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Effects of Beetroot Juice Supplementation on Performance, Blood-biochemistry of Kadaknath Chicken Raised Under Farm Conditions

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ABSTRACT

The present study aimed to determine the effects beetroot juice (*Beta vulgaris*) on performance and Blood-biochemical parameters of Kadaknath birds raised under farm conditions. Present investigation was carried out on Kadaknath chickens aged 6 weeks at poultry unit of Livestock farm complex, College of Veterinary and Animal Science, Navania, Udaipur (Rajasthan University of Veterinary and Animal Sciences) India. There were three treatment groups, each of which had four replicates and ten chicks. Beetroot juice was added to the birds' drinking water daily in quantities of 0 ml (T1) served as control, 15 ml (T2), and 25 ml (T3) for a period of six weeks. Each treatment group had an impact on body weights, weight gain, and feed conversion efficiency that was statistically significant (p <0.05). At six weeks of age, the treatment group T3 had the highest body weight, highest weight gain, and the best FCR. Treatment effects on packed cell volume (PVC), hemoglobin (Hb) and red blood cells (RBC) were significant (p <0.05) with T3 having the highest values of 41.33%, 11.05 g/dL and 3.72 × 106 uL respectively. There was no difference seen on lymphocytes and red blood cells in the present study. Serum biochemical markers significantly (p <0.05) varied; T3 birds had the lowest levels for triglycerides, cholesterol, and glucose. The results of this study showed that adding 25 ml of beet juice (*Beta vulgaris*) to drinking water will enhance growth performance, PCV, and Hb and also reduces glucose, cholesterol and triglyceride level of Kadaknath birds.

HIGHLIGHTS

- Inclusion of beetroot juice to drinking water of Kadaknath chickens improves their growth performance, FCR and blood-biochemical profile without antibiotic prophylactic treatment.
- Supplementation of beetroot juice at 0.02% in kadakanath drinking water improves their overall level of metabolis.

Keywords: Kadaknath, beetroot (*Beta vulgaris*), performance, blood-biochemistry, farm

Among the livestock industries in India, poultry farming holds a unique place due to its huge potential to promote rapid economic growth at a low cost. It is one of agriculture's most profitable sectors since it provides wholesome meat and eggs for human consumption in the shortest amount of time (Arora *et al.,* 2011; Das *et al.,* 2016). To remain competitive and grow in order to satisfy rising consumer demand for eggs and meat, poultry production in India must have access to low-cost, high-quality feeds on a consistent basis. About 70% of the total cost of raising chickens is incurred by feed alone. In order to make it economically viable and profitable for both skilled and unskilled labor, special emphasis had to be paid to lowering feed costs, which in turn reduce input costs. As per National Bureau of Animal Genetics and Resources (NBAGR), currently, 19 breeds of poultry are registered nationwide. One popular native breed among these is "Kadaknath," which refers to a bird with black flesh. The bird is a native of Madhya Pradesh's western

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Jhabua and Dhar regions. According to the research that is currently accessible, Kadaknath lays about 80–90 eggs every year (Rahangdale *et al.,* 2017). The popularity of Kadaknath birds is due to their adaptability to local climatic circumstances, breed-specific requirements, meat quality, and disease resistance (Shanmathy *et al.,* 2018; Karoriya *et al.,* 2019).

Over the past ten years, there has been an increase in public knowledge of feed additives. Broilers can be fed natural growth promoters like prebiotics, probiotics, enzymes, and plant extracts without any negative effects on the birds' performance (Borazjanizadeh *et al.,* 2011). Herbs and natural items are cheap and can be utilized as substitute feed additives to improve poultry bird performance (Hashemi *et al.,* 2011; Mona *et al.,* 2017). Native to the Mediterranean region, beetroot is often referred to as garden beet, table beet, or red beet. Additionally, its crimson red color is well-known. Beetroot is a native plant that is grown for its heavy, meaty roots. In addition to being a great source of vitamins, minerals, and antioxidants, beetroot also includes special phyto-constituents that make it a particularly potent nutritional (Kumar *et al.,* 2018; Grace *et al.,* 2020). In the poultry business, evaluating viable alternatives to the use of antibiotics in antibiotic-free programs is a critical issue right now. It is therefore essential to develop feed additives that support broiler performance in ABF programs. The purpose of this study was to evaluate the effectiveness of beet juice as an alternative in ABF programs and its impact on the performance and blood-biochemical parameters of Kadaknath chickens.

