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PERFORMANCE OF BROILER FED ON DIET CONTAINING DEOILED KOROCH (*Pongamia Pinnata)* SEED CAKE TREATED WITH NaOH AND HCl

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ABSTRACT

The study was conducted to investigate whether the productive performances and meat yield characteristics of broiler would be improved by feeding diet containing koroch (*Pongamia Pinnata)* seed cake (KSC) treated with NaOH and HCl. A total number of 160 day-old straight run broiler chicks were fed on 4 iso-energetic and iso-nitrogenous diets containing either basal diet with no KSC or basal diet containing 2% KSC treated with or without 1% NaOH or 1% HCl for a period of 28 days. These diets were considered as 4 different treatments. Each treatment was replicated 4 times, each having 10 birds. Inclusion of 2% KSC treated with NaOH or HCl in the diet resulted in lower live weight, live weight gain, feed intake, feed efficiency of broilers at all ages compared to inclusion of dietary 2% KSC alone ($P<0.01$). However, broilers, irrespective of age, fed on diet containing 2% KSC treated with 1% HCl exhibited better productive performances than those fed on 1% NaOH treated 2% KSC incorporated diet. The amount of feed intake of broilers on either KSC alone or HCl treated KSC was almost similar to that on control diet. The meat yield parameters showed a non-significant treatment effect except for the percentage of dressing yield, liver, gizzard, head and skin weight. Dressing percentage of broilers fed on HCl treated KSC at 2% level was significantly ($P<0.05$) lower compared to any other dietary treatment, whereas broilers in 2% KSC dietary group showed similar results to the control group. Percentage of head and skin weight relative to body weight were higher in treated (NaOH or HCl) KSC dietary group compared to either KSC alone or control group. However, the highest liver and gizzard weights were obtained from the broilers fed on diet containing 2% KSC treated with 1% HCl, followed by diet with 1% NaOH treated KSC, KSC alone diet and the control diet. The results of the present study clearly indicated that neither the 1% NaOH treated nor 1% HCl treated KSC alliviated the depressed productive performances and meat yield characteristics of broilers. It is concluded that the poor productive performances of broilers fed on KSC incorporated diet cannot be improved by treating KSC with either NaOH or HCl, and the oil extracted KSC may contain leftover oil which might have a potential toxic effect on growth and meat yield of broilers.

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INTRODUCTION

Efficient and economic poultry production is only possible when using cheaper locally available feed ingredients, because the feed alone contribute to 70 to 75 per cent of the total cost of poultry production (Panda and Mahapatra, 1989). The researchers are thus compelled to explore the possibilities of feeding unconventional agro-forest based industrial by-products, to meet the nutritional requirement of birds. Since protein sources are expensive, measures are often adapted to partially or completely replace the conventional dietary protein with unconventional protein supplements in order to reduce the cost of production. *Pongamia pinnata* known as koroch in Bangladesh could be used as an unconventional feed. Koroch or karanja, a small handsome evergreen shade tree with glabrous bright green foliage, grows wildly almost in all the districts of Bangladesh (Rahman *et al.,* 2011). Koroch kernels (air dried) had 19.0% moisture, 27.5% fatty oil, 17.4% protein, 6.6% starch, 7.3% crude fiber, and 2.4% ash (James, 1983).

Feeding of de-oiled koroch cake after extraction at high level (>5%) adversely affect the performance (Natanam *et al.*, 1989a; Dhara *et al.*, 1997) due to residual toxin (karanjin) left in the solvent extracted cake. Karanjin can be converted to less toxic intermediates by treatment with alkali (Seshadri and Venkateswarlu, 1943). However, studies have not been made for its proper utilization in poultry feeding after detoxification, except physical treatments with water washing and soaking (Mandal and Banerjee, 1974) and autoclaving (Natanum *et al.*, 1989a). Studies also showed that alkali treatment reduces the karanjin content of solvent extracted koroch seed cake (Panda *et al.*, 2008). Prabhu (2002) stated that hydrochloric acid (HCl) and glacial acetic acid treatments have reduced only 1/3rd of karanjin. Therefore, processing of koroch seed and cake by oven-drying, autoclaving, water extraction, alkali or acid extracted cake may have positive effect to formulate poultry diet. Thus, this study investigated the effect of oil extracted koroch seed cake (KSC), NaOH treated KSC and HCl treated KSC on growth and meat yield of broilers.

