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Growth and carcass characteristics of broilers fed alkali processed soyabeans

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Abstract

An eight- week feeding trial was conducted to investigate the effect of feeding alkali processed soybeans to broilers. Soyabeans were processed in aqueous solutions of sodium chloride, sodium sesquicarbonate (trona) and alum respectively. The concentration of each of the salts was 3 %. The soybeans, after drying, were used in compounding 3 different diets. The control (T1) contained raw soyabeans while diets T2, T3 and T4 contained NaCl, trona and alum respectively. Broiler feeding lasted for 8 weeks starting from day- old. The results indicated that feeding NaCl proceesed soybeans to broilers significantly (P< 0.05) depressed growth rate, feed consumption and body weight. NaCl treated soyabeans produced feed/gain ratio, protein efficiency ratio (PER), carcass and organ proportion comparable to the control. The growth rate, feed intake and weight gain of NaCl-treated soyabeans- fed broilers were likely due to inability of NaCl to sufficiently inactivate trypsin inhibitors and remove a substantial proportion of polyphenols and oligosaccharides in soyabeans. It was concluded that since the alkaline salts are cheap and readily available all the year round their use in processing soyabeans should be encouraged.

Key words: Growth, carcass, broilers, alkaline salts, soyabeans.

Introduction

The use of soyabeans as a cheap source of plant protein in animal diets is on the incease. However, raw soyabeans need to be processed before incorporating them into the animal diets in order to remove anti-nutrients including polyphenols and trypsin inhibitors. It is also desirable to reduce the high levels of oligosaccharides, notably raffinose and starchose, which cause flatulence and abdominal discomfort. Soaking and boiling are the methods commonly in use. Excessive soaking in tropical conditions can lead to serious microbial deterioration while boiling uses firewood or other fuel which may be scarce and expensive. This creates the need for seeking alternative methods of processing soyabeans. The addition of alkaline salts such as sodium bicarbonate has been shown to reduce soaking and cooking time for a number of legumes (Singh *et al.*, 1988). Polyphenols were removed by soaking legumes in water and sodium bicarbonate makes the process more efficient (Laurena, *et al.*, 1986). Removal of trypsin inhibitor by blanching was made more effective by addition of sodium bicarbonate (Nelson *et al.*, 1976). Omueti, *et al.*, (1992) reported that soaking and blanching of soyabeans is an effective way of inactivating trypsin inhibitors and removing significant proportion of polyphenols and oligosaccharides. Ayanwale (1999) reported that sodium sesquicarbonate can be used without detrimental effect on broiler performance and carcass quality. This work was

therefore designed to investigate the effect of sodium chloride, trona and alum, which are equally cheap and readily available, on growth and carcass characteristics of broilers.

Materials and Methods

Feed description and preparation.

Three alkaline salts, sodium chloride(NaCl), sodium sesquicarbonate (trona) ($Na_2C0_4NaHC0_3.2H_20$) and alum [$Al_2(S0_4).24H_20$] were bought in the market. Aqueous solutions of the powdered samples were prepared by adding 30g of each of the alkaline salts to 1,000 millilitres of water at room temperature. The raw soyabean seeds were then soaked in the prepared 3 % solutions of the salts for 24 hrs. After this, the soyabeans were air-dried and used in preparing isocaloric and isonitrogegenous diets (Table 1). Four diets were formulated and designated T_1, T_2, T_3 and T_4 respectively. Diet T_1 was the control and it contained roasted soyabeans, T_2, T_3 and T_4 diets contained sodium chloride, trona and alum processed soyabeans respectively.

Table 1: *Composition of the Experimental Diets (g/kg^{-1})*

	Starter Phase				Finishing Phase			
Ingredients	T1	T2	T3	T4	T1	T2	T3	T4
Maize	502.3	502.3	502.3	502.3	559.7	559.7	559.7	55.7
Rice Offal	50.0	50.0	50.0	50.0	70.0	70.0	70.0	70.0
Fish meal	50.0	50.0	50.0	50.0	25.0	25.0	25.0	25.0
Palm oil	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Bone meal	25.0	25.0	25.0	25.0	30.0	30.0	30.0	30.0
Salt	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Premix[a]	2.5	2.5	2.5	2.5	3.0	3.0	3.0	3.0
Lysine	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Methionine	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Soyabean meal	338.2	338.2	338.2	338.2	338.2	338.2	338.2	338.2
	100	100	100	100	100	100	100	100
Calculated Analysis								
Crude protein(%)	24.5	24.5	24.5	24.5	20.91	20.91	20.91	20.91
M.E (Kal/g)	3.10	3.10	3.10	3.10	3.10	3.10	3.10	3.10
Ether extract (%)	8.50	8.50	8.50	7.52	7.52	7.52	7.52	7.52