MATERIALS AND METHODS

The experiment was conducted at Poultry Farm of Livestock Farm Complex, College of Veterinary and Animal Science, Navania, Vallabhnagar, Udaipur (Rajasthan University of Veterinary and Animal Sciences, Bikaner). One hundred and twenty (120) day old Kadaknath chicks from a commercial hatchery in Udaipur, Rajasthan, were used for the study. In the brooding process, heat and light were provided by electrical hover brooders. The period of brooding lasted for 2 weeks.

Ethical permission

The institute's ethical standards were followed when handling animals. The Institutional Animal Ethics Committee (IAEC) authorized the experiment according to order no. 2143/G/Re/SL/22/RAJUVAS.

Procurement and processing of beetroot

Fresh beetroot were purchased from the local market in Vallabhnagar, Udaipur. The beetroot used were peeled and rinsed. It was further chopped into smaller cubes in half to make it easier to put the chunks into the juicer and extract the juice**.**

Experimental design, housing, feeding, and measured traits

A total of 120 birds were randomly assigned to three treatment groups up to six weeks of age. Each treatment received four replications, and ten chicks were assigned to each replication. The three treatment groups included graded levels of beetroot juice in drinking water were as follows: T1 control group: water plus antibiotic additive, T2: water plus 15 ml beetroot juice per liter of water, T3: water plus 25 ml beetroot juice per liter of water.

Both sexes were reared together on deep litter floor. The experimental pens, drinkers, and feeding troughs were cleaned, disinfected, and sprayed against external parasites before the commencement of experiment. During the entire experimental period, all experimental chicks were handled identically and strict hygienic measures were taken as per standard practice. On the 4^{th} and 14^{th} days, broiler chicks were vaccinated against Ranikhet Disease (F1 strain) and Infectious Bursal Disease (IBD).

The chicks were given commercially available ready-made broiler starter and broiler finisher feed. The chicks were fed in three phases: broiler pre-starter (0-8 days), starter (9-21 days), and broiler finisher (22-42 days) feeds for various treatments, as per BIS criteria provided in Tables 1 and 2. The feed was prepared as per standard available in nutrient requirements of poultry; book published by Indian Council of Agriculture research (ICAR), New Delhi, India (Singh, 2013).

Mortality

No mortality observed in the whole research trial period.

Table 1: Ingredients and nutrient composition (% DM) of pre starter, starter and finisher rations

Ingredients	Broiler pre-starter	Broiler starter	Broiler finisher
Maize (%)	54.2	55.3	58.4
Soyabean meal (%)	42.0	40.9	37.7
Di-calcium phosphate (%)	1.5	1.5	1.5
Limestone powder (%)	2.0	2.0	2.1
Salt (%)	0.32	0.32	0.32
Supplements (g/100kg)			
Mineral mixture	301	301	301
Vitamin mixture	149	149	149
Methionine (g/100kg)	362	362	325
Lysine	168	129	100
Choline chloride	58	58	58
Crude protein (%)	23.0	22.25	20.21
Metabolizable energy (Kcal/kg)	3010.6	3100.1	3201.22
E:P ratio	130.46:1	139.38:1	158.37:1
Lysine	170	130	100

Table 2: Estimated proximate analysis of broiler Pre- starter, starter and finisher ration

Sl. No.	Particular	Pre-starter (0-8 days)	Starter (9-21 days)	Finisher (22-42 days)
1	Moisture%	10.84	10.74	10.61
2	Crude protein %	22.47	21.55	19.38
3	Crude fat %	3.74	3.42	3.36
4	Crude fibre (CF %)	3.62	3.04	2.66
5	Total Ash	7.96	5.18	4.50
6	Acid Insol. Ash	0.38	0.22	0.43
7	Calcium	1.18	1.18	1.03
8	Phosphorous	0.71	0.68	0.57
9	Salt	0.33	0.32	0.32

Data collection and Statistical analysis

Data regarding growth performance, feed conversion efficiency and haemato-biochemical indices were recorded in M.S. Excel on daily basis. Weight gain was calculated on weekly basis by subtracting weight of the respective week from last week weight. The FCR was calculated by dividing the feed consumption by weight gain. Blood samples of approximately 3 ml of wing vein from 2 representative birds of each replication were collected on the 42nd day of the experiment for hematological and serum biochemical parameters. Using an automated hematology analyzer, half of the blood was transferred to sterilize EDTA containing vacutainer tubes for the measurement of PCV, hemoglobin (Hb), RBC_S, WBC_S and lymphocytes. The residual blood sample was transferred to non -EDTA tubes for serum restoration. The serum was collected and processed for examination under deep freezing temperature, as per the normal protocol. Such samples were analyzed using an electronic biochemistry analyzer for total cholesterol, triglycerides and glucose (Karoriya *et al.,* 2019).

