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Serum Profile and Growth Indices of Broilers Fed Diets Containing Alkaline Treated Soyabeans

[1]M.M. Ari and [2]B.A. Ayanwale

[1]Department of Animal Science, Faculty of Agriculture, Nasarawa State University, Keffi, Nigeria
[2]Department of Animal Production Technology, School of Agriculture and Agricultural Technology, Federal University of Technology Minna, Niger State, Nigeria

Corresponding Author: M.M. Ari, Department of Animal Science, Faculty of Agriculture, Nasarawa State University Keffi, Nigeria Tel: +234 803 625 3270

ABSTRACT

The aim of this study is to evaluate the effects of diets containing alkali treated soyabeans on serum profile and growth indices of broiler chickens using 240 days-old Anak broilers that were randomly divided into 4 experimental groups of three replicates each. Test soyabeans seeds were treatment by soaking in water, sodium carbonate (Na_2CO_3), Potassium carbonate (K_2CO_3) and sodium hydroxide (NaOH) prior to incorporation into the diets; these forms experimental diets D1, D2, D3 and D4. Significant ($p<0.05$) variations in the serum and blood parameters measured were observed, highest mean values recorded were in D1 for urea, creatine and hemoglobin while cholesterol had the highest value in D3. No significant ($p>0.05$) difference was observed in the packed cell volume of the treatment groups. Specific Growth Rate (SGR), Growth Efficiency (GE) and Feed Conversion Ratio (FCR) were significantly ($p<0.05$) affected by alkali treatment at both the starter and finisher phases. Similarly, Protein Efficiency Ratio (PER) and Energy Efficiency Ratio (EER) were significantly affected by dietary treatments ($p>0.05$) at both the starter and finisher phases. D3 showed better serum profile and growth indices in this study.

Key words: Alkali treatment, broilers, growth indices and serum profile

INTRODUCTION

The use of alkali treatment and nixtamalization of grains and oilseeds have been reported to increase the nutritional value (Ocheme and Gladys, 2011; Ari *et al*., 2013) of feed stuff. Similarly alkaline treatment of several types of plant proteins was earlier reported by De Groot and Slump (1969), Omueti *et al*. (1992), Ayanwale (1999, 2003) reported the removal of some antinutritional factors (polyphenols and trypsin inhibitor factor when soya beans are treated with sodium sesquicarbonate (trona). This was observed to support the improvement of the nutritive values of soyabeans by the same author. The use of sodium hydroxide and sodium hypochlorite in the detoxification of a toxic variety of *Jatropha curcas*, a protein rich oilseed for animal utilization was also evaluated (Asseleih *et al*., 1989; Aregheore *et al*., 2003). Vidal-Valverde *et al*. (1979), Parsons *et al*. (1991) and Ocheme and Gladys (2011) have also reported the removal of trypsin inhibitor activity in soyabeans and other oilseeds using alkali solutions like sodium bicarbonate solution, distilled water and potassium hydroxide.

Friedman *et al*. (1984) and Ayanwale (1999) reported the deleterious effects of using concentrated alkali in treating soyabeans as treatment of soyabeans with strong alkaline resulted

in decreased protein quality, loss of amino acids and the formation of amino acids lysinoalanine complex, which reduces lysine availability. This is supported by Oskoueian *et al.* (2011) who reported the effects of different concentrations and types of alkali salts in the inactivation of Tyrpsin inhibitor activity. Ayanwale (1999) evaluated the possibilities of alkaline salts to cause the release of bound minerals in feed stuff.

Alkali treatment of soyabeans was however observed (Moss *et al.*, 1990) to have caused reduction in the values of dry matter, crude fibre and ash content compared to values of raw soyabeans, while crude protein and either extracts values were higher than the values of raw soyabeans. A similar observation was reported by Wanjekeche *et al.* (2002), it was however ascribed to be as a result of the reduction in hemicelluloses content of residue. The effects of alkali treatment on the performance of poultry have also been reported (Akande and Fabiyi, 2010). The aim of this experiment was to evaluate the effects of diets containing soyabeans processed using different alkaline salts (sodium carbonate, potash and sodium hydroxide) on the serum profile and growth indices of broilers.

MATERIALS AND METHODS

Experimental site: This study was conducted at the Livestock Complex of College of Agriculture, Doma Road, Lafia which is located between latitude 8° and 9° North and longitude 80° and 90° East. The minimum temperature is 21.9°C and maximum temperature of 37.6°C between January to June and the average annual rainfall is 823 mm. The test ingredients were processed at both the Livestock Complex and the Nutrition Laboratory of the college while the final feed was compounded at the feed mill unit of the complex.

