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GROWTH PERFORMANCE OF BROILER AFTER INCLUSION OF PIGEON PEA (Cajanus cajan) SEED AS AN UNCONVENTIONAL FEED INGREDIENT IN DIETS

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An experiment was conducted to evaluate growth performance of Cobb-500 broilers by using Pigeon pea (*Cajanus cajan*) seed as an unconventional source of protein in the diet. Data on 160 birds divided into four equal groups were analyzed. The dietary treatments were control (D1), 5% pigeon pea (D2), 10% pigeon pea (D3) and 15% pigeon pea (D4). At the 5th week of age, the body weight of birds at different dietary treatments were 952.50, 987.75, 1030.25 and 1041.25g in D1, D2, D3 and D4 respectively; which shows that the 5th week body weight of broiler was significantly higher (P<0.01) in 10% pigeon pea (D3) and 15% pigeon pea (D4) groups than that of the control (D1) and 5% pigeon pea (D2) groups. The 5th week body weight gain of birds at different dietary treatments were 283.75 (D1), 313.25 (D2), 387.25 (D3) and 327.75g (D4) respectively; showing that the body weight gain after inclusion of 10% pigeon pea (D3) and 15% pigeon pea (D4) were significantly (P<0.01) higher than that of the control (D1) diet. The feed consumption at the 5th week age were 665.75 (D1), 678.75 (D2), 764.50 (D3) and 716.75g (D4) respectively; which indicates that the feed consumption were significantly (P<0.05 vs control) improved after feeding 10% pigeon pea (D3) and 15% pigeon pea (D4) diets. The FCR at the 5th week age were 2.34, 2.17, 1.98 and 2.18 in D1, D2, D3 and D4 respectively; showing the FCR value to be significantly (P<0.01) higher in the control than that of in all the other dietary groups, and the value was lowest for the 10% pigeon pea (D3) diet. Performance Index (%) at the 5th weeks of age was 42.67, 45.55, 52.19 and 47.48 in D1, D2, D3 and D4, respectively. At 5th week, the Performance Index (%) was significantly (P<0.01) higher in 10% pigeon pea (D3) and 15% pigeon pea (D4) than that of the other dietary groups. The results obtained from the study suggest that the pigeon pea can be used up to 10-15% as a protein source ingredient in commercial broiler diets.

Key word: Broiler, Pigeon pea, Feed consumption, Body weight gain, FCR and Performance Index.

Broiler industry in Bangladesh is playing a pivotal role in agricultural economy. It supplies prime high quality animal protein for human consumption. Broiler farming is increasing rapidly in Bangladesh because it takes a maximum of 6 weeks' time to harvest that results quick return for the producers. But poultry producers faces difficulties with the unavailability and high prices of the conventional feed ingredients particularly those of protein sources. Animal proteins are also in short supply and expensive as well. Formulation of balanced diet for poultry by using a good number of feed ingredients following the nutrient allowances recommended in different feeding standards is a common practice in developed countries. But in Bangladesh and other developing countries, availability of conventional feed ingredients in the

formulation of balanced diet is very much limited. Feed alone accounts for approximately 65-70% of the total cost of production and protein cost is about 13% (Singh, 1990; Banerjee, 1992). Therefore, unavailability and cost of poultry feed ingredients are the major constraints for the development of poultry production. Incorporation of some unconventional feed ingredients in the formulation of balanced diet may overcome the aforesaid problems and this may also minimize feed cost.

Due to lack and increasing demand of protein-based feed ingredients, Poultry nutritionists has been diverting their attention towards the use of unconventional, cheap and locally available feed ingredients, however, those ingredients might have reasonable level of anti-nutritional factor(s). We hypothesized that Pigeon pea (*Cajanus cajan*) seed may be considered as an alternative feed ingredient in this respect. Pigeon pea is an important unconventional legume and an important source of protein (up to 30%) (Amaefule & Obioha, 2001). Pigeon pea consumption in Bangladesh is quite low possibly due to the availability of other beans and therefore remains underexploited. Thus, attention may be paid to make the unconventional feed ingredients consumable for both human and animals.