[a]To provide the following per kg: Vit.A 1500*iu*; Vit.D3 1600*iu*; Riboflaving,9.omg; Biotin, 0.25mg; Pantothenic acid, 11.omg; Vit,k 3.0mg; Vit, B2 2.5mg; Vit.B6 0.3mg; Vit.B12, 8.0mg; Nicotinic acid 8.0 Fe, 5.0mg; zn 4.5mg; Mn 10.0mg; Co.02mg; Se 0.01mg.

A total of 180 day-old Light sussex broiler chicks were used for this work. They were randomly allocated to the diets at forty- five birds per diet and replicated in three groups of 15 birds each. All experimental birds were given feed and water [illegible] Records of average growth rate, feed consumption, body weight gain, feed/gain ratio, protein efficiency ratio (PER) and carcass characteristics were taken(Table 2). The starter diets were fed for 4 weeks (0- 28 days) while finishing diets were fed for 4 weeks(29- 56 days). The experimental design was randomized complete block (RCB) design.

Table 2: *Performance of broilers fed alkali treated soyabeans*

	Starter Phase				Finishing Phase			
	T1	T2	T3	T4	T1	T2	T3	T4
	540.0[a]	400.5[b]	484.35[a]	511.37[b]	1400.0[a]	1202.18[b]	1450.0[a]	1554.07[a]
	± 28.92	± 23.9	± 27.2	± 29.9	± 22.0	± 12.0	± 10.0	± 29.9
	989.0[a]	921.66[b]	993.00[a]	952.97[ab]	3102.00[a]	2400.3[b]	2596.33[b]	2998.00[ab]
	± 3.60	± 2.10	± 9.0	± 2.40	± 3.42	± 3.46	± 4.0	± 5.0
	507.5[a]	368.0[b]	452.0[a]	478.87[a]	989.00[a]	801.6[b] ±	965[ab]	1042.7[a]
	± 4.11	± 5.69	± 3.57	± 6.22	± 8.21	4.72	± 3.33	± 6.10
	1.95[ab]	1.36[b]	2.20[a]	1.99[ab]	3.14[a]	2.99[a]	2.69[b]	2.87[ab]
	± 0.08	± 0.26	± 0.33	± 0.07	± 0.03	± 0.12	± 0.24	± 0.04
	1.14[a]	1.03[b]	1.13[a]	1.13[a]	1.45[a]	1.07[a]	1.24[a]	1.37[a]
	± 0.12	± 0.07	± 0.05	± 0.05	± 0.08	± 0.11	± 0.27	± 0.15

[a] Means denoted by different alphabets in the same row are significantly different (P<0.05)

Carcass composition

At the end of the feeding trial (8weeks), two birds from each of the replicates were randomly selected, fasted over- night and slaughtered for carcass evaluation. Carcass parts were cut manually by the same person to minimize cutting errors to the barest minimum. Sensitive electronic weighing balances were used to weigh the cut parts and the internal organs. The internal organs and the cut parts were expressed as percentages of the live weight (Tables 3 and 4).

Analytical methods.

The feeds were analysed for their proximate composition according to A. O. A.C.(1990) methods. From the data on protein intake and weight gain, protein efficiency ratio (PER) was calculated.

Statistical analysis

The data collected were subjected to analysis of variance (ANOVA) according to Steel and Torrie (1980) and means separated where there were significant differences by Duncan (1955) method.