Soyabean collection and cleaning: Soyabeans seeds (*Glycine max*) were procured from a local market in Lafia metropolis of Nasarawa State, Nigeria. The collected seeds were cleaned by winnowing and hand picking of stones and debris before subjecting to alkali treatments.

Alkali processing of soyabeans: The cleaned raw soyabeans were treatment by soaking in water, sodium carbonate (Na_2CO_3), Potassium carbonate (K_2CO_3) and sodium hydroxide (NaOH) according to the methods reported by Ayanwale (1999) and adopted by Ari *et al.* (2012a). The treated soaked grains were drained and sun dried by spreading on jute bags. The sun dried samples were milled and bagged.

Experimental treatment and diet preparation: A total of 240 days-old Anak broilers that were randomly divided into 4 experimental groups of three replicate each. Dietary treatments were as follows: D1, D2, D3 and D4 which had: Soyabeans soaked in water, soyabeans processed with sodium carbonate, soyabeans processed with potash and soyabeans processed with sodium hydroxide at both starter and finisher phases using Completely randomized design having the test ingredients incorporation as the main source of variation. The starter diets were fed for 5 weeks (1-35 days) brooding phase and the finisher diets were fed for 4 weeks (36-63 days). The experimental feeds were formulated using a least cost feed formulation software Feedwin. The experimental fixed and variable ingredients were grinded using single grinding with Vent mill and a screen size of 3 mm before mixing. The compounded experimental feeds were packed in polythene bags, sealed, labelled and stored until required.

DATA COLLECTION

Growth indices: The following parameters were measured from the data generated and computed from daily and weekly recording in each of the feeding trials according to the methods adopted by Ari *et al.* (2012b) in the determination of growth indices, Specific growth rate (SGR), Growth Efficiency (GE), Feed Conversion Ratio (FCR), energy and protein intake and energy and protein efficiency ratios.

Chemical and serum analysis: Chemical composition of each of the alkali treated soyabeans samples and experimental diets faecal collections were determined following standard methods (AOAC, 1995) while the serum parameters were determined by the methods described by Aletor and Ogunyemi (1988).

Statistics: Data collected were subjected to One-way Analysis of Variance (ANOVA), means were separated ($p>0.05$) where there were significant differences using Duncan's Multiple Range Test (Duncan, 1995) using (SPSS, 2007).

RESULTS AND DISCUSSION

The chemical composition of alkaline treated soyabeans (test ingredient) is presented in Table 1. The Fry Matter (DM) percentage ranged from 89.8-90.17% while crude protein (CP) percentage ranged from 38.34-40.27%. Crude Fibre (CF) had values ranging from 12.37-22.87%. The highest value of Ether Extract (EE) was obtained in 0% alkaline while the least (6.72%) was obtained in 1% potash. The total ash percentages ranged from 3.61-5.29% while Nitrogen Free Extract (NFE) percentages ranged from 21.08-25.34%. The highest Ca and P percentage values were 0.44 and 0.36% in 1% $NaCO_3$ and 0% alkaline, respectively.

The composition of alkaline treated soyabeans were consistent with the reports of HNIS (1989) and Ensminger *et al.* (1990) who observed variations in the chemical composition of soyabeans subjected to different processing methods. Similar observations were reported by Ayanwale (1999) for different concentration of alkaline on soyabeans and Oskoueian *et al.* (2011) for oilseeds. DM, CP, CF and total ash values observed for alkali treated soyabeans by Ayanwale (1999) were slightly different from the values obtained in this study. The chemical composition of the broiler starter and finisher feeds are presented in Table 2. The Crude Protein (CP) and Metabolizable Energy (ME) values of the feeds ranged from 24-24.14% CP in the starter diets and 21.92-22.07% CP in the finisher diets, while the ME values ranged from 3003.74-3009.85 Kcal kg^{-1} in the starter diets and 3061.75-3108.37 Kcal kg^{-1} in the finisher diets. These values are within recommended feeding standards for broilers (Anonymous, 1994).

The results of the serum and blood profile analysis for broilers fed alkaline treated soyabean based diets are presented in Table 3. There were significant ($p<0.05$) variations in most of the

Table 1: Effect of alkaline treatment on the chemical composition of soyabean

	Chemical composition (%)							
Alkaline treatment	Dry matter	Crude protein	Crude fibre	Ether extract	Total ash	NFE	Ca	P
Soya 0% alkaline	90.02	39.70	13.76	21.85	3.61	21.08	0.39	0.36
Soya 1% Na_2Co_3	90.02	38.34	14.64	18.58	5.29	23.15	0.44	0.23
Soya 1% K_2CO_3	90.17	40.27	22.87	6.72	4.80	25.34	0.37	0.23
1% NaOH	89.83	39.64	12.37	21.31	5.05	21.63	0.42	0.23

