCR when compared with control birds.

It was observed that ADFI differed significantly (P<0.001) during d 7-21 and d 22-42. During d 7-21, ADFI was highest in T0, followed by T5 and lowest in T2 group. When birds were on finisher diet, ADFI was least in T5 group. Overall feed intake (d 0-42) significantly (P<0.05) decreased in response to supplementation than control. This might be due to bitter taste (limonoid) of NLP and strong, warm and spicy aroma associated with CNO, thus decreasing feed palatability (Paul *et al.,* 2020). Findings of present study are in agreement with that of Akintomide and Onibi (2018), Beg *et al*. (2018) and Ubua *et al*. (2019), but contradicted to Zanu *et al.* (2011), Adeyemo and Akanmu (2012) and Bonsu *et al.* (2012) who reported no significant difference in feed intake between control and neem leaf fed groups and Mehdipour *et al.* (2013) who reported feed intake was not affected by CNO treatments.

During d 7-21 and 22-42, all the supplemented groups (T1 to T5) showed better FCR (P<0.001) than control group. Overall FCR (d 0-42) ranged from 1.69 to 1.81 in supplemented groups, which was significantly (P<0.001) better than control (1.98). Within supplemented groups, T3 and T5 groups performed better than other groups. This effect was more pronounced for birds fed with 100 mg/kg CNO in comparison with 200 mg/kg CNO and neem supplemented groups. This finding is in accordance with Devi *et al*. (2018) and Mehdipour and Afsharmanesh (2018) who reported that feeding 3 g/kg CNO + 4 g/kg ajwain and 200 mg/kg CNO respectively, improved FCR significantly when compared with control.

Both T3 and T5 groups showed better (P<0.001) BPEI when compared with control and other supplemented groups. This finding is in accordance with Devi *et al.* (2018) who found that European Production Efficiency Index significantly enhanced during upon supplementation of 3 g/kg CNO and 4 g/kg ajwain.

The observed enhancement in growth traits upon addition of CNO (100 mg/kg) in broiler diets may be imputed due to effect of some active constituents (cinnamaldehyde and eugenol) in cinnamon plant, which are regarded as stimulatory agents for digestion because of their accelerating ability to secrete endogenous digestive enzymes, safeguard intestinal villi *via* intercellular antioxidant action and favourably impact how well digested nutrients are absorbed (Jamroz *et al*., 2006). According to Toghyani *et al.* (2011), broiler chickens fed 2 g/kg cinnamon powder at d 28 and 42

had a higher BW than control. Ciftci *et al.* (2009) stated that higher BW and FCR were observed at d 35 by supplementing 500 mg/kg CNO in broiler diet than control and antibiotic-treated groups. Contrarily, Symeon *et al.* (2014) didn't find any significant effect of CNO supplementation on broiler chickens' growth performance.

Better performance was observed when CNO (100 mg/kg) and same dose of CNO with combination of NLP (2 g/kg) were fed to broiler chickens. This may be due to synergistic effect of CNO and NLP. Synergistic feed additives operate by combining their individual effects to produce outcomes that are superior to those of their single use (Ren *et al.*, 2019). Potency of lesser doses of herbal products like neem oil as compared to individual components can be attributed to synergistic interactions between multiple ingredients prevalent within plant extracts, which may be preferred over a single isolated substance (Aiyegoro and Okoh, 2009). Combining essential oils (EO) can provide a synergistic result. Components of different plants' EOs have been postulated to work synergistically in a plethora of ways, such as by impacting diverse targets as well as through physicochemical interactions (Vankar and Wijayapala, 2019).

CONCLUSION

Based on the results, it may be concluded that CNO @ 100 mg/kg and same dose of CNO with combination of NLP @ 2 g/kg performed better in respect of growth, FCR and BPEI than NLP. Lower dose of NLP (2 g/kg) also proved to be better than control. NLP can be included in broiler diets up to 2 g/kg and CNO up to 100 mg/kg without any adverse effects on their growth performance. It was observed that NLP with CNO combination yielded better results than individual NLP supplementation and similar results with 100 mg/kg CNO. Hence, 100 mg/kg CNO can be recommended in broiler chicken diet as an alternative growth promoter (feed additive) for better production. However, further more intricate studies with different amount of dietary supplementation of NLP and CNO and/or combination of both may be helpful in achieving better health status of broiler chickens.

Conflict of interest: None.

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