Trop. J. Anim. Sci. 2(1): 85-93 (1999)
ISSN: 1119-4308

PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKENS FED SODIUM SESQUICARBONATE PROCESSED SOYABEAN DIETS.

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Target Audience: Nutritionists, feedmillers, poultry producers, scientists

ABSTRACT

Soyabean seeds were processed by soaking in water and aqueous solutions of sodium sesquicarbonate at 0.0%, 0.1%, 0.5% and 1.0% concentration at room temperature for 24hrs. The soaked soyabean seeds were drained through 0.02mm sieve, dried under shade and used in compounding 4 isocaloric and isonitrogenous diets. The diets were fed to 4 groups of Avian Broiler chicks in a Randomized Complete Block (RCB) design experiment.

The results indicated that crude protein of the soyabean seeds processed with 1% sodium sesquicarbonate was lower while DM, CF and ash contents of the treated soyabeans were slightly but not significantly reduced ($P>0.05$). The highest ash value, Na+ ions were found in soyabean seeds treated with 1% sodium sesquicarbonate. Broiler fed with 1% sodium sesquicarbonate processed soyabean had higher live weight and better carcass quality than broilers on the control at finisher phase but these were not significantly different ($P>0.05$). Nitrogen retention and protein efficiency ratio (per) were significantly better ($P<0.05$) in broilers fed sodium sesquicarbonate process soyabeans. It was concluded that sodium sesquicarbonate could be used in aqueous solutions up to 1% level to process soyabean seeds without any detrimental effects on broiler performance and carcass quality.

Key words: Performance, carcass characteristics, broiler, soyabean, sodium sesquicarbonate, processing

DESCRIPTION OF PROBLEM:

The nutritional significance of protein can not be overemphasized. However, high quality protein of animal origin is scarce and when available is beyond the reach of most farmers. Consequently, the focus is now on leguminous crops as sources of plant protein. One of such plant is soyabean. This important crop contains anti-nutritional factors such as polyphenols and tryspsin inhibitors which inhibits the enzymatic action of trypsin and heightens methionine defficiency (1).

Some of the anti-nutrional factors of soyabean are heat labile (2) but when the heat processing is applied below or above a required level, protein availability and solubility are adversely affected (3). Heat processing of soyabean may therefore not be advantageous considering the effect of excessive heat treatment on the nutritional value of legumes.

The use of alkali in the treatment of several types of plant proteins is well known (4). Treatment of soyabean with a strong alkali like phosphate (KH_2PO_4), results in decreased protein quality, loss of amino acids and formation of a complex amino acid, lysinoalanine, which reduces lysine availability (5). This effect increases with increasing concentration of KH_2PO_4, high pH, temperature and time. The use of mildy alkaline salts has been shown to improve the nutritive value of products. (6,7). An alkaline salt that is cheap and widely available in Nigeria is trona (sodium sesquicarbonate) (8) which is used in many homes as a flavouring agent and a tenderizer in cooking legumes and vegetable (9,10). Trona has also been found to improve the texture, nutritional and organoleptic properties of cowpeas (11,12). It is, however, feared that the use of trona in processing soyabean may have undesirable nutritional and toxicological consequences on farm animals. This work was therefore designed to investigate the effect of soyabean processed with trona on the performance and carcass quality of broilers.

MATERIALS AND METHODS

1. Sodium sesquicarbonate (trona), $Na_2CO_3NaHCO_3.2H_2O$ was bought from the market and aqeous solutions of the powdered samples were prepared by adding 0.0g, 1.0g, 5.0g and 10.0g of trona to 1,000 millilitres of water at room temperature. Raw soyabean seeds (Glycine max) were soaked in 0.0%, 0.1%, 0.5% and 1.0% solutions of trona respectively for 24hours after which the soyabean seeds were drained, air-dried and used in preparing four isocaloric and isonitrogenous diets (Table 1) designated T0, T1, T2 and T3 diets.

2. One hundred and twenty Avian broiler chicks from ZARTECH hatchery, Ibadan, were randomly allocated to the diets at thirty birds per diet replicated in two groups of fifteen birds each. All experimental birds were given feed and water ad-libitum. Records of average growth rate, feed consumption, body weight gain, feed conversion ratio and protein efficiency ratio (PER) were taken. The starter diets were fed for 4 weeks (0-28 days) while finisher diets were fed for 5 weeks (29-63 days). The experimental design was randomized complete block (RBC) design.

