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Evaluating the Dietary Supplementation of Canna indica essential oil on the growth performance and Carcass measurement of broiler chickens

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Abstract

A 42-day experiment was carried out to examine the dietary supplementation of Canna indica essential oil on the growth performance and carcass measurement of broiler chickens. 200 one-day old unsexed broiler chicks (Cobb 500) with average initial BW of 45.00 ± 0.20 g were randomly divided into four dietary treatments and five replications per a treatment having 10 chicks per a replicate. Treatment 1 which also serves as the control contains basal diet only, treatment 2, 3, 4 and 5 were given basal diet supplemented with Canna indica leaf oil at 0.3 mL, 0.6 mL, 0.9 mL and 1.2 mL per kilogram dry matter feed daily. Result obtained suggests that average daily weight gain, average daily feed consumption and feed conversion ratio improved ($p<0.05$) among birds supplemented with Canna indica oil compared to the control. Mortality of 2 % was recorded only among birds which received diet A ($p<0.05$). Dietary supplementation of Canna oil up to 1.2 ml/kg also enhanced ($p<0.05$) dressing percentage, weights of the neck, wing, back, breast, thigh, shank and abdominal fat except the head ($p>0.05$). It was concluded that Canna indica oil is a pharmacological powerhouse with numerous bioactive compounds which possess the ability to promote growth and improve carcass parameters without causing any deleterious effect when supplemented up to 1.2 ml/kg in the diet of broiler chickens.

Key words: antimicrobial; anti-inflammatory; broilers; canna indica; carcass; growth; performance

Introduction

Canna indica (Cannaceae) is a perennial and rhizomatous herb that has a long standing role in traditional medicine that is now been validated by modern science [1]. The plant parts (seeds, roots and leaves) contains chemical compounds (phytochemicals) including, phenols, alkaloids, flavonoids, tannins, terpenoids, glycosides, anthocyanin, saponins and phlobatinins that do more than nourish [2]. Research has shown that extracts from Canna indica have anti-inflammatory properties which has been linked to the inhibition of inflammatory markers, making it a potential natural aid for conditions like cough, fever, malaria, arthritis, stomach disorder, skin disease, sexually transmitted disease, snake bite, eye problem amongst others [3]. The leaves of Canna indica contains polyphenols capable of protecting cells from oxidative damage, helping to combat some pathogenic bacteria's, improve glucose metabolism and help to reduce insulin response [4]. In pre-clinical studies, essential oils from Canna indica have shown anti-tumor activity by reducing cancer cell proliferation and are used to treat skin irritations [8, 9]. C. indica oil is rich in quercetin, a powerful antioxidant that prevents liver from toxins, it strengthens intestinal lining preventing against ulcers and neutralize free radicals that causes cellular damage [10, 11].

Previous studies by [12, 13] have shown that essential oils used as feed additives for broilers can promote the activities of gastric enzymes like trypsin and amylase. It has also been suggested that the presence of bioactive compounds can induce changes in cell membrane fluidity and permeability properties, resulting in an increased absorption of nutrients from the small intestine [11, 14]. Furthermore, active plant pyto-compounds are the potential effectors on microbial communities and therefore could considered as alternatives in controlling the intestinal microbial population [15, 16]. Improvement in body weight and feed conversion ratio have been recorded in broilers fed diet supplemented with Sunflower oil at 0.5 ml/kg diet. Similarly, [14,17] reported a higher body weight gain and feed conversion ratio was achieved on broilers receiving 0.8 ml/kg turmeric oil in diets followed by birds receiving diets with 0.6 ml/kg than the control group birds. [15] recorded a higher dressing percentage as well as breast weights of broilers fed a diet containing 2.5 g/kg of Polyalthia longifolia meal. Correspondingly, [18] recorded the highest dressed and breast weights in birds fed a diet containing 0.5 ml/kg Prosopis africana oil.

