ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 5 (10): 927-931, 2006
ISSN 1682-8356

Performance and Egg Quality Characteristics of Pullets Fed Activated Sheabutter Charcoal Based Diets

B.A. Ayanwale[1], A.G. Lanko[2] and Y.S. Kudu[3]
[1,3]Department of Animal Production, Federal University of Technology,
P.M.B 65, Minna, Niger State, Nigeria
[2]Niger State Ministry of Agriculture, Veterinary Services Division, Bosso, Minna, Nigeria

Abstract: An experiment was conducted to investigate the growth performance, nutrient utilization, egg quality characteristics and cost-benefit values of feeding different levels activated sheabutter tree charcoal to laying pullets. Five experimental diets supplemented with activated sheabutter charcoal were formulated to contain 0.0 (control), 10.0, 20.0, 30.0 and 40.0% levels of the charcoal. A total of 150 day-old pullets were used for the study and were fed the diets till they were 22 weeks of age. The results showed no beneficial effect of feeding activated sheabutter charcoal to pullets up to 15 weeks of age as there were no significant ($p>0.05$) differences in the performance parameters measured up to this stage. At the laying stage, activated sheabutter charcoal significantly ($p<0.05$) improved egg weight from (48 ± 3.01) in the control to (54.86 ± 3.01) in 40.0% charcoal level. Percent cracked eggs also reduced significantly ($p<0.05$) from 15.33% (control) to 0.20% in 40.0% activated sheabutter charcoal level. No significant ($p>0.05$) effect of activated sheabutter charcoal was observed on the internal egg quality parameters measured. The pullets fed activated charcoal had higher economic returns than the control. The results were attributed to increased mineral intake and utilization enhanced by charcoal supplementation and also improved absorption capacity of charcoal for dietary fat.

Key words: Sheabutter tree charcoal, cost-benefit, egg quality

Introduction

The term charcoal generally refers to the carbonaceous residue of wood, cellulose, coconut shells or various industrial wastes left after heating organic matter in absence of oxygen (Kutlu *et al*., 2000). It is a fine, odourless, tasteless black powder and adsorbent of many toxins, gases, drugs, fat and fat-soluble substances. Kutlu *et al*. (2000) stated that the adsorptive capacity of charcoal is increased by treating with temperatures ranging from 500°C to 900°C and with various substances. The product of such treatment, according to Osol (1975) is known as "activated charcoal".

Activated charcoal is widely used in adsorption therapy as a non-digestible carrier which is one of the important methods of preventing ingested toxicants from being formed in gastrointestinal tract (Varma, 1986; Mulyanto, 1988; McLennan and Amos, 1989, McKenzie, 1991; Jindal *et al*., 1994; Jindal and MahiPal, 1999; Kutlu *et al*., 2000). Various other functions of activiated charcoal include, control of lactic acid concentration, maintenance of pH level and microfloria in the steer rumen during and after acute rumen over loading with barley (Hoshi *et al*., 1991), control of pathogenic bacteria (Almagambetov *et al*., 1992; Nikoleava *et al*., 1994) and control of complexes formation with phonelics in the gastrointestinal tract so as to prevent hydrosable tannin interfering with enzyme function and protein digestion (Murdiat *et al*., 1991). Kutlu *et al*. (2000) however, stated that activated charcoal should be considered as a potential sequestering agent for some toxins and anti-nutritional metabolites which are detrimental to animals. The authors, however worked on "inactivated charcoal", a situation which suggests that the effect of activated charcoal on the performance of birds, carcass parameters, egg production and egg quality characteristics have not been examined. This study was therefore carried out to examine the growth, nutrient utilization, egg quality characteristics and cost/ benefit values of pullets fed activated sheabutter
charcoal in the diets.

Materials and Methods

A total of 150 day-old Isa brown pullet chicks were used for this study. They were randomly distributed into 5 treatment groups in three replicates. Initial average body weight was recorded (66.67g). The brooding temperatures were between 32-35°C for the first 4 weeks of age in accordance with the recommendation of Oluyemi and Roberts (1979) for birds raised in hot humid tropical environment.

