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Research Article

Economic Implications of Utilizing Yeast Treated Soya Bean in the Diets of Broiler Chickens

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ABSTRACT

The study was designed to determine the cost effectiveness of utilizing yeast treated soya beans in the diets of broiler starter and broiler finisher. A total of fifteen diets were formulated whereby raw soy bean(RSB)was used to replaced full fat soya bean (FFSB) at 0, 25, 50, 75 and 100%, but each of these having three levels of treatment with yeast and without yeast inclusions. Diets were prepared for starters (0-28 days) and finishers (29-56 days). The diets compounded were isonitrogenous (circa 23% CP for starter and 20% CP for finisher) and isocaloric (circa 2900 kcal/kg ME for broiler and 3000 kcal/kg ME for finisher). One hundred and eighty Marshal Broilers were randomly assigned to fifteen dietary treatments with twelve birds per treatment divided into two replicates of six birds each. The study maintained that the use of RSB with yeast inclusion in broiler diets is profitable for optimal broiler production, and recommends feeding RSB at 25% level with 6g/kg yeast inclusion during the starter phase and 25% level without yeast inclusion during the finisher phase. It further revealed that profitable broiler production may be achieved by replacing FFSB with 75% RSB (with 12g/kg yeast inclusion) infinisher's diet. Consequently, poultry farmers are advocated to fortify raw soya beans with yeast extracts to minimize their production costs.

Key words: Cost benefit, FFSB, RSB, Yeast extracts

INTRODUCTION

Poultry, like every other farm animal requires the six classes of nutrients namely carbohydrate, fat and oil, protein, mineral salt, vitamin and water. Feeding makes up the major cost of poultry production and good nutrition is reflected in the birds performances and it products. Poultry feed ingredients include energy concentrate sources such as maize, wheat, oats, sorghum and milling by-products. Protein concentrate sources include soya bean meal and other oilseed meal (groundnut, sesame, and safflower etc), grain legumes such as dry beans and alfafa, cottonseed meal, animal protein sources (Blood and bone meal, fish meal etc),

Over the years, the costs of feed ingredients have been on a steady increase. This is mainly due to intense competition between humans and animals for some food item and of course, the higher demands from industries sourcing raw materials from organic materials and their bye-products. The global society being a dynamic one, attempts have been made by interest groups such as researchers to probe into the effective use of conventional and non-conventional feedstuff. Nigeria produces large quantities of agricultural and agro-industrial by-products, which are regarded as non-conventional feed sources (Oluokun and Olaloku, 1999). Some of these have been utilized by several animal nutritionists in feed formulation.

Tona *et al.* (2006) replaced corn bran at various levels with coca bean shell in the diet of cock and observed a reduced packed cell volume (PCV) in their blood. Durunna *et al.* (2006) showed that *Anthonatamacrophyla* seed meal can be used as partial source of crude protein to replace groundnut cake up to 20% in broiler finisher diet. They also applauded the cost effectiveness of the test ingredients. Ezeokeke and Okpogode (2006) in their experiment showed that appreciable level of palm oil inclusion with Vitamin E enhanced growth of the broilers especially at the starter phase. The work of Ani (2006) also revealed that up to 20% processed mucuna seed can be included in the diets of the pullet chicks without any deleterious effects on chicks.

Soya bean (*Glycine max*) is legume that grows in tropical, subtropical and temperate climates. The legume

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family is worldwide in distribution, but its greatest concentration is in tropical and subtropical regions. The fruit is the feature by which the family is best characterized. Technically known as a legume, it is a single-chambered, flattered seed pot with two sutures (Crosby, 2006).Bean is a common name widely applied to many plants of the legume family. The seeds and pods of these are used for food and forage. The seeds themselves are also called beans and are valuable as food because of their high protein content. The cowpea, asparagus bean and hyacinth bean are also cultivated, particularly for forage. The Soya bean is the common bean of the orient and has been more widely cultivated in Nigeria in recent years and find usage i many industries and human food. Most Soya beans are grown today for their oil, which is used in industrial manufacturing and as fodder for livestock. The development of a Soya bean processing industry in early 1920, gave Soya bean cultivation a great impetus, and today Soya bean is a lending crop both in the United States and Nigeria, ranking only behind corn and wheat (Bernard, 2006).