Previous published reports suggest that broilers fed boiled pigeon pea seed meal diet showed improved daily weight gain (Amaefule and Onwudike, 2000). Pigeon pea has attracted attention as a crop capable of providing feed for animals because high yields of grains can be obtained under relatively adverse conditions. Tangtaweewipat and Elliott (1989) reported the nutritional value of pigeon pea seed meal in poultry diets. Other works also showed that pigeon pea seed possess required qualities to be considered as poultry feed ingredients (Udedibie and Mba, 1996; Amaefule and Onwudike, 2000).

In Bangladesh, practically the supply of feed is scarce and its price is high enough which limits the commercial poultry farmers to run their business profitably. Recently Poultry nutritionists consider the use of pigeon pea in the poultry ration as a protein source to overcome the problem of high price of protein from other sources. Keeping the above facts in view, the present study was undertaken to study the growth performance of broiler using Pigeon pea (*Cajanus cajan*) seed as an unconventional protein source.

MATERIALS AND METHODS

Place of the experiment: The experiment was conducted at Bangladesh Agricultural University Poultry Farm, Mymensingh with 160-day old broilers (Cobb 500) for a period of 35 days to observe the feasibility of using pigeon pea as an alternative source of plant protein**.**

Collection, drying, processing and storage of Pigeon pea (*Cajanus cajan*) seeds: Pigeon pea seeds were procured from the Department of Crop Botany, Bangladesh Agricultural University, Mymensingh. Required amount of raw pigeon pea was sun-dried and stored in polythene bags until processing. For boiling, raw pigeon pea (without dehulling) was washed with tap water by using a large pan. Then the grains were taken in another pan with pre-boiled water (100^0C) and the pan was covered with a lid. Now the grains were boiled for 15 minutes at 110^0C and then sun-dried, and kept in polythene bags, which was covered by gunny bags until grinding and used for experimentation.

Preparation of the experimental house and equipment: An open sided shed type house was selected. One room, an area of 20'×20', was partitioned into 16 pens of equal size. For partitioning the pens, expanded wire net, wood and bamboo materials were used. A service area was running along the middle of the pens for routine monitoring of the birds and for supplying feed, water, litter materials; and for performing vaccination and all other management practices. The floor and walls of the house was brushed, swiped and adequately cleaned using tap water. After washing with clean water, the pens were disinfected (Virkon solution, 5g/liter water) and left to dry up properly. During this time, all feeders, waterers and other necessary equipment were cleaned, washed and disinfected (Virkon solution, 5g/liter water) and dried before placement in the house.

Table1. Layout of the experiment

Dietary treatments	Replications				Total number of birds in each treatment
	R1	R2	R3	R4	
T1 (D1)	10	10	10	10	40
T2 (D2)	10	10	10	10	40
T3 (D3)	10	10	10	10	40
T4 (D4)	10	10	10	10	40
Total number	40	40	40	40	Grand Total= 160

Table 2. Composition of the experimental diets

Feed Ingredients	Control diet		5 kg Pigeon pea/100 kg diet		10 kg Pigeon pea/ 100 kg diet		15 kg Pigeon pea/ 100 kg diet	
	Starter	Grower	Starter	Grower	Starter	Grower	Starter	Grower
Maize	53	54	52	51	48	49	45	48
Soybean Meal	22	23	19	22	19	22	20	20
Rice Polish	14	15	15	16	14	13	12	12
Pigeon Pea	0	0	5	5	10	10	15	15
Protein Conc.	6	4	5	3	5	2	5	3
DCP	4	3	3	2	4	3	2	2
Premix*	0.30	0.20	0.20	0.20	0.20	0.20	0.30	0.30
Soybean Oil	0.40	0.30	0.20	0.40	0.30	0.30	0.30	0.30
Common Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100	100	100	100
Chemical composition								
ME(Kcal/kg)	3017.08	3130	3021	3148	3020	3159	3023	3130
CP (%)	20.1	19.69	18.89	18.7	19.41	18.6	18.9	18.6
Ca ((%)	1.07	0.52	0.80	0.7	1.11	0.87	0.71	0.71
P (%)	0.40	0.35	0.40	0.3	0.42	0.22	0.34	0.23
Meth. (%)	0.34	0.23	0.24	0.23	0.23	0.39	0.27	0.26
Lys. (%)	0.87	0.79	0.79	0.81	0.72	0.82	0.71	0.69
Tryp. (%)	0.18	0.17	0.18	0.17	0.17	0.16	0.16	0.17