Table 1: Gross composition of experimental diets (g/kg)

	Starter diets				Finisher diets			
Ingredients	T0	T1	T2	T3	T0	T1	T2	T3
Maize	432.0	432.0	432.0	432.0	442.0	442.0	442.0	442.0
Soyabean	150.0	150.0	150.0	150.0	110.0	110.0	110.0	110.0
Maize offal	100.0	100.0	100.0	100.0	165.0	165.0	165.0	165.0
Groundnut cake	190.0	190.0	190.0	190.0	160.0	160.0	160.0	160.0
Fish meal	35.0	35.0	35.0	35.0	30.0	30.0	30.0	30.0
Palm oil	20.0	20.0	20.0	20.0	40.0	40.0	40.0	40.0
Bone meal	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Oyster shell	25.5	25.5	25.5	25.5	25.5	25.5	25.5	25.5
Salt	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Premix	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Methionine	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lysine	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Total	1000	1000	1000	1000	1000	1000	1000	1000

Digestibility Study:

At week 3 and 7, two experimental birds per replicate were randomly selected and transferred to metabolic cages. Weighed quantities of feed were supplied and dropping collected over a 72 hour period, using the total collection method (13). Faecal samples were oven-dried at 80^{0}C, weighed and ground prior to chemical analysis.

Gross Carcass Composition:

At the end of the feeding trial (9 weeks), two birds were randomly selected per replicate, fasted overnight and slaughtered for carcass evaluation.

Analytical Methods:

The test ingredients, feeds and faecal samples were analyzed for their proximate constituents according to standard methods (14). Gross energy was determined using Gallen Kamp oxygen bomb calorimeter. (15). Minerals in the soyabean samples were determined from a wet nitric acid digest by atomic absorption spectrophotometry but phosphorous was determined calorimetrically using the vanadomolybdate reagent, sodium and potassium were determined by flame photometry (14). From the data on protein intake and weight gain, protein efficiency ratio (PER) was calculated according to the procedure outlined by National Academy of Science/National Research Council (16). Nitrogen digestibility was estimated according to the procedure of Dryer (17).

Statistics

The experimental designed was randomized complete block (RCB). The data collected were subjected to analysis of variance (ANOVA) (18) and means were separated where there were significant differences (19).

RESULTS AND DISCUSSION

The proximate consumption of the soyabean seeds proccessed with trona solution is shown in Table 2. The results indicated that dry matter, crude fibre and ash contents of the trona processed soyabean were slightly lower than the values obtained from the raw soyabean seeds while crude protein and ether extract values were higher. The crude protein of the trona-treated seeds decreased as the concentration of trona increased. This could be attributed to the increased solubility of soyabean protein at the alkaline pH of trona resulting in increased leaching of proteins into the solution (21). The crude fibre slightly decreased with increasing concentration of trona. A similar decrease in fibre content due to (NaOH) alkali treatment of farm residue was ascribed almost entirely to a reduction in hemicellulose content of the residue (22).

Table 2: Proximate Composition of soyabean seeds processed with different concentration of sodium sequicarbonate (g/kg)

	Concentrations of Sodium sesquicarbonate (%).			
Ingredients	0.0	0.1	0.5	1.0
Dry matter	916.0	905.0	906.0	906.0
Crude Protein	480.2	481.0	480.0	462.0
Ether extract	220.3	220.5	220.6	220.6
Crude fibre	20.6	20.5	20.4	20.3
Ash	30.3	30.4	30.6	30.9
Gross energy (Kcal/g)	5.55	5.69	5.8	6.0

The results of the mineral analyses in Table 3 compare well with similar values reported for soyabean flour processed with trona (8). The highest ash value was found in soyabeans processed with 1% trona solution reflecting the uptake of the minerals from the processing solution. An increase in inorganic elements of cocoa pod husk resulting from alkali (NaOH) treatment was also attributed to mineral uptake from the alkali solution (23). It is possible that the trona solutions used in this work caused the bound minerals

to be released. Phytic acid is known to chelate some minerals such as Ca, Mg, Zn, Fe, and Cu in the legumes which could be released with the alkali processing of the legumes.

Table 3: Mineral composition of soyabean seeds processed with trona (g/kg)

	Trona concentration (%)			
Minerals	0.0	0.1	0.5	1.0
Ca	3.00	3.10	3.30	3.31
Na	0.60	0.90	1.50	2.40
Mg	2.00	2.00	1.90	1.80
K	9.00	7.80	8.00	8.90
P	6.00	3.90	4.00	4.50

The performance of the broiler fed trona processed soyabean is shown in Table IV. At the end of the starter phase (0-28 days), these were no significant differences ($P>0.05$) in the mean values obtained for live weight, feed consumption, weight gain and feed/gain ratio. At the finisher phase, the weight of the broilers increased with the level of trona concentration. Broilers fed 1% trona-treated soyabeans had slightly higher weight gain than the control. These result could be attributed to better efficiency of protein utilization and higher nitrogen retention of broilers fed the treated soyabeans than in the control as shown in Table V.

Table 4: Performance characteristics of broilers fed the experimental diets:

	Dietary treatments				
Stater Phase (0-28 days)	0.0	0.1	0.5	1.0	SEM
Initial live weight (g/bird)	55.55	55.60	55.60	55.56	—
Final live weight (g/bird)	544.15	560.14	562.23	565.43	2.03
Weight gain (g/bird)	488.60	504.54	506.63	509.87	1.03
Feed intake (kg/bird)	1.04	1.03	1.03	1.03	5.25
Feed: gain ratio	2.13	2.05	2.04	2.03	0.18
Finisher phase (29-63 days)					
Final live weight (kg/bird)	2.14	2.18	2.19	2.19	39.21
Weight gain (kg/bird)	1.60	1.68	1.68	1.68	25.34
Feed intake (kg/bird)	1.52	4.50	4.57	4.30	14.62
Feed: gain ratio	2.82	2.68	2.72	2.56	0.51

SEM is the standard error of mean.