The two basic products of Soya bean are protein meal and oil. In the United States, more than 90 percent of the oil is consumed as margarine shortening, products; the rest is used in industrial products such as pain, varnish, linoleum, and rubber fabrics (Bernard, 2006), while in Nigeria, it is used primarily as food for man and to lesser extent livestock.

Soya bean is an important source of high quality but inexpensive protein and oil. It has an average protein content of 40% and oil content of 20% (IITA, 2007). Hence, soya bean has great potential as a major source of dietary protein; more so as it has a superior amino acid profile. In the protein-short areas of the world and elsewhere, soya bean meal is finding increasing use in human food products. The oil produced from soya bean is highly digestible and contains no cholesterol (FAO, 1996; IITA, 2007). In addition, its oil is more of polyunsaturated fraction, containing both essential fatty acids at high proportion of 48-52% linolenic acid and 2-12% linoleic acid. The oil can be removed by using either a solvent extraction or by mechanically pressing the soya bean.

Soya bean meal is an excellent feed for livestock; it is very palatable, highly digestible and contains a high amount of digestible energy (Animal Feed Resource information system, 1992). The majority of soya bean meal is fed to poultry and swine with an increasing amount of specially processed soya bean been fed to dairy cattle. It is one of the consistent feed ingredients available. Soya bean meal is also one of the best protein sources for complementing the limiting amino acid profile of other plant protein sources (Kerley and Allee, 2003).

Soya bean is nutritively regarded as a choice feedstuff of plant origin because of its high nutritive quality whose amino acids profile is comparable to meat and egg (Akpodiete and Okagbare, 2005). It has one of the best amino acid balances of the oil seed meals. Its high concentration of lysine and tryptophan makes it a choice source of plant protein that can combine well with grains especially maize to make a balanced diet for livestock. When blended with cereal grains, its amino acid profile compliments most of the cereal grains very well. All the same, in a corn-soya bean diet, methionine would need to be supplemented. Again, applying excessive amount of heat to soya bean will cause a mallard reaction to occur, which binds the lysine and causes it to be unavailable to the animal. Hence, Akpodiete and Okagbare (2005) proposed treating raw soya bean with higher dosage of fermented yeast, and reported improved performance of broilers in terms of final live-weight and average weight gains. By the reason of anti-nutritional factors inherent in raw soya bean, there is need to venture into various combination-ratios of raw and full fat roasted soya bean with various levels of yeast inclusion (to the raw soya bean). This will aid to reveal where the general broiler performance will be optimum and also cost benefit implication.

MATERIALS AND METHODS

The experimental site

This study was carried out in the poultry unit of the Teaching and Research Farm of the, Delta State University, Asaba Campus. The farm is located on Longitude 6^0 $45^/$E and Latitude 6^0 $12^/$N, with an annual rainfall that ranges from 1800mm to 3000mm, and also with the maximum day Temperature range of 27.5 ^{0}C to 30.9 ^{0}C (Asaba Meteorological Centre).

The poultry house and its preparation

One of the poultry houses at the Teaching and Research Farm was used for this study. The poultry house has dwarf walls and netted fully to permit good ventilation and it is managed on deep litter system. Both sides of the poultry house was partitioned into 30 unit cells, hitherto called pens, of equal sizes, measuring 1.8m x 1.5m each and 0.7 – 0.9m^2 floor space per bird.

A large floor space is left at the middle of the twin columns of pens, which served as the buffer zone. Wood and ½ inch wire mesh was used in the demarcation of the pens. Each pen in the column represented an experimental treatment (T1,T2,T3,T4,…., or T15), while each row of pen represented an experimental replicate (R_1 or R_2), giving a total of 30 pens.