Table 2: Composition and analysis of diets containing alkali-treated soyabeans

	Starter diets				Finisher diets			
Ingredients	D1	D2	D3	D4	D1	D2	D3	D4
Maize	38.00	38.00	37.00	38.00	46.55	46.00	46.00	46.30
Maize bran	10.25	10.00	10.25	10.50	8.00	8.00	9.30	8.00
Rice bran	2.50	20.25	2.80	2.55	1.25	1.25	1.75	1.5
Soya 0% alkaline	32.00	-	-	-	31.50	-	-	-
Soya 1% Na_2Co_3	-	33.25	-	-	-	32.55	-	-
Soya 1% K_2CO_3	-	-	33.00	-	-	-	31.00	-
Soya 1% NaOH	-	-	-	33.25	-	-	-	31.50
Blood meal	3.50	3.50	3.25	3.25	3.00	3.00	3.00	3.00
Fish meal	3.50	3.50	3.25	3.25	1.00	1.00	1.00	1.00
Bone meal	3.50	3.50	3.50	3.50	3.00	3.00	3.00	3.00
Limestone	0.80	1.05	2.00	0.75	-	-	-	-
Palm oil	3.00	2.00	2.00	2.00	2.75	2.25	2.00	2.75
L-Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
DL-methionine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Salt (NaCl)	2.50	0.25	2.50	2.50	2.50	2.50	2.50	2.50
Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis								
ME Kcal kg^{-1}	3009.85	3007.13	3009.17	3003.74	3061.75	3088.23	3107.94	3108.37
CP%	24.00	24.00	24.14	24.11	21.99	21.92	22.07	21.97
Determined analysis								
Dry matter (%)	92.10	92.10	91.30	92.42	91.81	92.12	92.73	91.99
Crude protein (%)	21.14	21.86	23.36	23.36	20.44	23.63	20.56	20.62
Crude fibre (%)	7.15	6.58	6.88	6.24	7.06	7.01	7.41	6.80
Ether extract (%)	11.75	9.52	10.32	8.86	12.45	11.16	13.52	11.93
Total ash (%)	11.49	10.55	11.2	11.25	5.72	6.80	14.03	7.76
NFE (%)	37.57	43.59	39.49	42.71	46.14	43.52	37.21	44.88

*D1: Soya 0% alkaline, D2: Soya 1% Na_2Co_3, D3: Soya 1% K_2CO_3, D4: Soya 1% NaOH, **Premix to provide the following per Kg of diet: Vitamin A: 9,000 IU, Vitamin D3: 2,000, IU, Vitamin E: 18 IU, Vitamin B1: 1.8 mg, Vitamin B2: 6.6 mg, Vitamin B3: 10 mg, Vitamin B5: 30 mg, Vitamin B6: 3.0 mg, Vitamin B9: 1 mg, Vitamin B12: 1.5 mg, Vitamin K3: 2 mg, Vitamin H2: 0.01 mg, Folic acid: 0.21 g, Nicotinic acid: 0.65 mg, Biotin: 0.14 mg, Choline chloride: 500 mg, Fe: 50 mg, Mn: 100 mg, Cu, 10 mg, Zn: 85 mg, I: 1 mg, Se: 0.2 mg

Table 3: Effect of diets containing alkaline treated soyabeans on serum and blood profile of broilers

	Alkaline treatment based diets				
Parameters	D1	D2	D3	D4	SEM
Urea (mmn 1^{-1})	3.0^{a}	2.17^{c}	2.73^{b}	2.27^{c}	0.11*
Cholesterol (mmn 1^{-1})	2.17^{d}	3.13^{b}	3.47^{a}	2.43^{c}	0.16*
Creatine (mn 1^{-1})	102.00^{a}	83.33^{b}	82.33^{b}	89.00	2.38*
Packed Cell Volume (PCV)	30.67	30.33	31.00	25.67	0.67NS
Haemoglobin (Hb) (g dL^{-1})	10.67^{a}	10.43^{a}	10.37^{b}	8.73^{c}	0.23*

D1: Soya 0% alkaline, D2: Soya 1% Na_2Co_3, D3: Soya 1% K_2CO_3, D4: Soya 1% NaOH

serum and blood parameters measured. The highest mean values recorded were in D1 group for urea, creatine and hemoglobin (3.0 mmn 1^{-1},102 mn 1^{-1} and 10.67 g dL^{-1}, respectively) while cholesterol had the highest value (3.47 mmn 1^{-1}) in D3 group. No significant ($p>0.05$) difference

Table 4: Effects of diets containing alkali treatment of soyabeans on growth indices of broiler chickens