Experimental diets

Sheabutter charcoal preparation: Sheabutter charcoal used in this study as a feed ingredient or as a supplement was taken after activation in a mud bakery

Table 1: Composition of experimental diets

Chicks mash:		Ingredients (%)										
Charcoal Levels	Maize	Ground Nut cake	Char-coal	Fish meal	Bone meal	Oyster shell	Salt	Palm oil	Lys-ine	Methi-onine	Premix	
0.00	49.05	35	0	4	3	6	0.3	2	0.2	0.2	0.25	
10.00	44.05	35	10	4	1	3	0.3	2	0.2	0.2	0.25	
20.00	34.05	35	20	4	1	3	0.3	2	0.2	0.2	0.25	
30.00	24.05	35	30	4	1	3	0.3	2	0.2	0.2	0.25	
40.00	14.05	35	40	4	1	3	0.3	2	0.2	0.2	0.25	
Growers mash												
0.00	49.45	35	0	3	3	6	0.3	2	0.2	0.2	0.25	
10.00	44.45	35	10	3	1	3	3	2	0.2	0.2	0.25	
20.00	34.45	35	20	3	1	3	3	2	0.2	0.2	0.25	
30.00	24.45	35	30	3	1	3	3	2	0.2	0.2	0.25	
40.00	14.45	35	40	3	1	3	3	2	0.2	0.2	0.25	
Layers mash												
0.00	60.85	20	0	4	5	2	0.3	2	0.3	0.3	0.25	5
10.00	50.85	20	10	4	5	2	0.3	2	0.3	0.3	0.25	5
20.00	40.85	20	20	4	5	2	0.3	2	0.3	0.3	0.25	5
30.00	30.85	20	30	4	5	2	0.3	2	0.3	0.3	0.25	5
40.00	20.85	20	40	4	5	2	0.3	2	0.3	0.3	0.25	5

Premix to supply the following per kg; Vit A, 4,000.000 IN; Vit .E, 6.00g; Vit. D3, - 1,000,000 iu; nicotinic acid, 12-0g; calcium pentothenate, 4-00g; vit. B12, 4-8mg; folic acid, 0-40g; biotin, 0-02g; zinc 18.0g; cu, 0.08g; I2, 062g; cobalt, 080g; selenium, 0-04g.

Table 2: Proximate composition of sheabutter charcoal (%)

Dry Matter	Crude protein	Crude fibre	Ash	Ether extract	Nitrogen Free extract
90.96	2.39	6.89	1.55	0.00	80.00

furnace and ground to pass through 0.02mm sieve. The ground charcoal was then mixed thoroughly with other feed ingredients (Table 1). Five different diets containing 0.0 (control) 10.0, 20.0, 30.0 and 40.0% ground sheabuter charcoal were formulated for chicks, growers' and layers' stages (Table 1).

Growth measurements: The effects of dietary sheabutter charcoal growth at chicks and growers phases were assessed. The pullets were raised on deep litter system in an open sided house. The relative humidity in the house was between 60-70%. The open sides of the house were covered with polythene sheets during brooding. Brooding was stopped at 4 weeks of age. Feed and water were given *ad – libitum*. Light was provided 24 hrs each day except when there was occasional power outage, during which heat supply was augmented with heat from kerosene stove or coal pots. Chicks diets were fed till the end of 8 weeks while growers diets were fed between 8-15weeks. The pullets were housed in a randomized complete block (RCB) design. Data were collected on average body weight, weight gain, feed intake, feed/gain ratio and protein efficiency ratio at chicks and pullets stages.