MATERIALS AND METHODS

The study was conducted at Bangladesh Agricultural University Poultry Farm, Mymensingh, Bangladesh. The experimental day old broilers were purchased from “Nourish Poultry and Hatchery Ltd.” Shreepur, Gazipur, Bangladesh. Koroch seeds were collected from Sunamgonj Hoar area. The oil from seeds was expelled locally from an oil extraction mill. Then the remaining cake was dried and proximate analysis was done for KSC. The proximate compositions of the feed ingredients were analyzed as per AOAC (1995) and are furnished in Table 1. The NaOH and HCl treated KSC was prepared by soaking the cake for 24h in water (1:1, W/V) containing either NaOH or HCl at 1% (v/v). The processed cake was sun dried ground and stored in gunny bags for incorporation into the diet.

The experiment was carried out with 160 broilers fed on diet containing either 0% KSC, 2% KSC 2% KSC treated with 1% NaOH or 2% KSC treated with 1% HCl, considered as 4 different dietary treatments. Each treatment was consisting of 4 replications having 10 birds per replication. The chicks were reared up to 28 days of age. The vaccination schedule that was followed during the experimental period is given in Table 4.
The chicks were individually weighed at the beginning of the experiment (initial body weight) and allocated to different replication pens of each of the 4 treatment groups. Body weight was also measured on a weekly basis for all birds from each replication. The average body weight gain of the broiler in each replication was calculated by deducting initial body weight from the final body weight. The amounts of feed consumed by the birds in each replication of each treatment group were calculated from the amount supplied at each week and the amounts leftover at the end of that week. Feed conversion ratio (FCR) was calculated as the unit of feed consumed per unit of body weight gain.

At the end of feeding trial, one broiler weighing average from each pen was randomly selected for recording meat yield parameters. Broilers were fasted from feed and water for twelve hours prior to slaughtering. After complete bleeding, birds were immersed in hot water (51-55°C) for 120 seconds for proper defeathering manually. After defeathering, the birds were again individually weighed. Then head, shank, viscera, giblet (heart, liver and gizzard) and abdominal fat were removed for determination of meat yield parameters. Dressed broilers were cut into different parts such as breast, thigh, drumstick and wing. Finally, every cut up parts were weighed and recorded separately for each broiler of all replications.

Statistical analysis

All recorded and calculated data were analyzed using analysis of variance (ANOVA) technique by a computer using SAS statistical package program in accordance with the principles of Completely Randomized Design (SAS, 2009). Duncan's multiple range test (DMRT) was done to compare variations among diets where ANOVA showed significant differences.

Table 1. Proximate composition of Koroch seed and cake

	Moisture (%)	CP (%)	Ash (%)	CF (%)	EE (%)
Seed	9.04	22.43	2.41	5.57	26.17
Cake	8.89	24.27	3.12	2.37	14.61

Table 2. Ingredients and nutrient composition (%) of starter diet (0-21 days)

Ingredients	Different level of oil extracted Koroch seed cake			
	0% KSC	2% KSC	2% KSC treated with 1% NaOH	2% KSC treated with 1% HCl
Maize	61.00	59.90	59.90	59.90
Rice Polish	2.00	2.00	2.00	2.00
Soybean meal	24.9	24.0	24.0	24.0
Protein Con.	9.00	9.00	9.00	9.00
Koroch cake	0.00	2.00	2.00	2.00
Vegetable oil	0.00	0.00	0.00	0.00
DCP	2.00	2.00	2.00	2.00
Vit.-min. premix	0.25	0.25	0.25	0.25
DL-Meth.	0.20	0.20	0.20	0.20
L-lysine	0.15	0.15	0.15	0.15
Common Salt	0.50	0.50	0.50	0.50
Nutrient composition				
ME Kcal/kg	2971	2952	2952	2952
Crude protein (%)	22.38	22.37	22.37	22.37
Crude fiber (%)	3.82	3.78	3.78	3.78
Calcium (%)	1.28	1.28	1.28	1.28
AV. Phosphorus (%)	0.71	0.71	0.71	0.71
Lysine (%)	1.30	1.27	1.27	1.27
Methionine (%)	0.55	0.54	0.54	0.54