However, there is little or no information on the dietary effect of Canna indica oil, this research is timely because there is increasing awareness on

the use dietary supplementation on the use of medicinal plants to curb the rising global cases of antimicrobial resistance. Supplementation of Canna oil will further help to promote sustainability, food safety and reveal its tolerable level in animal feed to avoid toxicity.

Materials and methods

Description of the experimental location and processing of Canna indica leaf oil

The Poultry Unit at Gandhi College of Agriculture, Rajasthan in India was used for the experiment which took place between January to March, 2025. Canna indica leaf oil was obtained from Biochemistry Department, Gandhi College of Agriculture, India. Oil was previously extracted using steam distillation extraction technique according to the method described by [12] and stored in a sample collection bottles. Chemical composition of bioactive compounds identified in Canna bidentate seed oil as previously described by [19] is presented in Table 2.

Animals and their management

200 one-day old unsexed broiler chicks (Cobb 500) with average initial BW of 45.00 ± 0.20 g were randomly divided into four dietary treatments and five replications per a treatment having 10 chicks per a replicate. Before the commencement of the trial, battery cages, pens, watering and feeding troughs and other equipment's were thoroughly washed and disinfected with disinfectant with Morigadx Plus® and the room was fumigated by mixing potassium permanganate with formalin 10 percent solution. Basal diet was formulated as presented in Table 1 according to the Nutritional Research Council's requirement [20]. Animals were managed according to the management procedures outlined by Indian Society of Animal Production and the experimental treatments includes: treatment 1 which also serves as the control contains basal diet only, treatment 2, 3, 4 and 5 were given basal diet supplemented with Canna indica leaf oil at 0.3 mL, 0.6 mL, 0.9 mL and 1.2 mL per kg DM feed daily. The initial brooding temperature for birds was left at 32°C during the first week. Subsequently it was lowered by 2°C until it reached the room temperature of 26°C towards the end of the experiment. Strict bio-security measures were maintained throughout the experimental periods and a completely randomized design was adopted. Feed and fresh water were served unrestricted and the experiment lasted for 42 days under close supervision. Birds were weighed in group before the commencement of the trial and on weekly basis until the end of the experiment with a digital sensitive scale. Body weight gain was estimated as the sdifference between the final weight and initial body weight. Average daily body weight was calculated as body weight gain divided by number of experimental days. The amount of feed offered and refused per replicate were recorded daily. Feed consumption was estimated as the difference between the feed offered and refused. Feed conversion ratio (feed consumed to produce a unit of gain) was calculated as the ratio of average feed consumption to average body weight gain. Proximate analysis of experimental diet was carried out using Nobb Rapid Near Infra-Red Feed analyzer (Model ASD 3006C, Netherlands). Kit was operated in accordance to the technical guidelines stated on the manufacturer's manual.

Carcass and organ weight measurement

At the end of 42 days, fifty broiler chickens (2 birds/replicate) were selected at random, tagged, feed starved for 12 hours and weighed prior to slaughtering. Birds were slaughtered by severing the jugular vein, allowed to bleed and scalded in warm water and manually de-feathered. Carcass was washed in a cool water and manually eviscerated, weight of cut parts (wings, breast, thighs, back and drumsticks) and organs were taken using a digital sensitive scale. Dressing percentage was estimated using the formula below:

$$\text{Dressing percentage} = \frac{\text{Eviscerated weight}}{\text{Live weight}} \times 100$$

Statistical Analysis

The collected on performance and carcass measurements were subjected to the analysis of variance test using the General Linear Model (GLM) procedures of SAS statistical package version [11]. Duncan's multiple range test was used to examine the differences among the treatment means at ($p<0.05$)