Laying stage: The same management procedures used for the growers'' stage were adopted at this stage. Pullets were given supplements of sheabutter charcoal in their diets, at 0.0, 10.0, 20.0, 30.0 and 40.0% levels respectively. Both external and internal egg quality characteristics were evaluated. Each egg was weighed to the nearest 0.0lg using a sensitive top loading electric weighing balance. Egg Length and width were measured with Vernier sliding calipers and the results were used to compute egg shape index, that is, egg width over egg length. Each egg was broken on a petri-dish. Egg shells were collected and allowed to dry after which egg membranes were removed. The shell thickness was then measured with micrometer screw gauge. The measurements were taken from the top (pointed part) bottom (round part) and middle of the eggs and the average found as described by Ayanwale and Gado (2001).

The internal egg quality measured included egg albumen and yolk heights using tripod micrometer. The yolk diameter was taken as the maximum cross sectional diameter of the yolk using spherometer, read in millimeters. Yolk was carefully separated from the albumen with yolk cups. The yolk was carefully rolled on a damp paper to remove any adhering albumen prior to weighing. Haugh unit was then calculated as:

$$(Hu) = 100 \log (H + 7.57 - 1.7^{W0.37})$$

where

HU = Haugh Unit

H = albumen height (mm)

W = egg weight (g)

Table 3: Proximate composition of the experimental diets (%)

Charcoal concentration chicks' mash	Dry matter	ash	ether extract	crude protein	crude fibre	NFE
0	91.6	7.23	8.99	24.5	1.99	48.69
10	91.01	8.84	7.46	23.37	7.46	43.88
20	91.28	9.45	6.19	23.33	6.96	45.45
30	92.26	10.34	5.96	23.9	5.83	46.93
40	91.84	12.48	4.83	24	5.99	44.54
Growers' diet						
0	92.24	7.45	10.09	14.06	6.87	52.77
10	91.73	8.79	8.5	13.37	4.17	52.9
20	91.98	8.77	9.1	12.4	4.29	57.4
30	91.97	8.01	8.69	13.45	4.08	57.74
40	91.84	8.24	8.02	13.11	5.03	57.44
Layers' diet						
0	89.55	9.16	16.1	24.15	6.5	49.74
10	89.75	30.45	15.17	16.4	8.12	34.78
20	93.35	15.51	13.99	18.61	5.8	53.43
30	89.65	8.41	14.81	25.7	15.49	40.05
40	91.68	12.65	15.01	21.6	15.17	7.26

Table 4: Growth performance of pullets fed activated sheabutter charcoal based diets (0-8 weeks)

Chicks stage: Charcoal levels (%)	Initial Body Weight,	Weight at 8 weeks (g)	Mean weekly feed intake (g)	Mean weekly weight gain (g)	Feed conversion efficiency ratio	Protein efficiency ratio
0.00	66.68	264.39	190	60.4	2.65	1.73
10.00	66.7	264.19	190.63	60.4	2.73	1.74
20.00	66.69	258.21	200.6	61.79	2.99	0.64
30.00	66.68	260.52	207.2	62.14	3.13	1.54
40.00	66.67	261.6	208.2	62.28	3.14	1.43
5EM	0.03	26.68	15.76	18.42	0.12	0.11
	NS	NS	NS	NS	NS	NS
Growers' stage						
0.00	264.38	741.31	52.45	486.63	4.99	1.28
10.00	264.19	741.28	52.5	486.84	4.98	1.18
20.00	258.21	740.8	51.13	496.06	5.09	1.18
30.00	260.52	736.83	51.25	503.88	5.23	1.25
40.00	261.6	744.15	51.25	504.83	5.11	1.25
SEM	26.68	21.26	12.24	11.74	1.45	0.06
	NS	NS	NS	NS	NS	NS
Laying stage:						
0.00	741.31	1135.00	706.58	58.33	1.30	2.20
10.00	741.28	1135.00	760.79	58.33	1.39	2.11
20.00	740.80	1135.60	770.64	58.24	3.39	2.46
30.00	736.83	1139.20	777.5	58.27	1.37	2.49
40.00	744.15	1140.40	743.95	58.27	1.67	2.39
SEM	21.26	20.06	21.09	16.16	0.50	2.39

Chemical analysis: The different diets were oven-dried at 80^{o}C until constant weights were obtained, after which they were stored in air-tight bottles for chemical analysis. The chemical composition of the diets was determined by A.O.A.C. (2000) methods.