The trona solution used in this study probably destroyed the trypsin inhibitor in the soya bean seeds resulting in increased availability of protein in the soya beans seeds. Growth retardation by the raw soya beans was due mainly to unavailability of protein for the broilers as a result of the presence of the trypsin inhibitors. The results of the in vitro trona treatment of soya beans flour showed that trona destroyed the trypin inhibitors present in raw soyabeans resulting in high digestibility (8). The better protein efficiency ratio value as well as better nitrogen retention of the broilers fed trona-processed soyabeans could also be as a result of the release of the inorganic mineral elements of the treated soyabeans (Table III) which were in the chelated from in the control. Some of the minerals when available, serve as co-enyzmes and cofactors of the enzyme system involved in protein metabolism (24, 25) and their levels in a diet affect utilization (16) . This probably partly explains the better PER and nitrogen retention values obtained at the finisher phase of broilers fed trona processed soyabeans diets. Although the formation of lysinoalanine has been reported for soyabeans soaked in aqueous NaOH (4) the authors also remarked that feeding mildly treated soyabeans to broilers did not produce any adverse effect in the birds. This is in agreement with the result of this work. It also agrees with the observation (7, 27) that soaking and blanching in 0.5% Sodium bicarbonate removed polyphenols and destroyed trypsin inhibitors of treated soyabeans.

Table 5: Nitrogen utilization by birds fed the experimental diets.

	Dietary treatments				
Starter phase (0-28 days)	0.0	0.1	0.5	1.0	SEM
Nitrogen intake (g/day)	3.39	3.34	3.42	3.36	0.05
Nitrogen output (g/day)	1.14	1.11	1.10	1.06	0.24
Nitrogen retained (g/day)	2.25	2.23	2.27	2.20	0.20
Nitrogen retention (%)	66.37	66.77	67.84	68.45	1.58
Protein efficiency ratio	1.97a	1.69ab	1.59b	1.56b	0.11
Finisher phase (29 - 63 days)					
Nitrogen intake (g/day)	4.54	4.52	4.60	4.50	0.06
Nitrogen output (g/day)	1.14	1.11	1.80	1.03	0.09
Nitrogen retained (g/day)	3.30	3.41	3.52	3.47	0.18
Nitrogen retention (%)	72.69b	75.44a	76.52a	77.11a	1.67
Protein efficiency ratio	2.25a	1.90ab	1.82b	1.75b	0.10

SEM is the standard error of mean.

Values without a common letter in the same row differ significantly ($p<0.05$).

The results of carcass evaluation shown in Table VI did not indicate significant

differences in the proportions of drumsticks, gizzards, liver, head, abdominal fat, and other cut-up parts but the values were consistently higher in boilers fed 1% trona-treated soyabeans. The same trend was observed for the final live weight and dressing percentages of birds. The slight differences observed in the gross carcass composition may be attributed to the exclusion of trona in the control diet. Minerals, vitamins and alkali are known to affect protein utilization (24,4).

Table 6: Carcass evaluation of birds fed experimental diets.

Parameters:	Trona processed diets				
	0.0%	0.1%	0.5%	1.0%	SEM
Mean live weight (kg)	1.97	2.12	2.39	2.49	0.01
Plucked weight (kg)	1.79	1.94	2.19	2.35	0.20
Plucked weight (%)	90.86	91.51	91.63	91.70	1.56
Dressed weight (kg)	1.43	1.59	1.83	1.92	0.01
Dressing (%)	72.59	75.00	76.57	77.42	1.35
Carcass composition (%)					
Drumstick	8.42	9.32	9.68	11.38	0.28
Wings	10.38	10.75	10.55	12.67	0.29
Breast	15.16	15.27	18.15	19.00	0.39
Back	15.56	17.39	18.03	18.64	1.22
Neck	3.38	3.36	3.39	3.87	0.13
Shank	4.16	4.02	5.16	5.37	0.21
Heart	0.68	0.87	0.91	0.98	0.09
Gizzard	2.41	2.96	3.04	3.18	0.17
Liver	1.74	2.08	2.20	2.28	0.09
Head	2.51	2.32	2.89	3.10	0.15
Intestine	3.04	3.10	3.30	3.33	0.15
Thigh	10.36	10.92	11.84	12.36	0.26
Abdominal fat	1.36	2.18	2.12	2.25	0.21

SEM is standard error of mean.
Percentages are with respect to plucked weight.

The data presented in this study suggest that trona or sodium sesquicarbonate is a good processing material for soyabean at a concentration of up to 1.0%, without any detrimental effect on performance of birds and carcass quality. At such a low concentration it is effective in deactivating trypsin inhibitors without significant adverse effect on the overall soyabean protein utilization and carcass quality of the broilers.

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