Ingredients	Starter mash (0-21 d)	Finisher mash (22-42d)
Corn (9 % CP)	50.00	52.00
Wheat offal (10.9 % CP)	3.00	5.75
Soymeal (48 % CP)	35.25	30.00
Fish meal (70 % CP)	3.00	2.00
Bone meal	5.00	6.00
Oyster shell	2.50	3.00
L-Lysine	0.20	0.25
DL-Methionine	0.25	0.25
Premix (Mineral/Vitamins)	0.25	0.25
Mayes Toxin binder	0.20	0.20
Salt	0.35	0.30
Total	100.0	100.0
Determined analysis (%)		
Crude protein	23.45	21.19
Crude fibre	3.61	3.78
Ether extract	4.63	3.97
Calcium	1.18	1.20
Phosphorus	0.60	0.62
Lysine	1.31	1.16
Methionine	0.50	0.53
Energy (Kcal/kg)	3009.8	3200.3

Table 1: Chemical composition of the basal diet (expressed in percentage dry matter)

Mineral/Vitamin Premix: Thiamine, 2000 mg, riboflavin, 7000 mg, pyridoxine, 5000 mg, cyanocobalamine, 1700 mg, niacin, 30,000 mg, pantothenic acid, 10,000 mg, folic acid, 800 mg, biotin, 2000 mg, ascorbic acid, 60,000 mg, manganese, 20 mg, iron, 70mg ,200 mg, zinc, 500 mg, copper, 86.5 mg, cobalt, 200.3 mg, iodine, 40.0 mg, selenium, 80 mg, choline chloride, 500 mg

Results and discussion

Analysis of prominent bioactive compounds in Canna indica leaf oil displayed in Table 2. The oil contained: β-Caryophyllene (15.39 %), α-Terpinolene (13.08 %), 1,8-Cineole (10.92 %) followed by β-Cyclocitral (9.04 %), 2-Butyl octanol (8.29 %), β-Linalol (8.18 %), Cis-9-Tetradecenol

(8.06 %), α-Cedrene (5.66 %), α-Selinene (4.77 %), Humulane-1,6-dien-3-ol (4.31 %), α-Bergamotene (4.19 %), Hexadecanoic acid (4.06 %), Squalene (3.91 %), Cis-9-Octadecenoic acid (3.05 %), Cubenol (2.96 %), Trans Phytol (2.17 %) and Ethylbenzene (3.05 %) respectively. This result shows that Canna indica oil holds different kinds of medicine that heals and rebuilds the body system of animals. These molecules or compounds protects the liver from oxidative stress, enhances bile flow and supports detoxification [21, 22]. α-Terpinolene, 1,8-Cineole, Hexadecanoic acid and β-Caryophyllene have been reported to possess antimicrobial properties and could hinder the activities of some pathogens in the gut [23]. They are chemical powerhouse which serves as topical antibacterial base, stabilize deoxyribonucleic acid and protects lipids from peroxidation [24]. β-Linalol, β-Cyclocitral, α-Cedrene, α-Selinene and Squalene behaves like a biological shield, increases antioxidant enzymes like catalase, superoxide dismutase and glutathione peroxidase protecting liver from fatty accumulation, improving insulin sensitivity achieved without drugs [25]. Cubenol can serve as a topical antibacterial base and inhibit the proliferation of Staphylococcus aureus, Escherichia coli and Candida albicans in bird's gastrointestinal tract [26]. Humulane-1,6-dien-3-ol and 2-Butyl octanol have been suggested to reduce inflammation in the respiratory tract and act as expectorant clearing mucus and calming irritation [20]. Concentration of Canna indica oil observed in this study further aligns with the previous result by [27]. Together, these bioactive compounds form a pharmacological synergy to form a complete defense system, antioxidant at cellular level, antimicrobial at microbial level and metabolic at systemic level [28, 29].