The data collected on various parameters were subjected to one-way ANOVA using SPSS software Version 22.0 (Snedecor *et al.,* 1994). Differences were considered to be statistically significant if probability value was less than 0.05. Significant ($p<0.05$) differences among variables were separated using Duncan's Multiple Range Test (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Effect of beetroot juice on growth performance

Results pertaining to growth performance of Kadaknath birds are presented in table 3 to 6. In the current study, the addition of graded levels of beetroot juice to water had a significant ($p\leq 0.05$) impact on the weekly body weight, weight gain, feed consumption, and FCR.

Table 3: Effect of graded level of beetroot juice on Body weight (g) of kadaknath chicken

Age (weeks)	Treatment groups		
	$T1_{(0ML)}$	$T2_{(15\ ML)}$	$T3_{(25\ ML)}$
1st	35.01±0.16 ^{a}	36±0.35 ^{b}	36.47±0.11^{b}
2nd	50.25±0.08 ^{a}	54.23±0.30 ^{b}	55.43±0.11 ^{c}
3rd	83.06±0.17 ^{NS}	83.37±0.14 ^{NS}	83.68±0.38 ^{NS}
4th	126.06±0.23 ^{a}	126.42±0.17 ^{a}	128.36±0.39 ^{b}
5th	176.03±0.31 ^{a}	176.65±0.31 ^{a}	177.69±0.37^{b}
6th	250.09±0.20 ^{a}	250.81±0.19 ^{b}	253.19±0.26 ^{c}

** Significant (P<0.05), * - Significant (P< 0.01)**, N.S.-Non – significant, [1]SEM, standard error mean, [a,b,c] Means in distinct columns with different superscripts differ significantly from one another.*

Results showed that the T3 group had higher final body weight (253.19 g) and body weight gain (76.25 g) while T1 (control) group had the lowest body weight (250.09 g) and least weight gain (73.98 g). However, the T1 (control) group had the highest feed intake (155.80 g), followed by the T2 (154.87 g) group and least intake was observed in T3 (154.42 g) treatment group. The birds in the T3 group had the best FCR (2.09), whereas birds fed control diets had higher FCR (2.10), as shown in Table 6. Contradictory to this (Emam *et al.,* 2018), found non -significant effect of sugar beet pulp on the performance of broiler chickens.

Table 4: Effect of graded level of beetroot juice on Body weight gain (g) of kadaknath chicken

Age (weeks)	Treatment groups		
	T1 (0ML)	T2 (15 ML)	T3 (25 ML)
1st	8.08±0.20 a	9.09±0.35 b	9.23±0.21 b
2nd	15.24±0.17 a	17.98±0.29 b	19.08±0.14 c
3rd	31.96±0.15 NS	31.66±0.16 NS	31.64±0.14 NS
4th	43.29±0.26 b	43.29±0.24 b	45.20±0.83 a
5th	50.09±0.35 NS	50.43±0.35 NS	50.44±0.47 NS
6th	73.98±0.43 a	74.01±0.25 a	76.25±0.37 b

** Significant (P<0.05), * - Significant (P< 0.01)**, N.S.-Non – significant, [1]SEM, standard error mean, [a,b,c] Means in distinct columns with different superscripts differ significantly from one another.*

Table 5: Effect of graded level of beetroot juice on feed consumption (g) of kadaknath chicken

Age (weeks)	Treatment groups		
	T1 (0ML)	T2 (15 ML)	T3 (25 ML)
1st	23.08±0.17b	22.67±0.14a	22.28±0.09a
2nd	45.67±0.07 b	45.16±0.06 a	45.04±0.4 a
3rd	85.26±0.26 b	84.61±0.29 b	83.58±0.12 a
4th	106.13±0.03 c	105.97±0.03 b	105.65±0.06 a
5th	116.12±0.05 c	115.84±0.04 b	115.44±0.05 a
6th	155.80±0.07 c	154.87±0.11 b	154.42±0.06 a

** Significant (P<0.05), * - Significant (P< 0.01)**, N.S.-Non – significant, [1]SEM, standard error mean, [a,b,c] Means in distinct columns with different superscripts differ significantly from one another.*

Table 6: Effect of graded level of beetroot juice on feed conversion efficiency (g) of kadaknath chicken