The poultry house and its environment was kept in good sanitary condition, with the interior properly swept, washed, disinfected and allowed to stand for two weeks. This is to allow the strong odour of the disinfectant to thin out for the health of the chicks. Thereafter, a fresh litter of wood shavings were spread on the floor of the pens, and the shavings were changed as need arose. Prior to the commencement of the experiment, condemned engine oil was poured round the surrounding to prevent soldier ants from entering the experimental house. This was repeatedly done as need arose throughout the experimental period. The entire house was then covered with black polythene sheets to conserve heat provided by the electricity, stoves and lanterns. This continued for the brooding period of 4 weeks. Heat and ventilation were properly monitored to prevent adverse effect.

The experimental diets

The test ingredient

The test ingredient was soya bean. The soya bean was purchased at Ose market in Onitsha, Anambra State. The soya bean to be used was divided into two equal parts for the respective preparatory methods of the Soya bean processing before inclusion in the diets. The diets formulated were labelled T1, T2 - - - T15 with the following proportions of FFSB, RSB and yeast extract: T1=100% Full fat Soya Bean (FFSB), T2=100% Raw Soya Bean (RSB), T3= 75% FFSB + 25% RSB, T4=75% FFSB + 25% RSB + 6 g/kg yeast, T5=75% FFSB + 25% RSB + 12 g/kg yeast, T6=75% FFSB + 25% RSB + 8 g/kg yeast, T7= 50% FFSB + 50% RSB + 6 g/kg yeast, T8=50% FFSB + 50% RSB + 12 g/kg yeast, T9=50% FFSB + 50% RSB + 18 g/kg yeast, T10= 25% FFSB + 75% RSB + 6 g/kg yeast, T11=25% FFSB + 75% RSB + 12 g/kg yeast, T12=25% FFSB + 75% RSB + 18 g/kg yeast, T13= 100% RSB + 6 g/kg yeast, T14= 100% RSB + 12 g/kg yeast, T15=100% RSB + 18 g/kg yeast

Feed Efficiency: this was obtained by dividing the weight gain of the birds in each replicate by the total amount of feed consumed during the same period of time by the number of birds in that replicate.

Thus, Feed Efficiency = Weight Gain / Feed Consumed

Percentage mortality

The percentage Mortality was determined per replica as follows:

% Mortality = [No. of dead birds in the replicate] / [Initial no. of birds in the replicate] x 100

Economy of feed conversion of the broiler production

This was based on the cost of the compounded diets in relation to the prevailing market prices of the ingredients at the time of purchase. The information was used to compute the cost of feed consumed per kilogram weight gain for each of the diets. The cost differentials in relation to the control diet were also calculated as shown below:

Cost differential (₦) = cost/kg wt. gain of test diet – cost/kg wt. gain of control diet.

Relative cost benefit = cost/kg wt of control / Cost/kg wt of test treatment X 100

The experimental design and data analyses

The experimental design was a one- way classification in a completely randomized design (CRD) with the following model:

$X_{ij} = \mu + \alpha_i + e_{ij}$

Where X_{ij} = the observed value of each of the response variables

μ = the overall population mean.

α_i = observed effect of the ith dietary treatment

e_{ij} = random or residual error due to the experimentation

All data collected from the field and laboratories were subjected to analysis of variance (Steel and Torrie, 1980). Means showing significant differences were separated using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Economy of feed conversion of the effect of feeding varying levels of raw soya beans to broiler

Tables 1, 2 and 3 show the results of the economy of feed conversion for the production of the broiler fed the experimental diets from 0-28 days, 29-56 days and for the entire production period (0-56 days). During the starter phase, the average total feed consumed (kg/bird) by the birds fed the control diet were similar (P>0.05) to those of birds fed diets T2, T6, T7, T9, T10, T11 and T12, but differ significantly (P < 0.05) to those of birds fed diets T3, T4, T5, T8, T13 ,T14 and T15 .