Data analysis: The various data collected on egg quality parameters were statistically analyzed using completely randomized design (CRD) according to Gomez and Gomez (1984). Mean separation was done where significant differences exist using Duncan (1955) producers.

Results and Discussion

Table 1 shows the gross composition of the experimental chicks, growers' and layers' diets while Tables 2 and 3 indicate the proximate composition of the activated shea butter charcoal and the experimental diets respectively. The results of the growth performance (Table 4) shows that the dietary sheabutter charcoal had no significant ($p>0.05$) effect on the growth performance characteristics measured at the 3 stages. This is in agreement with Kutlu *et al.* (2000).

Table 5 shows that activated shea butter charcoal at 40.0 % level significantly ($p<0.05$) increased egg weight

Table 5: External egg quality characteristics of laying pullets fed activated sheabutter charcoal based diets

Egg parameters measured:					
Charcoal levels (%)	Mean egg weight (g)	Mean shell thickness (mm)	Mean shell weight (g)	cracked eggs (%)	Eggs shape index
0	48.93[a]	0.42	5.29	15.33[c]	2.53[b]
10	51.00[a]	0.41	5.5	9.96[bc]	2.47[b]
20	50.88[ab]	0.45	4.95	5.18[ab]	2.54[b]
30	53.46[ab]	0.44	4.96	1.40[a]	2.66[a]
40	54.86[b]	0.45	7.76	0.20[a]	2.66[a]
Sem	3.01	0.09	0.49	0.41	0.12

a,b means denoted by different alphabets in the same column are significantly ($p<0.05$) different.

Table 6: Internal egg quality characteristics of laying pullets fed activated shea butter charcoal supplemented diets

Charcoal levels (%)	Mean yolk weight (g)	Yolk index	Albumen weight (g)	Haugh unit
0.00	13.23	0.41	38.2	75.63
10.00	13.32	0.43	39.13	75.33
20.00	13.73	0.44	39.84	76.65
30.00	14.49	0.43	40.22	76.57
40.00	14.18	0.44	41.56	76.92
SEM	0.23	0.04	0.78	0.80
	NS	NS	NS	NS

a,b means denoted by different alphabets in the same column are significantly different ($p<0.05$)

Table 7: Cost- benefits of feeding activated she abutter charcoal to laying pullets

Charcoal levels (%)	No. of eggs collected at 22 weeks of age	Price per egg ($)	Total amount of egg sold ($)	Weights of birds sold (kg)	Price per kg of bird sold ($)	No. of birds sold	Total amount from birds sold ($)	Total income from eggs + meet
0.00	30	0.15	4.45	1.1	4.45	30	146.85	151.3
10.00	17	0.15	2.52	1.12	4.45	30	149.52	152.04
20.00	31	0.15	4.59	1.17	4.45	30	156.52	160.79
30.00	32	0.15	4.74	1.06	4.45	30	141.51	146.25
40.00	30	0.15	4.45	1.22	4.45	30	162.87	167.32

and reduced percent cracked eggs compared to the control and 10.0% inclusion level and similarly affected egg shape index. There appeared to be a high and negative correlation between the proportion of cracked eggs and weights such that as the egg weight increased the proportion of cracked eggs decreased. These results were attributed to the better mineral availability or utilization enhanced by the higher level of activated charcoal. Kutlu *et al*. (2000) attributed the reduction in cracked eggs by charcoal inclusion to increase in shell strength, improved mineral intake from charcoal, and absorption capacity of charcoal for dietary fat and its excretion. The authors stated that the major components of charcoal are calcium, potassium and magnesium. Sheabutter charcoal inclusion had no significant ($p> 0.05$) effect on the internal egg quality characteristics measured (Table 6). This agrees with the findings of Kutlu *et al*. (2000).

The results of the cost / benefit analysis shown in Table 7 shows that the highest income was from the pullets fed 40% activated charcoal and the least was from the pullets fed the control diet.