Starter diet = 0-15 days, Grower diet = 16-35 days; *****Rena-Broiler Vitamin-Mineral Premix: Each 250 g premix contained- Vitamin A-12,000,000 IU; Vitamin D3-2,000,000 IU ; Vitamin E-23g; Vitamin K-2g; Vitamin B1-1.5g; Vitamin B2-5g; Vitamin B6-4g; Nicotinic acid-30g; Calcium-D-Pantothenet-8g; Vitamin B12-10mg; Folic acid-0.50g; Biotin-40mg; Cobalt-0.25g; Copper-6g; Ferric-24g; Iodine-0.60g; Manganese-48g; Zinc-40g; Selenium-120g; D-L-Methionine-50g; L-Lysine-30g.

Sun-dried rice husk litter materials were spreaded on the floor of each pen with an approximate depth of 3cm.

Layout of the experiment: The day old broilers were purchased from Nourish Poultry Hatchery, Maona, Gazipur, Bangladesh. The chicks were equally and randomly divided and distributed in to 4 (four) dietary treatments having 4 (four) replications in each treatment. A total number of 10 chicks were put in each replication. The layout of the experiment is shown in Table 1. The dietary groups were assigned as; D1- Basal diets (Control), D2-

Table 3. Vitamins available in Megavit WS (Each kg contains)

Vitamins	Quantity
Vitamin A	120,000,000IU
Vitamin D3	26500000IU
Vitamin E	22.0g
Vitamin K3	17.5 g
Vitamin B1	12.5 g
Vitamin B2	35.5 g
Vitamin B6	12.5 g
Vitamin B12	25.0 g
Vitamin B3	22.0 g
Vitamin B5	18.5 g
Vitamin B9	1.2 g
Vitamin C	320.0 g

Megavit WS manufactured by the NOVARTIS Bangladesh Limited which is a unique combination of feed grade water soluble multi-vitamin premix. Recommended dose for poultry is 1g Megavit WS/5 liter water.

Table 4. Composition of Jasoprot Protein Concentrate

Nutrients	Quantity (%)	Nutrients	Quantity (%)
CP	60	Lysine	3.20
Moisture max.	7	Cystine	1.96
CF max.	20	Phenylalanine	4.19
CF	4	Tryptophan	0.49
Ash max.	21	Leucine	4.26
Ca min.	4.75	Histidine	1.20
Ca max.	5.80	Methionine	2.35
P min.	2.40	Phenylalanine	2.21
Arginine	4.05	Threonine	2.61
Isoleucine	1.72	Total ME(kcal/kg)	3230

Jasoprot is a trade name of protein concentrate manufactured by Jayson Agrovet Ltd. Dhaka, Bangladesh.

Basal diets + 5% Pigeon pea, D3- Basal diets + 10% Pigeon pea and D4- Basal diets + 15% Pigeon pea.

Experimental diet: The broiler diet was formulated for two phases (starter and grower) with the feed ingredients that are available in local markets. Feed ingredients used in the experiments were confirmed as fresh and of good quality. Initial 15 days were considered as first phase, and the birds were supplied starter diet. In the remaining period (16-35 days), the experimental birds were supplied grower diet. In all cases, feeds were offered to the birds *ad libitum.* The nutrient requirements (ME, CP, Ca, P, Lysine, Methionine, and Tryptophan) were satisfied as recommended for Cobb 500 broiler diets. The table of nutrient recommendations for Cobb-500 broilers is shown in the appendix (Table-11).

Preparation of the experimental diets and dietary treatments: After weighing according to requirement maize, soybean meal and Pigeon pea seeds were ground by a grinding machine. All feed ingredients were hand mixed thoroughly. The vitamin-mineral premix, Di-calcium phosphate and salt were first mixed with each other and then mixed with a small quantity of mixed feed and then gradually increased in quantity by adding with remaining mixed feed. Diets for different treatment groups were prepared separately. Eight diets for four different treatments, each treatment containing starter and finisher diet were formulated. The dietary treatments contained 0, 5, 10 and 15

kg Pigeon pea seed/100kg mixed feed. Finally, the whole mixed feed was stored in plastic containers.