The cost of total feed consumed per bird (₦) for the starter phase was lowest in birds fed the control diet which differed significantly (P < 0.05) to those of birds fed dietary treatments T6, T13, T14 and T15. For the starter phase, the cost per kilogram of body weight gain (₦) was lowest (₦=147.25) in birds fed the control diet which varied significantly (p<0.05) to those of birds fed diets T2, T7, T14, and T15. Birds fed diet T15recorded the highest (₦234.36) cost per kilogram body weight for the starter phase which was similar (P<0.05) to that of birds fed diets T11, T13, T14, and T15. The cost differential per kilogram weight gain (₦) followed similar pattern to the cost per kilogram body weight gain (₦) of the starter phase as well. The relative cost benefit per

Table 1: Cost effect of feeding varying Levels of Raw Soya Beans to Broilers (0-28 Days)

Treatment	Cost of total feed consumed (kg/bird) N	Total feed cost/ bird	Cost/ kg body weight	Cost differentiate/ Kg wt gain	Relative cost benefit/ kg wt gain
T1	0.98^{c}	77.30^{c}	147.25^{c}	-	100.00^{a}
T2	1.11^{abc}	87.16^{ccd}	193.10^{bcd}	45.85^{bcd}	76.55^{cdef}
T3	1.14^{ab}	89.53^{cd}	158.00^{de}	10.75^{de}	86.12^{bcd}
T4	1.15^{ab}	94.16^{bcd}	1.48.30^{e}	1.67^{de}	99.50^{a}
T5	1.19^{a}	97.44^{abcd}	180.45^{cde}	33.20^{cde}	81.99^{bcde}
T6	1.05^{abc}	85.16^{de}	164.00^{dc}	16.75^{dc}	89.51^{abc}
T7	1.09^{abc}	92.52b^{cdb}	158.15^{de}	10.90^{de}	92.98^{ab}
T8	1.15^{ab}	97.61^{abc}	187.99^{bcd}	40.74^{bcd}	79.05^{cdef}
T9	1.09^{abc}	92.52^{bcd}	185.04^{cd}	37.79^{cd}	79.58^{cdef}
T10	1.12^{abc}	98.20^{abc}	189.13^{bcd}	41.88^{bcd}	78.01^{cdef}
T11	1.08^{abc}	94.26^{bcd}	202.82^{abc}	55.57^{abc}	72.60^{defg}
T12	1.03^{bc}	89.88^{cd}	189.21^{bcd}	41.96^{bcd}	78.01^{cdef}
T13	1.15^{ab}	104.11^{0ab}	207.31^{abc}	60.06^{abc}	72.00^{efg}
T14	1.14^{ab}	102.75^{ab}	223.67^{ab}	76.42^{ab}	66.02^{fg}
T15	1.19^{a}	107.74^{a}	234.36^{a}	87.11^{a}	63.02
SEM	0.01	1.55	5.09	5.09	2.11

a, b, c ; means with the same superscripts within each column, are not significantly different (P<0.05), SEM= Standard error of the means.

Table 2: Cost effect of feeding varying Levels of Raw Soya Beans to Broilers (29-56 Days)

Treatment	Cost of total feed consumed (kg/bird) N	Total feed cost/ bird	Cost/ kg body weight	Cost differentiate/ Kg wt gain	Relative cost benefit/ kg wt gain
T1	3.86^{abcd}	290.67^{abc}	172.29^{bc}	-	100.00^{bc}
T2	3.65^{abcd}	274.50^{abc}	200.89^{ab}	25.60^{abc}	85.75^{cdef}
T3	3.32^{bcd}	242.87^{bc}	146.53^{c}	-25.76^{d}	119.76^{a}
T4	4.19^{abc}	327.29^{abc}	182.05^{abc}	9.76^{bcd}	95.00^{bcd}
T5	4.15^{abc}	324.56^{abc}	196.24^{ab}	23.95^{abc}	88.00^{bcd}
T6	4.94^{a}	386.81^{a}	209.69^{ab}	37.40^{abc}	82.50^{bcd}
T7	4.46^{ab}	362.23^{ab}	211.38^{ab}	39.09^{abc}	82.00^{bcd}
T8	4.06^{abcd}	329.71^{abc}	215.31^{ab}	43.02^{ab}	80.00^{cd}
T9	3.28^{abcd}	266.69^{abc}	203.63^{ab}	31.34^{abc}	85.00^{bcd}
T10	4.01^{abcd}	337.24^{abc}	191.87^{abc}	19.58^{abc}	90.23^{bcd}
T11	2.89^{cd}	242.63^{bc}	171.01^{bc}	-1.28^{cd}	101.41^{ab}
T12	4.08^{abcd}	342.71^{abc}	226.36^{a}	54.07^{a}	76.81^{d}
T13	3.56^{abcd}	309.54^{abc}	201.31^{ab}	29.02^{abcd}	86.19^{bcd}
T14	2.64^{d}	229.12^{c}	188.13^{abc}	15.84^{abc}	92.08^{bcd}
T15	3.31^{bcd}	287.81^{abc}	212.40^{ab}	40.11^{abc}	82.44^{bcd}
SEM	10.55	4.50	4.34	2.23	1.72