Results and discussion

Feeding sodium chloride processed soyabeans to broilers depressed growth rate at both starter and finisher phases. The results obtained by feeding trona and alum processed soyabeans to broilers compared well with the control or roasted soyabeans(Table 2). Feed intake and weight gain of the broilers were similarly depressed by sodium chloride. Feed/gain ratio was better at the starter phase in broilers on roasted soyabeans (control) than in broilers of the other groups. This trend was not maintained till the end of the finisher phase as broilers fed trona treated soyabeans had a better feed/gain ratio. Protein efficiency (PER) did not indicate a significant difference between the treatment means at either phases.

The lower body weight and feed intake observed in broilers fed soyabeans treated with NaCl were attributed to inability of this alkaline salt to sufficiently remove the polyphenols and oligosaccharides in the soyabeans compared to other alkaline salts and the control at the level used.

Table 3: *Carcass characteristics of broilers fed alkali processed soyabeans at 8th weeks*

	Diets				
Parameters	T_1,	T_2,	T_3,	T_4,	SEM
Live weight(g)	1400[b]	1350[b]	1450[ab]	1525[a]	10.00
Head (%)	3.37	3.37	2.90	2.60	± 0.41
Neck(%)	5.55	4.59	5.29	5.88	± 2.1
Breast (%)	13.72	11.29	13.28	13.92	± 4.22
Wings (%)	3.55	3.16	2.29	3.30	± 0.88
Thigh (%)	5.24	5.38	4.85	5.35	± 1.93
Drumstick(%)	11.82	12.27	10.78	10.00	± 4.02
Shank (%)	4.81	4.23	4.41	4.64	± 1.66
Dressing (%)	68.11	65.91	68.56	68.80	± 2.57

[a, b,] Means denoted by different alphabets in the same row are significantly different (P<0.05)

Table 4.: *Effect of the different alkaline salts on the organ – proportion*

	Diets				
Organ proportions (%)	T_1	T_2	T_3	T_4	SEM
Liver (%)	2.20	2.79	2.72	2.77	± 183
Gizzard (%)	2.34	2.37	3.61	3.49	± 0.95s
Heart (%)	0.52	0.54	0.56	0.66	± 0.02
Lung (%)	0.73	0.89	0.76	0.73	± 0.01
Pancrease (%)	0.35	0.45	0.41	0.42	± 0.04

Means denoted by the same alphabet in the same row are not significantly different (P>0.05

The works of Nelson *et al.* (1976), Ku *et al.* (1976) and Laurena *et al.*(1986) indicated that polyphenols and oligosaccharides of legumes can be decreased by soaking in water and blanching but the process is made more effective by the addition of sodium bicarbonate which is an alkaline salt. It is possible that the effect of sodium chloride in reducing these substances is less than in any of the other salts used. The non- significant difference (P>0.05) observed in PER is in consonant with the statement of Omueti *et al.*(1992) that the overall amino acid balance of the soyabeans processed with different concentrations of trona combined with blanching or soaking was not consistently affected. In this work, it is possible that the overall amino acid balance is the same in all the treatments. The carcass proportions in Table 3 show no significant difference (P>0.05). Many workers had reported lack of significant differences in carcass characteristics of broilers fed soyabean based diets (Robert *et al.*, 1982; Ayanwale, 1999). No remarkable differences (P>0.05) were also recorded in the internal organ proportion of the broilers. This indicates that the of trypsin inhibitors were reduced to such a level that did not cause distortions or disproportionate growth of the organs. Gertler and Nitsan (1970) reported

trypsin inhibitors depressed the activity of trypsin and chymotrypsin which results in hypertrophy of the pancrease and a reduction in growth rate. Since no hypertrophy of pancraese was observed in this work, the reduction observed in treatment T_4 could be attributed to insufficient removal of polypenols and oligpsaccharides in the NaCl treated soyabeans rather than the effect of tyrpsin inhibitors. This is also confirmed by the results of PER in all the treatment groups. The major effect of anti-nutritional factors of raw soyabeans which include increased pancreatic weight (Gertler and Nitan, 1970; Liener, 1976; Pusztai *et al.*, 1979) were not observed in this work. Therefore, the results of the work indicate that the three alkaline salts (NaCl, trona and alum) could be used to process soyabeans for broilers. However, NaCl treatment will have to be used with caution since it gave the poorest results in terms of growth rate. Trona and alum gave results comparable to the control. Since these alkaline salts are cheap and readily available all the year round their use in processing soyabeans for broiler diets should be encouraged.

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