RESULTS AND DISCUSSION

Growth performance

The overall productive performances of broiler chicks as affected by inclusion of different dietary levels of KSC are shown in Table 6. Final body weight, body weight gain, feed consumption and FCR were significantly ($P<0.01$) influenced by dietary treatments. All performance of broiler fed KSC alone or treated KSC were significantly ($P<0.01$) depressed compared to the control. However, the feed intake of birds fed either KSC alone or HCl treated KSC dietary treatment was comparable with the control diet. Dietary incorporation of treated (NaOH or HCl) KSC at 2% resulted in poor feed efficiency, whereas FCR of broilers fed on KSC alone at 2% level was comparable with the control diet. All sorts of performance during the experimental period (1st to 4th week) followed the same trend as described above (Table 5).

The depression in body weight and feed intake and poor weight gain in the present study on koroch seed cake incorporated diet was in agreement with the findings of Mandal and Banerjee (1974) and Panda *et al.* (2008). Panda *et al.* (2008) observed that enhancing the inclusion of solvent extracted karanj cake significantly

decreased the body weight gain and feed intake and resulted in poor feed efficiency. On the other hand, Mandal and Banerjee (1979) recommended that deoiled karanj cake (EE<0.05%) could safely be included at 5% in the diet of broiler chicken. Similarly, Dhara et al. (1997) reported that deoiled karanj cake could be included in the diet to a maximum level of 4.45%. Higher level resulted in adverse effect on growth and feed intake, which was attributed to the presence of toxic factors left back in the cake after oil extraction.

Dietary incorporation of treated (NaOH or HCl) KSC at 2% depressed the feed efficiency in the present study. Dhara et al. (1997) found poor feed efficiency by dietary incorporation of 11.20% to 22.40% deoiled karanj cake in the diet of Japanese quail. But, Natanam et al. (1989b) reported comparable feed efficiency with control diet in broiler chicks by incorporating solvent extracted karanj cake at 10% level in the diet. Efficiency of feed utilization depends on the level of protein and energy (Mellen et al., 1984) and their ratio (Davidson, 1964) in addition to the presence of incriminated factors (Chand, 1987). Probably the presence of higher levels of residual toxic factors in diets containing koroch seed cake at all levels of incorporation resulted in poor efficiency in broiler chicks.

Table 3. Ingredients and nutrient composition (%) of grower diet (21-28 days)

Ingredients	**Different level of oil extracted Koroch seed cake**			
	0% KSC	**2% KSC**	**2% KSC treated with 1% NaOH**	**2% KSC treated with 1% HCl**
Maize	65.05	63.44	63.44	63.44
Rice Polish	2.00	2.00	2.00	2.00
Soybean meal	20.69	19.91	19.91	19.91
Protein Con.	7.50	7.50	7.50	7.50
Koroch cake	0.00	2.00	2.00	2.00
Vegetable oil	1.66	2.05	2.05	2.05
DCP	2.00	2.00	2.00	2.00
Vit.-min. premix	0.25	0.25	0.25	0.25
DL-Meth.	0.20	0.20	0.20	0.20
L-lysine	0.15	0.15	0.15	0.15
Common Salt	0.50	0.50	0.50	0.50
Nutrient composition				
ME Kcal/kg	3100	3100	3100	3100
Crude protein (%)	20.0	20.0	20.0	20.0
Crude fiber (%)	3.61	3.56	3.51	3.47
Calcium (%)	1.20	1.19	1.19	1.19
AV. Phosphorus (%)	0.68	0.67	0.67	0.66
Lysine (%)	1.14	1.12	1.09	1.06
Methionine (%)	0.52	0.51	0.50	0.49

Table 4. Vaccination schedule for the experimental broilers

Age of broilers (day)	**Name of Vaccine**	**Trade Name***	**Dose**	**Route of vaccination**
4	IB+ND	MA5+Clone30	One drop	Ocular
10	IBD	D-78	One drop	Ocular
21	IBD	D-78	One drop	Ocular

IB, Infectious Bronchitis; ND, Newcastle Disease; IBD, Infectious Bursal Disease *Intervet International, B.V. BOXMEER, The Netherlands