a, b, c ; means with the same superscripts within each column, are not significantly different (P<0.05), SEM= Standard error of the means.

Table 3: Cost effect of feeding varying Levels of Raw Soya Beans to Broilers (0-56 Days)

Treatment	Total feed consumed (kg/bird)	Total feed cost/ bird	Cost/ kg body weight	Cost differentiate/ Kg wt gain	Relative cost benefit/ kg wt gain
T1	4.84^{abcd}	367.97^{abc}	218.17^{de}		100.00^{ab}
T2	4.75^{abcd}	361.66^{abc}	268.36^{abc}	50.19^{abcd}	81.00^{defg}
T3	4.36^{bcd}	332.40^{c}	202.00^{e}	-16.18^{f}	108.29^{a}
T4	45.34^{abc}	421.85^{abc}	234.36^{cde}	16.19^{de}	93.12^{dc}
T5	5.24^{abc}	422.00^{abc}	255.47^{abcd}	37.30^{bcd}	86.02^{cdef}
T6	5.97^{a}	471.96^{a}	255.79^{abcd}	37.62^{bcd}	86.02^{cdef}
T7	5.55^{ab}	454.75^{ab}	266.06^{abc}	47.89^{abcd}	82.17^{cdefg}
T8	5.21^{abcd}	427.32^{abc}	279.20^{ab}	61.03^{abc}	78.73^{egf}
T9	4.37^{bcd}	359.2^{abc}	278.25^{ab}	60.08^{abc}	78.67^{efg}
T10	5.13^{abcd}	435.44^{abc}	247.83^{bcd}	29.66^{cde}	88.50^{cde}
T11	3.96^{cd}	336.89^{bc}	238.05^{cde}	19.88^{de}	91.50^{bcd}
T12	5.10^{abcd}	432.59^{abc}	285.69^{ab}	67.52^{ab}	76.70^{fg}
T13	4.71^{abcd}	413.67^{abc}	268.95^{abc}	49.78^{abcd}	81.59^{defg}
T14	3.77^{d}	331.87^{c}	273.86^{abc}	55.69^{abc}	79.61^{efg}
T15	4.50^{bcd}	395.54^{abc}	295.59^{a}	77.42^{a}	74.11^{g}
SEM	0.13	10.41	5.12	5.00	1.78

a, b, c ; means with the same superscripts within each column, are not significantly different (P<0.05), SEM= Standard error of the means.

kilogram weight gain (%) for the starter phase of birds that were fed dietary treatments T4, T6 and T7 was similar (P>0.05) to that of birds fed the control diet. The least relative cost benefit per kilogram weight gain for the starter phase was recorded for birds that were fed diet T15, which was similar (P>0.05) to those of birds fed diets T11, T13, T14, and T15.

In the Finisher phase, the total feed consumed (kg/birds) was high in birds fed dietary treatment T6, which was significantly (p<0.05) higher than those birds that fed diets T3, T9, T11, T14 and T15. The birds fed diet T14 recorded the least value of total feed consumed. For the cost of total feed consumed per bird (₦) in the finisher phase, the highest amount recorded was for birds that fed dietary treatment T6. Birds that were fed dietary treatment T12 recorded the highest value of cost/kg body weight gain (₦ 226.36) in the finisher phase which varied significantly (p<0.05) to that of birds fed diets T11, T3 and control diet (T1). The cost differential per kilogram weight gain (₦) for the finisher phase recorded negative values in birds fed diet T3and T11which were only similar (P<0.05) to that of birds fed diet T4. For the finisher phase, the relative cost benefit per kilogram weight gain (%) was high in birds fed diets T3 and T11 which were similar (P> 0.05). The relative cost benefit per kilogram weight gain (%) of birds that fed dietary treatment T3 was significant (P<0.05) with those of birds that were fed the rest diets with exception of diet T1. For birds fed diet T11, the relative cost benefit per kilogram weight gain (%) was not significant to that of birds fed diets T2, T8 and T12.