Routine management: The following management procedures were carried out during the entire experimental period. A) **Litter and Floor space management:** Fresh and dried rice husk was used as litter material. The depth of litter was 3cm. The litter material was disinfected with Virkon (5g/liter water) solution, and was stirred three times in a week from 2 weeks prior to use in the experiment to avoid cake formation. Further, while running the experiment, once the litter material was found damp it was replaced partially or fully by new litter. For the floor space, the size of each pen was 2'×5' where 10 birds (one replicate) were kept. Thus, the space given for each bird was 1.0 sq. ft. B) **Brooding of chicks:** Electric bulbs were used for brooding. One 200 watt non-fluorescent bulb was hanged in each pen (area 2'×5') for 10 birds. The bulb was hanged just above the bird's level at the center of each pen. Brooding temperature was kept 32°C at the beginning of the first week and decreased gradually in subsequent weeks until it was adjusted to ambient temperature. Adjustments were done by lowering or raising the bulbs according to the temperature prevailed in the house and also by observing the bird's behavior. C) **Bio-security measures and Sanitization:** To prevent any outbreak of diseases, strict bio-security was maintained during the experimental period. Proper hygiene and sanitation programs were also followed.

Data collection and record keeping: The following parameters were recorded from the beginning of the experiment: A) **Body weight:** Body weights of chicks were recorded initially and then weekly for each replication, B) **Body weight gain:** The average body weight gain of birds in each replication was calculated by deducting the initial body weight from the final body weight. C) **Feed consumption:** Feed consumption was recorded by deducting refusal from the supplied feed divided by the number of birds at the end of each week per replication. Feed intake at different ages was calculated by following formula: Feed consumption per week (g/chick) = Feed supplied in week (g) - Feed weight back in a week (g)/ No. of birds, D) **Feed conversion**

Table 5. Vaccination schedule

Age	Name and type of the vaccine	Name of disease	Route of administration
3rd day	BCRDV	Newcastle	One drop in each eye
14th day	IBD	Gumboro	One drop in each eye
21st day	BCRDV	Newcastle	One drop in each eye

Baby Chick Ranikhet Disease Vaccine (BCRDV) produced by Livestock Research Institute (LRI), Mohakhali, Dhaka. The Gumboro vaccine used in the experiment was produced by Intervet, The Netherlands.

Table 6. The body weight of broilers (g) fed four Pigeon pea seed diets

Age (wk)	Diet			
	D1 Control	D2 5% Pigeon pea	D3 10 % Pigeon pea	D4 15 % Pigeon pea
Initial	42.25±1.16	42.50±0.91	42.90±.85	42.62±1.60
1st	128.82±6.94	129.73±1.25	130.12±1.75	129.62±1.11
2nd	229.62±7.33	230.25±2.22	229.02±2.61	230.75±2.33
3rd	413.50±11.47	438.30±8.70	399.50±8.23	473.50±9.47
4th	655.00±7.07	674.50±13.53	643.00±13.39	713.50±13.48
5th	952.50^{c}±5.45	987.75^{b}±20.66*	1030.25^{a}±26.96**	1041.25^{a}±17.02**

"Values are Means ± SD". Letters with different superscripts within the same row differ significantly. *= significant (P<0.05); **= significant (P<0.01)

Table 7. The growth performance of broilers (g/wk) fed four Pigeon pea seed diets

Age (wk)	Diet			
	D1 Control	D2 5% Pigeon pea	D3 10 % Pigeon pea	D4 15 % Pigeon pea
1st	86.57±7.09	87.12±1.03	87.00±2.27	86.87±2.46
2nd	100.70±3.82	100.62±2.56	98.87±2.29	101.12±1.31
3rd	183.87±4.83	208.25±9.91	160.47±11.19	242.75±7.60
4th	241.50±5.92	235.75±12.61	243.50±17.60	240.00±7.44
5th	283.75^{c}±14.36	313.25^{bc}±18.95*	387.25^{a}±25.33**	327.75^{b}±20.40**

"Values are Means ± SD". Letters with different superscripts within the same row differ significantly. *= significant (P<0.05); **= significant (P<0.01)