Meat yield characteristics

The data on carcass traits like dressing percentage, percent live weight of neck, head, gizzard, heart, liver, shank, breast, drumstick, thigh, wing, skin and abdominal fat have been shown in Table 7. All the parameters determined showed a non-significant treatment effect except for the percentage of dressing yield, liver, gizzard, head and skin weight (Table 7). Percent live weight of dressing yield, liver, head and skin were significantly (P<0.05) influenced by dietary treatments. Dressing percentage of birds fed on HCl treated KSC at 2% level was significantly (P<0.05) depressed compared to any other dietary treatment, whereas birds fed on 2% KSC dietary group was similar to the control group. Although, broilers in NaOH treated 2% KSC dietary group was comparable with those in control group. Percentage of head and skin weight relative to body weight were higher in treated (NaOH or HCl) KSC dietary group compared to either KSC alone or control group. However, liver weight (P<0.05) and gizzard weight (P<0.05) increased significantly due to incorporation of KSC alone, NaOH treated KSC and HCl treated KSC diet at 2% levels as compared to that of control diet.

Table 5. The weekly growth performance of broilers fed on oil extracted Koroch seed cake

Trait	Age (week)	Different level of oil extracted Koroch seed cake				Level of Significance
		0% KSC	2% KSC	2% KSC treated with 1% NaOH	2% KSC treated with 1% HCl	
Body weight (g)	Day-old	44.23±0.48	44.15±0.10	44.00±0.16	44.20±0.16	NS
	1st	132.80±2.45^{a}	131.05±3.42^{ab}	126.00±8.66^{ab}	123.45±3.78^{b}	NS
	2nd	311.50±6.27^{a}	281.65±14.32^{b}	270.33±18.02^{b}	265.90±14.47^{b}	**
	3rd	635.28±7.01^{a}	565.70±22.14^{b}	537.20±19.54^{b}	559.70±57.40^{b}	**
	4th	1096.6±29.51^{a}	1026.0±32.12^{ab}	874.80±50.80^{b}	978.0±106.97^{b}	**
Body weight gain (g)	1st	88.58±2.08^{a}	86.90±3.45^{ab}	82.00±8.79^{ab}	79.25±3.73^{b}	NS
	2nd	178.70±7.87^{a}	150.60±11.47^{b}	144.33±12.97^{b}	142.25±11.05^{b}	**
	3rd	323.78±0.75^{a}	284.05±30.13^{ab}	266.88±13.20^{b}	293.8±48.31^{ab}	NS
	4th	461.33±23.92^{a}	388.48±14.85^{ab}	337.60±33.12^{b}	354.1±29.62^{ab}	**
Feed intake (g)	1st	95.73±1.95	96.88±4.11	102.48±5.14	101.80±5.46	NS
	2nd	205.15±1.00^{ab}	204.80±1.83^{b}	207.55±2.24^{ab}	207.83±1.53^{a}	NS
	3rd	538.75±25.94	525.00±24.49	530.00±8.16	542.50±11.90	NS
	4th	848.63±50.79^{a}	776.05±48.24^{b}	753.60±25.57^{b}	779.60±33.8^{b}	**
Feed con -version ratio	1st	1.08±0.04^{a}	1.12±0.09^{ab}	1.26±0.16^{b}	1.29±0.10^{b}	*
	2nd	1.15±0.05^{a}	1.37±0.11^{b}	1.45±0.12^{b}	1.47±0.12^{b}	**
	3rd	1.66±0.08^{a}	1.86±0.15^{ab}	1.99±0.08^{ab}	1.88±0.25^{b}	NS
	4th	1.84±0.12^{a}	2.00±0.12^{ab}	2.25±0.25^{b}	2.22±0.24^{b}	*

$^{a-d}$Mean±SD values with different superscripts within same row differ significantly; NS=Non-significant; **=significant (p<0.01)

Table 6. Performances of broilers fed on oil extracted Koroch *(Pongamia Pinnata)* seed cake during the experimental period

Parameter	Different level of oil extracted Koroch seed cake				Level of Significance
	0% KSC	2% KSC	2% KSC treated with 1% NaOH	2% KSC treated with 1% HCl	
Initial weight (g)	44.23±0.48	44.15±0.10	44.0±0.16	44.20±0.16	NS
Final weight (g)	1096.6±29.51^{a}	1026.0±32.12^{b}	874.8±50.80^{b}	978.0±106.97^{b}	**
Body weight gain (g)	1052.4±29.85^{a}	910.03±29.35^{b}	830.8±50.78^{b}	869.6±70.7^{b}	**
Feed consumption (g)	1688.3±67.94^{a}	1602.7±68.78^{ab}	1593.6±24.12^{b}	1631.7±37.94^{ab}	**
Feed conversion ratio	1.61±0.08^{a}	1.76±0.08^{ab}	1.92±0.11^{b}	1.89±0.16^{b}	**