Age (weeks)	Treatment groups		
	T1 (0ML)	T2 (15 ML)	T3 (25 ML)
1st	2.9±0.07b	2.5±0.07a	2.47±0.05a
2nd	3.0±0.03 c	2.53±0.04 b	2.36±0.11 a
3rd	2.66±0.14 NS	2.67±0.17 NS	2.64±0.11 NS
4th	2.45±0.01 NS	2.45±0.01 NS	2.40±0.09 NS
5th	2.32±0.01 b	2.30±0.01 b	2.23±0.02 a
6th	2.10±0.01 b	2.09±0.01 b	2.02±0.01 a

** Significant (P<0.05), * - Significant (P< 0.01)**, N.S.-Non – significant, [1]SEM, standard error mean, [a,b,c] Means in distinct columns with different superscripts differ significantly from one another.*

Effect of beetroot juice on blood-biochemistry

Table 7 depicts the blood-biochemical parameters of kadaknath birds. The current study found the addition of graded levels of beetroot juice to water had a significant ($p \leq 0.05$) effect on blood-biochemical parameters viz; PCV, Hb, RBC_S, total cholesterol, glucose and triglycerides.

Table 7: Effect of graded level of beetroot juice on Hemato-biochemical parameters of kadaknath chicken

Parameters	Treatment groups		
	T1 (0ML)	T2 (15 ML)	T3 (25 ML)
PCV (%)	36.33±2.18a	39.66±2.12b	41.33±2.35c
Hemoglobin (g/dL)	9.250±.46a	10.47±0.18b	11.05±0.35b
Red blood cells (10^6 uL)	3.40±0.12 a	3.70±0.13 b	3.72±0.13b
White blood cells (10^6 uL)	15.10±2.0NS	15.12±2.0NS	15.6±2.17 NS
Lymphocytes (%)	65.23±1.14 NS	66.66±1.15 NS	66.23±1.15 NS
Total cholesterol (mg/dL)	131.59±0.25b	129.16±0.23a	128.94±0.63a
Glucose (mg/ dL)	187.7±0.05b	186.43±0.01 a	186.18±0.04a
Triglyceride (mg/ dL)	129.14±0.27 b	128.22±08 a	128.60±0.07 a

** -Significant (P<0.05), ** - Significant (P< 0.01), NS-Non – significant, a, b, c, Means with different superscript within the columns differ significantly with each other.*

The control group T1 had the lowest levels of PCV, Hb, and RBCS (36.33%, 9.25 g, and 3.40 uL, respectively) whereas the T3 group had the highest values (41.33%, 11.05 g, and 3.72 uL). On WBCs and lymphocytes, a non-significant effect was seen. T3 group had the lowest values for the biochemical parameters (128.94, 186.18, and 128.60 mg/ dL), while the T1 control group had higher values (131.59, 187.7, and 129.14 mg/ dL). It was observed that the value of total cholesterol, glucose, and triglycerides decreased when the inclusion level of beetroot juice get increased.

The results obtained in the current investigation revealed that the birds feed with beetroot juice had higher levels of body weight and body weight gain .This might be due to the factor that extracted juice used in this study might have higher values of proteins and micro-nutrients. The results of the current research also support the findings of (Kumar *et al.,* 2014; Grace *et al.,* 2020) who claimed that chickens fed sugar beet significantly ($p \leq 0.05$) increased growth rate, better FCR in comparison to the control. In contrast, (Emam *et al.,* 2018) observed that sugar beet pulp had no significant influence on the performance of broiler chickens.

The findings of the study show that the hemato-biochemical indices of all groups obtained were within the recommended standards of poultry. In the current experiment an increase of PCV, Hb and RBC by 0.87, 0.84 and 0.91 % was noted in T3 group as compared to the control group T1. When compared to the T1 control group, the T3 group showed a 1% decrease in the levels of biochemical indicators viz; total cholesterol, glucose, and triglycerides. It affirms to the improvement in oxygen supply, the acceleration of redox processes, and the consequent stimulation of metabolic processes in the experimental groups' blood respiratory function. The present findings are in agreement with that of (Koschayevet *et al.,* 2019) and (Grace *et al*., 2020), who reported that all the hematological parameters of chickens fed with dry beet pulp were within the normal range. The present study also agrees with the findings of (Grace *et al.,* 2020), who observed significantly ($p \leq 0.05$) higher values of PCV, Hb, RBC and reduction in biochemical indicators for birds fed on beetroot pulp.

CONCLUSION

Beetroot juice applied to Kadaknath bird's drinking water enhances their growth performance and FCR, which suggests a potential reduction in production costs for the poultry industry. Beetroot's accessibility to local markets and low consumption as a vegetable are further benefits for its usage in poultry nutrition. Therefore, it is recommended that adding beetroot to drinking water at a rate of 0.02% will improve chicken growth and health status.

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