Table 8. The feed consumption of broilers (g/wk) fed four Pigeon pea seed diets

Age (wk)	Diet			
	D1 Control	D2 5% Pigeon pea	D3 10 % Pigeon pea	D4 15 % Pigeon pea
1st	119.75±1.71	119.50±0.96	120.00±3.11	119.75±2.63
2nd	159.75±1.71	158.50±6.24	157.75±7.89	158.50±7.33
3rd	346.75±6.40	383.50±7.23	322.00±4.32	398.50±12.23
4th	476.25±15.20	478.75±18.25	480.75±34.65	466.50±11.62
5th	665.75^{c}±15.24*	678.75^{bc}±17.23*	764.50^{a}±34.93**	716.75^{ab}±46.78**

"Values are Means ± SD". Letters with different superscripts within the same row differ significantly. *= significant (P<0.05); **=significant (P<0.01)

ratio (FCR): The amount of feed consumed per unit of weight gain is considered as feed conversion ratio. This was calculated by using the following formula: Feed conversion ratio (FCR) = Feed intake (g)/ Body weight gain (g), E) **Performance index (PI):** Performance index was calculated by following formula: PI (%) = Live weight (kg)/ Feed Conversion Ratio ×100

Statistical analysis: All recorded and calculated data were analyzed through Completely Randomized Design (CRD) with the help of MSTAT statistical computer package program. Duncan's Multiple Range Test was computed to compare any significant differences among the four treatment groups.

RESULTS AND DISCUSSION

This experiment was conducted with 160 Cobb 500 straight run broiler chicks, which were divided into four treatment groups having four replications in each group. The experiment was conducted in two phases; starter for the period of 0-15 days, and grower for the period of 16-35 days.

Live weight

The effect of four different diets on the body weight of broilers is shown in Table 6. At the time of commencement of experimental trial, the day old chicks were selected randomly for each replication and their average body weight in each replication were adjusted to minimize any variations in body weight among the different replications. During the 1st, 2nd, 3rd and 4th weeks of age, no significant (P>0.05) differences in the body weight were found in all dietary treatment groups. However, the body weight of broilers at the 5th weeks was significantly higher (P<0.01) in 10% pigeon pea (D3) and 15% pigeon pea (D4) groups than that of the control (D1) and 5% pigeon pea (D2) groups. Similar result was reported by Babiker *et al*. (2006) who found higher body weight with feeding 10% Pigeon pea in broiler diets. This is the first report to show significant improvement in the body weight at the 5th week of age of broilers fed either 10% pigeon pea or 15% pigeon pea under local condition.

Table 9. The Feed Conversion Ratio of broilers fed four Pigeon pea seed diets

Age (wk)	Diet			
	D1 Control	D2 5% Pigeon pea	D3 10 % Pigeon pea	D4 15 % Pigeon pea
1st	1.39±0.11	1.37±0.01	1.36±0.02	1.37±0.01
2nd	1.58±0.05	1.57±0.03	1.59±0.10	1.56±0.07
3rd	1.88^{a}±0.04	1.84^{a}±0.06	1.89^{a}±0.11	1.64^{b}±0.06**
4th	1.97±0.04	2.00±0.04	1.97±0.03	1.94±0.04
5th	2.34^{a}±0.15**	2.17^{b}±0.10**	1.98^{c}±0.04**	2.18^{b}±0.02**

"Values are Means ± SD". Letters with different superscripts within the same row differ significantly. *= significant (P<0.05); **= significant (P<0.01)

Table 10. The Performance Index (%) of broilers fed four Pigeon pea seed diets

Age (wk)	Diet			
	D1 Control	D2 5% Pigeon pea	D3 10 % Pigeon pea	D4 15 % Pigeon pea
1st	9.32±1.16	9.46±0.13	9.53±0.21	9.44±0.15
2nd	14.54±0.76	14.66±0.21	14.43±0.88	14.76±0.69
3rd	21.97±0.99	23.85±1.29	21.21±1.76	28.89±1.40
4th	33.25^{b}±0.59	33.33^{b}±1.58	32.64^{b}±0.75	36.78^{a}±0.99**
5th	42.67^{c}±1.13	45.55b^{c}±2.79	52.19^{a}±2.35**	47.48^{b}±0.97**

"Values are Means ± SD". Letters with different superscripts within the same row differ significantly. *= significant (P<0.05); **= significant (P<0.01)