The results of economy of feed conversion of birds fed the experimental diets for the entire production period, 0-56 days (Table 4.15) showed that the total feed consumed (kg/bird) by birds fed dietary treatment T6 was the highest (5.97). This varied significantly (P < 0.05) with the total feed consumed (kg/bird) for birds fed dietary treatments T3,T9, T11, T14and T15 .The same pattern observed in similarity (P>0.05) and significant difference (P < 0.05) of average total feed consumed for the entire production period was found in the finisher phase. As well the cost of total feed consumed per bird (₦) in the finisher phase and the entire production period followed the same pattern. Birds fed diet T6 had the highest cost of total feed consumed per bird (₦) which varied significantly (p<0.05) with those of birds fed diets T3, T11 and T14.

The cost per kilogram body weight gain (₦) of birds fed dietary treatment T15 was high, and this was significantly ($p<0.05$) different with those of birds fed diets T1,T3, T4, T10 and T11 , in the entire production period. The cost differential per kilogram weight gain (₦) recorded a negative value for birds fed dietary treatment T3, which was significantly ($P < 0.05$) different to other birds fed the remaining diets. Birds fed diet T15 had the highest value of cost differential per kilogram weight gain (₦) which differed significantly ($p<0.05$) to birds fed diets T3, T4, T5, T6, T10 and T11. The relative cost benefit per kilogram weight gain (%) recorded the highest value in the birds fed dietary treatment T3 which was similar ($P > 0.05$) to that of birds fed the control diet (T1) but significantly ($P < 0.05$) higher than those of birds fed the rest of the diets. Birds fed dietary treatment T15 had the lowest relative cost benefit per kilogram cost benefit per kilogram weight gain (%) which was similar ($p>0.05$) to those of birds fed diets T2, T7, T8, T9, T12, T13 and T14.

Economy of feed conversion of the effect of feeding varying levels of raw soya beans to broilers

Generally, there was significant ($p<0.05$) increase in the cost of total feed consumed per bird during the starter phase at all levels of the test diet while there was no significant increase ($p>0.05$) in the cost of increased incorporation of the test diet at the finisher phase. This implies that Full Fat Soya Bean (FFSB) should not be substituted for Raw Soya Bean (with yeast inclusion) up to 100% level at the starter phase. The cost of producing a kilogram of body weight gain between broilers on the control dietary treatment and on those on 75% RSB with 12g/kg inclusion (T11), at all the production phases (0-28, 29-56 days and 0-56 days) suggests that RSB with yeast inclusion may be most profitably utilized in broiler diets at 75% level of inclusion.

Records of cost differential per kilogram weight gain were least only at the 25% level of inclusion of the test ingredient (with 6g/kg yeast inclusion) for starter birds and at the 25% levels (without yeast inclusion) for the finisher phase and overall production period. This implies that RSB can be profitably utilized in broiler diet up to 25% level (with 6g/kg yeast inclusion) during the starter phase, but at 25% level (without yeast inclusion) during the finisher phase.

Mortality was similar for broilers on the diets T1 (control), T2, T3, T4, T5, T7, T8, T9, and T11. The very low mortality observed in this study is an indication of the safety of the test ingredient as a potential poultry feed ingredient, with or without yeast inclusion.

Conclusion and Recommendation

The cost benefit analysis revealed that 25% replacement levels with RSB (without yeast inclusion) in broiler diets fairly reduced the cost of feed, which gave the highest profit per bird, and this was followed by 75% replacement level with RSB (+ 12g/kg yeast inclusion).

Based on the economic analysis of the production process, the use of RSB with yeast in broiler diets is profitable at the recommended levels. Hence, RSB can be profitably utilized in broiler diet up to 25% level (with 6g/kg yeast inclusion) during the starter phase, but at 25% level (without yeast inclusion) during the finisher phase.

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