$^{a-d}$Mean±SD values with different superscripts within same row differ significantly; NS=Non-significant; **=significant (p<0.01)

Table 7. Meat yield characteristics of broilers fed on oil extracted Koroch *(Pongamia Pinnata)* seed cake up to 28 days of age

Parameter	Different level of oil extracted Koroch seed cake				Level of Significance
	0% KSC	2% KSC	2% KSC treated with 1% NaOH	2% KSC treated with 1% HCl	
Live weight (g)	1125.5^{a}	1026.0^{ab}	945.5^{b}	978.0^{b}	*
Dressing yield (%)	62.80^{a}	64.91^{a}	62.05^{ab}	59.59^{b}	*
Blood (%)	4.09	4.60	6.11	4.89	NS
Feather (%)	4.66	3.75	3.52	2.88	NS
Neck (%)	3.38	4.15	3.80	3.65	NS
Head (%)	2.21^{b}	2.49^{ab}	2.68^{a}	2.76^{a}	*
Gizzard (%)	1.46^{b}	2.24^{a}	2.23^{a}	2.25^{a}	**
Heart (%)	0.49	0.63	0.54	0.46	NS
Liver (%)	1.99^{b}	3.12^{a}	2.78^{a}	3.03^{a}	*
Shank (%)	3.55	3.79	3.78	3.79	NS
Breast (%)	11.03	10.46	9.88	10.58	NS
Drumstick (%)	7.38	8.30	7.71	7.90	NS
Thigh (%)	7.89	8.85	8.43	8.67	NS
Wing (%)	6.41	6.33	6.56	6.72	NS
Skin (%)	1.77^{b}	1.71^{a}	2.35^{a}	2.21^{a}	*
Abdominal fat (%)	0.36	0.34	0.27	0.46	NS

^{a,b}Mean values with different superscripts within same row differ significantly; NS=Non-significant; **=significant (p<0.01)

Mandal and Banerjee (1982) reported no difference on organ weights like liver, heart, kidney and spleen of cockerels due to dietary replacement of black til cake with deoiled karanj cake at 30% level. Dhara *et al.* (1997) also found no significant variation in weight of different commercial cuts (neck, wing, thigh, shank, breast and trunk) and organs (giblet, liver, heart and gizzard) due to incorporation of deoiled karanj cake up to 22.40% in the diet of Japanese quail. However, in the present study, dietary inclusion of KSC alone, NaOH treated KSC and HCl treated KSC diet at 2% levels significantly reduced the weight of dressing yield. Panda *et al.* (2008) observed the dietary inclusion of either solvent extracted karanj cake (SKC) or NaOH treated SKC at 25% level and $Ca(OH)_2$ treated SKC at 12.5% and 25% levels significantly increased the weight of liver leading to liver hypertrophy. Gizzard weight also increased significantly due to incorporation of SKC at both the levels. These findings are similar to the findings of the present study where liver and gizzard weight increased significantly due to incorporation of KSC alone, NaOH treated KSC and HCl treated KSC diet at 2% levels. Higher percentage of head and skin weight in treated (NaOH or HCl) KSC dietary group compared to KSC alone and control group was observed in the present study. Body surface area might be the causes of weight variation of head and skin in different dietary treatment groups. Panda et al. (2008) noticed that the adverse effect on growth and feed intake was found when daily karanjin intake was18mg and above. Similarly Natanam (1989a) reported the adverse effect of karanj cake feeding is due to the left over karanjin in the processed cake. Probably the higher daily karanjin intake (>18 mg) could be the potential reason for showing adverse effect on growth and meat yield characteristics in the present study.

CONCLUSION

The results revealed that the treatment of koroch seed cake with either NaOH or HCl did not improve performance of broilers. The oil content of koroch seed cake may leftover even after NaOH or HCl treatment which might have an antagonistic effect on metabolism of broilers. However, further research to investigate

the efficacy of other alternative processing techniqute for the complete removal of leftover oil content in association to the improvement of broiler growth performance and meat yield characteristics is advocated.

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