In Table 3, the growth performance of broiler chicken fed basal diet supplemented with Canna indica oil. In the starter phase (0 to 21d), average daily weight gain and average daily feed consumption values which varied from 29.98 to 33.27 g/b and 67.15 to 71.34 g/b were significantly ($p<0.05$) influenced by the treatment. Average daily weight gain was higher in diet B (32.28 g), C (33.07 g) and D (33.27 g) than in diet A (28.98 g). Similarly, at the finisher phase, Average daily weight gain was lower in among birds which fed diet A (68.60 g) than in diet B (81.36 g), C (81.50 g) and D (81.68 g) ($p<0.05$). Overall production (0 to 42 d) shows that birds fed diet supplemented with Canna indica oil had the highest average daily body weight and average daily feed consumption relative to the control which received diet A. However, total body weight gains of birds fed diet B (2386.72 g/b) and C (2406.15 g/b) were similar ($p>0.05$) to those in diet D. Total feed consumption among birds fed was lower among birds in diet A (4591.0 g/b) than in diet B (5039.4 g/b), C (5049.4 g/b) and diet D (5057.4 g/b) ($p<0.05$). This outcome suggests that C. indica oil can enhance the secretion of gastro intestinal enzymes, augment nutrient absorption and suppress the activities of pathogenic organisms in the avian gut resulting in increased body weight. This result obtained aligns with the report of [30] when papaya oil was supplemented in the diet of broilers at 50 mg/kg diet. Similar observation was made by [31] when broiler chickens were fed aqueous extract of Balanites aegyptiaca and Alchornea cordifolia stem bark mixture. Because of the experimental diet's flavor and aroma, Canna indica oil had a positive effect of birds feed consumption at both the starter and finisher phase, this result is in line with the findings of [32, 25] who discovered that feeding broilers with different levels of ginger (Zingiber officinale) and garlic (Allium sativum) oil enhanced feed intake. The higher feed consumption may be caused by the oil's bioactive components which have proven track record of efficiency and safety [32]. Higher mortality among birds which received diet A confirms the antibacterial potential of Canna indica oil. Previous studies by [26, 33] have shown that supplementation of essential oil in the diet of birds can modulate immunity and serve as a natural drug carrier.

In Table 4, carcass and organ measurement of broiler chicken fed basal diet supplemented with Canna indica oil. Eviscerated weight and dressing percentage were lower ($p<0.05$) in diet A (1400.7 g; 80.36 %) than diet B (1770.5 g; 88.76 %), diet C (1783.5 g; 89.17 %) and D (1785.6 g; 89.26 %) respectively. Dressing percentage were within 80.19 – 89.37 % reported by [28] when broilers were fed different levels of Moringa oleifera and Allium sativum. Significant influence ($p<0.05$) was observed in weight of back (223.6 – 271.2 g), breast (361.2 – 460.9 g), wing (141.6 – 159.2 g), neck (75.53 – 88.91 g), thigh (177.4 – 213.1 g), shank (70.02 – 84.03 g) and abdominal fat (6.34 – 10.46 g) except for the head (42.11 – 45.64 g) ($p>0.05$). The outcome obtained in this study indicates that Canna indica oil can positively influence the body weight of birds by creating a balanced intestinal flora which gives room for a better feed conversion ratio. According to [34], ginger, garlic and Negro pepper could have a significant effect on the dressing percentage of broiler meat. Abdominal fat value which varied from 6.34 – 10.46 g was within 6.60 – 12.00 g reported by [35].

Bioactive components	Concentration (%)[12]	Reaction time (min)
α-Terpinolene	13.08	3.04
1,8-Cineole	10.92	5.51
β-Linalol	8.18	7.80
β-Cyclocitral	9.04	10.24
2-Butyl octanol	8.29	11.21
α-Cedrene	5.66	13.30
β-Caryophyllene	15.39	14.05
α-Selinene	4.77	14.84
Cis-9-Tetradecenol	8.06	15.23
Humulane-1,6-dien-3-ol	4.31	15.98
Hexadecanoic acid	4.06	16.05
Squalene	3.91	17.12
Cis-9-Octadecenoic acid	3.05	18.04
Cubenol	2.96	18.55
Trans Phytol	2.17	19.21
Ethylbenzene	3.05	19.56
α-Bergamotene	4.19	19.80

Table 2: Analysis of prominent bioactive compounds in Canna indica leaf oil13

Parameters	A	B	C	D	SEM
Starter phase (0 to 21d)					
Initial body weight (g/b)	43.11	43.09	42.95	42.88	0.02
Final body weight (g/b)	651.8	721.11	737.5	741.6	4.33
Body weight gain (g/b)	608.69b	678.02a	694.55a	698.72a	3.81