Growth indices		Dietary treatments				
SGR (%day^{-1})		D1	D2	D3	D4	SEM
	Starter phase	10.87±0.01^{d}	11.11±0.03^{c}	12.98±0.02^{b}	13.19±0.03^{a}	±0.32
	Finisher phase	33.69±0.06^{c}	39.29±0.01^{b}	39.99±0.06^{a}	32.89±0.01^{d}	±0.96
GE						
	Starter phase	2.86±0.32^{d}	3.58±0.03^{b}	3.83±0.03^{a}	3.03±0.05^{c}	±0.12
	Finisher phase	0.67±0.01^{b}	0.77±0.00^{a}	0.61±0.01^{c}	0.50±0.01^{d}	±0.03
FCR						
	Starter phase	3.06±0.01^{c}	4.63±0.01^{a}	2.45±0.01^{d}	3.55±0.01^{b}	±0.24
	Finisher phase	3.46±0.01^{c}	2.83±0.01^{d}	3.75±0.01^{b}	4.62±0.01^{a}	±0.19
Protein intake (g)						
	Starter phase	78.78±0.06^{d}	144.54±0.25^{a}	86.67±0.00^{c}	99.20±0.09^{b}	±7.67
	Finisher phase	201.18±0.18^{d}	219.21±0.07^{c}	234.48±0.14^{b}	235.98±0.26^{a}	±4.24
PER						
	Starter phase	1.54±0.02^{b}	1.00±0.01^{d}	1.77±0.03^{a}	1.21±0.01^{c}	±0.09
	Finisher phase-	1.42±0.01^{b}	1.50±0.00^{a}	1.29±0.01^{c}	1.06±0.01^{a}	±0.05
Energy intake						
	Starter phase	1249.60±0.99^{d}	2235.30±3.85^{a}	1255.60±0.00^{c}	1436.10±1.29^{b}	±122.41
	Finisher phase	3634.30±3.21^{c}	3368.70 ±1.05^{d}	3964.40±2.41^{b}	4122.50±4.61^{a}	±88.10
EER						
	Starter phase	9.73±0.08^{b}	6.95±0.05^{d}	12.19±0.08^{a}	8.38±0.04^{c}	±0.63
	Finisher phase	7.84±0.02^{b}	9.79±0.01^{a}	7.65±0.02^{c}	6.05±0.004	±0.40

*SGR: Specific growth rate, GE: Growth efficiency, FCR: Feed conversion ratio, PER: Protein efficiency ratio, EER: Energy efficiency ratio

was observed in the packed cell volume of the treatment groups. The variation in serum the blood profile is attributable to the levels of Trypsin Inhibitor Activity (TIA) and phytic acid in the treated soyabeans based diets. Birds fed diets D1 (0% alkaline) with the lowest reduction level of TIA and phytic acid recorded the highest mean value of urea and creatine (Ari *et al*., 2012a). The influences of dietary nutrients variations may have also been responsible for the differences observed in the serum profile as reported by Aletor and Ogunyemi (1988) and Jiang *et al*. (1990).

The effects of different alkali treatment on growth indices of broilers are presented in the Table 4. SGR and GE were significantly ($p<0.05$) affected by treatment, alkali treatment groups had significant ($p<0.05$) increase in SGR and GE values when compared to soaking in water (controlled group) at the starter (1-35 days) and finisher phases (36-63 days). FCR were significantly ($p<0.05$) different at both the starter and finisher phases with D3 group having the best FCR values of 2.45 a at the starter phases while D2 group gave the best value of 2.83 at the finisher phase. There were significant ($p<0.05$) difference in the PER values at both starter and finisher phases. PER values ranged from 1.0 in D2 to 1.77 in D3 in the starter phase and from 1.06 in D4 to1.50 in D2 in the finisher phase. EER showed significant ($p<0.05$) different at both the starter and finisher phases with values ranging from 6.95 in D2 to12.19 in D3 and 6.05 in D4 to 9.79 in D2, respectively.

The differences observed between the starter and finisher phases and treatment groups in the growth indices SGR, GE, FCR, PER and EER were as a result of anti-nutritional factor removal and type of alkaline salts used, as 0% alkaline and 1% NaOH which had the lowest levels of anti-nutritional factors removal recorded the poorest growth performances. Alkaline salts utilization in the treatment of soyabeans was found to be advantageous in the nutritional improvement of soyabeans in the diets of broilers.

CONCLUSION

The findings of this study indicates that biological assay using serum profile and growth indicators measurements of the broilers fed different alkaline treated soyabeans based diets provided an assessment of the various alkali treated based diets quality as compared with chemical analysis of test diets.

It is therefore inferred from the findings of this research that serum profile and were growth indices were relatively better with broilers fed with 1% potash treated soyabeans based diets. The relative poor results associated with birds fed sodium hydroxide treated soyabeans based diets was an indication that the type of alkaline salt used in the treatment of soyabean for broiler has significant effect the performance and some serum metabolites the birds.

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