Table11. Nutrients recommendation for Cobb-500 broiler

Nutrient Composition	Starter (0-15 days)	Grower (16-35 days)
ME(Kcal/kg)	3035	3176
CP (%)	20.00	19.00
Ca (%)	1.00	0.90
P (%)	0.50	0.45
Meth. (%)	0.44	0.43
Lys. (%)	1.20	1.05
Tryp. (%)	0.20	0.19

Growth Performance

The effect of four different diets on the body weight gain of broilers is shown in Table 7. No significant differences were observed on the body weight gain of the birds fed various levels of pigeon pea at the age of 1st, 2nd, 3rd and 4th weeks. During the 5th week of age, the body weight gain of birds was significantly higher (P<0.01) in 10% pigeon pea (D3) and 15% pigeon pea (D4) diets than that of the control (D1) and 5% pigeon pea (D2) diets. This result is similar with the previous report of Igene *et al*. (2012) who found that 15% pigeon pea diet showed significantly (P<0.01) higher body weight gain among different dietary groups. The body weight gain at the 5th week of age was more or less similar and non-significant in the control and 5% pigeon pea containing diet. In contrast, the body weight gain during the 5th week of age of birds fed 10% pigeon pea and 15% pigeon pea were more or less similar and significant (P<0.01) compared to the control diet which showed the lowest body weight gain among all the treatment groups. These results are in line with the findings of Babiker *et al*. (2006) who reported that the weight gain of broiler was higher in 10% pigeon pea than that of other dietary treatments. There was a trend of slight decrement in body weight gain in the birds fed D4 diet (15% Pigeon pea) compared to D3 (10% Pigeon pea) in this study.

Feed consumption

The feed consumption of birds fed pigeon pea is shown in Table 8. During the1st to 4th weeks of age, no significant difference was observed in feed consumption of broilers. However, during the 5th week of age, feed consumption of birds were significantly (P<0.01) improved at 10% and 15% level of pigeon pea compared to the control and 5% level. During the 5th week of age, feed consumption was significantly (P<0.01) improved and highest at the 10% pigeon pea (D3) diet. The result is similar with the report of Babiker *et al*. (2006) who found the feed consumption to be higher in serving 10% pigeon pea diet. The 5th week feed consumption was more or less similar and high between 10% pigeon pea, 15% pigeon pea group. But the control and 5% pigeon pea group showed significantly (P<0.05) lower feed consumption than that of the other groups.

Feed Conversion Ratio (FCR)

Changes in the feed conversion ratio (FCR) of broilers are shown in Table 9. During the 1st, 2nd and 4th week of age, no significant (P>0.05) differences in feed conversion ratio were found. However at the 3rd week of age, the FCR values were non-significant (P>0.05) and more or less similar in birds fed the control, 5% and 10% pigeon pea, but the FCR value was significant (P<0.01) in 15% pigeon pea (D4) suggesting that the birds in D4 utilized feed more efficiently than the control, D2 and D3. During the 5th week, the FCR value was significantly (P<0.01) higher in the control and it was lowest in the 10% pigeon pea (D3) group. The result contradicted with Igene *et al*. (2012) who reported that FCR value was lower in the control group than other dietary groups.

Performance index (%)

Performance index (%) of broilers fed on four different diets did not show significant (P>0.05) differences in 1st, 2nd and 3rd weeks (Table 10). Performance index (%) at 4th and 5th week were highly significant (P<0.01) among the four different treatment groups. During the 4th week, Performance index (%) of broilers fed control (D1), 5% (D2) and 10% pigeon pea (D3) were more or less similar and non-significant but 15% pigeon pea (D4) group showed significantly (P<0.01) higher Performance index (%). During the 5th week, Performance index (%) was significantly (P<0.01) higher in 10% pigeon pea (D3) and 15% Pigeon pea (D4) group than that of the other groups. The result agreed with the previous report of Babiker *et al*. (2006) who found that Performance index was higher after inclusion of 10% pigeon pea in broiler diets.

CONCLUSION

It may be concluded from the study that, inclusion of Pigeon pea seed in the diet of commercial broilers up to 10-15% may improve the body weight gain, decrease feed consumption, increase feed conversion efficiency, and performance index with no apparent detrimental effect on the productive performance of broilers.

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