Conclusion: The results of this study indicated that there is no beneficial effect of feeding activated sheabutter charcoal to pullet chicks and growers up to 15 weeks of age. However, feeding of activated sheabutter charcoal at the laying stage significantly ($p< 0.05$) improved egg weight and reduced the proportion of cracked eggs particularly at 40% inclusion level. No significant ($p>0.05$) effect of sheabutter charcoal inclusion in the diets was observed on the internal egg quality characteristics. The results were attributed to improved mineral intake and utilization enhanced by charcoal inclusion, and improved absorption capacity of charcoal for dietary fat and its excretion. Pullets fed activated charcoal had higher economic returns than the pullets fed the control diet.

Reference

Almagambetov, K. Kh., V.M. Bonderenko, E.M. Gorskaia, L.A. Pavolova, E.V. Sudzhan and A.V. Grigore'ev, 1992.The prevention of the translocation of intestinal microflora after the rescue of an organism from a terminal state. Zh. Mikrobiol. Epidemiol. Immunobio., 5-6: 11-14.

A.O.A., 2000. Association of Official Analytical Chemists. Official Methods of Analysis, 17th edn.

Ayanwale, B.A. and Y. Gado, 2001. Effect of Commercial diets on egg quality characteristics. Nig. J. Anim. Prod., 28: 2002-206.

Duncan, D.B., 1955. Multiple range and multiple F-tests. Biometrics, 11: 1-42.

Gomez, A.K. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research, Wiley and sons, New York.

Hoshi, K., T. Yamamoto, N. Takemura, T. Sako, H. Koyama and S. Motoyoshi, 1991. Effects of activated charcoal on intraruminal lactic acid. Bull. Nippon Vet. Zootech . Coll., 40: 22-28.

Jindal, N. and S.K. MahiPal, 1999. Toxic effects of Fusarium Moniliforme containing known levels of fumonisin B1 in broiler chicks and its reduction by activated charcoals. In proc. of 12th European symposium on poultry nutrition 15-19 Aug, 1999. Veldhoven the Netherlands, Pg: 131.

Jindal, N., S.K. Mahipal and N.K. Mahajan, 1994. Toxicity of aflatoxin B1 in broiler chicks and its reduction by activated charcoal. Res. Vet. Sci., 56: 37-40.

Kutlu, H.R., I. Unsal and M. Gorgulu, 2000. Effects of providing directory wood (oak) charcoal to broiler chicks and laying hens. Anim. Feed Sci. Tec. Elsevier, 90: 213-226.

Mckenzie, R.A., 1991. Bentonite as therapy for Lantana camara poisoning of cattle. Aust. Vet. J., 68: 146-248.

McLennan, M.W. and M.L. Amos, 1989. Treatment of lantana poisoning in cattle. Aust. Vet. J., 66: 93-94.

Mulyanto, M., 1988. Active charcoal as an alternative for neutralizing pozoming effect of Lantana camara fed by cattle. Bull media (Q) Indonesia, 4: 7-8.

Murdiat, T.B., C. Mc Sweenney and J.B. Lowry, 1991. Complexing of the toxic hydrolysable tannins of yellow wood (Terminalia Oblongata) and harendong (Climedia hirta) with reactive substances: an approach to preventing toxicity. J. Appl. Toxicity, 11: 333-338.

Nikoleava, L., A.V. grigor' ev., znamenskill and V koval' chik, V.K., 1994. An experimental study of the efficacy of enterosorbents in salmonellosis. Zh. Microbial. Epidemiol. immunobiol., 2: 7-7.

Oluyemi, J.A. and F.A. Roberts, 1979. Poultry Production in Warm Wet Climates, Mcmillan press, Ltd, 2nd edn pg 1-140.

Osol, A., 1975. Remington's pharmaceutiacal sciences 15th edn. Marck Publishing Co, Pennsylvania, U.S.A.

Varma, R.K., 1986. Anti-dotal treatment of experimental Kalanchoe integra poisoning, Ind. J. Anim. Sci., (India), 56: 411.