Average daily weight gain (g/b)	28.98b	32.28a	33.07a	33.27a	0.11
Feed consumption (g/b)	1410.2b	1488.3a	1491.2a	1498.3a	45.61
Average daily feed consumption (g/b)	67.15b	70.87a	71.00a	71.34a	0.23
Feed conversion ratio	2.31a	2.19b	2.14c	2.14c	0.01
Finisher phase (22 to 42d)	2.00	-	-	-	0.001
Body weight gain (g/b)	1440.7	1708.7	1711.6	1715.3	25.69
Average daily weight gain (g/b)	68.60b	81.36a	81.50a	81.68a	0.02
Feed consumption (g/b)	3180.8b	3551.1a	3558.2a	3559.1a	72.07
Feed conversion ratio	2.21a	2.08b	2.07b	2.07b	0.01
Overall production (0-42 d)	-	-	-	-	
Total weight gain (g/b)	2049.39b	2386.72a	2406.15a	2414.02a	74.11
Average daily weight gain (g/b)	48.79b	56.82a	57.28a	57.47a	0.04
Total feed consumption (g/b)	4591b	5039.4a	5049.4a	5057.4a	59.31
Average daily feed consumption (g/b)	109.3b	119.9a	120.2a	120.4a	0.44
Feed conversion ratio	2.24a	2.11b	2.10b	2.10b	0.01
Mortality (%)	2.00	-	-	-	

Table 3: Growth performance of broiler chicken fed basal diet supplemented with Canna indica oil

*a,b within a row with different superscripts differ significantly ($p<0.05$); diet A = Control: basal diet without Canna indica oil, diet B = basal diet + 0.3 mL per kg dry matter feed daily, diet C = basal diet + 0.6 mL per kg dry matter feed daily, diet D = basal diet + 0.9 mL per kg dry matter feed daily, diet E = basal diet + 1.2 mL per kg dry matter feed daily; SEM = Standard error of the mean.

Parameters	A	B	C	D	SEM
Live weight (g)	1981.6	2206.5	2304.5	2311.1	60.82
Dressed weight	1700.6b	1994.6a	2000.1a	2000.4a	49.26
Eviscerated weight	1400.7b	1770.5a	1783.5a	1785.6a	27.10
Dressing %	80.36b	88.76a	89.17a	89.26a	0.05
Head (g)	42.11	45.28	45.52	45.64	0.03
Neck (g)	75.53b	87.83a	88.55a	88.91a	0.02
Wing (g)	141.6b	156.7a	158.9a	159.2a	0.14
Back (g)	223.6b	266.7a	270.4a	271.2a	0.17
Breast (g)	361.2b	453.1a	458.7a	460.9a	0.95
Thigh (g)	177.4b	205.8a	211.4a	213.1a	0.47
Shank (g)	70.02b	82.56a	83.14a	84.03a	0.48
Abdominal fat (g)	6.34b	10.05a	10.33a	10.46a	0.92

Table 4: Carcass and organ measurement of broiler chicken fed basal diet supplemented with Canna indica oil

*a,b within a row with different superscripts differ significantly ($p<0.05$); diet A = Control: basal diet without Canna indica oil, diet B = basal diet + 0.3 mL per kg dry matter feed daily, diet C = basal diet + 0.6 mL per kg dry matter feed daily, diet D = basal diet + 0.9 mL per kg dry matter feed daily, diet E = basal diet + 1.2 mL per kg dry matter feed daily; SEM = Standard error of the mean.

Conclusion

In conclusion, Canna indica oil is packed with nutrients and bioactive compounds with numerous pharmacological relevance. These compounds are not only food that heals, it is natures prescription rooted in tradition and growing scientific promise. The experimental result showed that the supplementation of Canna indica oil in the diet of broiler chickens up to 1.2 ml/kg dry matter had a positive effect on their growth performance and dressing percentage without compromising their health status.

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