

Cost-benefit analysis of replacing maize with rice husk supplemented with grindazyme, nutrsea xyla or roxazyme g enzyme supplementation in the diet of Arbor Acres broilers

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Abstract

The experiment was carried out to investigate the cost-benefit of replacing maize with rice husk supplemented with enzymes in the diet of arbor acres broilers. The experimental design was a 2x4 factorial combination of two dietary level of rice husk (0 or 25%) with four levels of different enzymes 0E (without enzyme 0ppm), 100E (100ppm of Nutrase xyla), 150E (150 ppm of Roxazyme G), or 350E (350ppm of Grindazyme). Rice husk was added at the expense of maize in the control diet and each experimental diet was tested during a 56-day feeding trial in triplicate. One hundred and ninety-two (192) one-day old unsexed Arbor acres chicks were used in the trial. Each of these was undertaken in the presence of no enzyme 0E (0ppm) or with different types of commercial enzymes at recommended level, which are 100E (100ppm of Nutrase xyla), 150E (150ppm of Roxazyme G), and 350E (350ppm of Grindazyme). Cost of each ingredient was used to calculate the total cost; there were reductions in the cost of raising 1Kg of Arbor acre broiler on supplementation of the rice husk diets with commercial enzymes. The 25% replacement of maize with rice husk supplemented with commercial enzymes has no detrimental effect on the performance of the birds; rather the saving cost was associated with improved weight gain. The inclusion of rice husk supplemented with any of the enzymes in the diets reduced the cost of producing broilers and hence increased profit.

Key words: Broiler, Cost-benefit, Grindazyme, Nutrase xyla, Roxayzme G

Introduction

The low level of protein intake is of great concern to the developing countries among which Nigeria is one. Unlike plant protein, animal protein is of high biological value, which is important for optimum health of man. It is a known fact that Nigeria has not been able to provide animal protein in sufficient quantity to meet the animal protein requirement of the populace (World Bank,

2007). In order to have a fast means of protein supply in abundance, the poultry industry must be developed. However, lack of adequate supply of feedstuffs at economic prices is a major factor militating against rapid development of poultry industry (Atteh, 2000), such that the panacea for the instant provision of cheap animal protein has often been more of a burden than an asset. Feed represents the major cost of poultry

production, constituting up to 70 percent of the total feed cost, about 95percent of the total feed cost is used to meet energy and protein requirements, about 3to 4 percent for major mineral, trace mineral and vitamin requirements and 1 to 2 percent for various feed additives. Poultry diets are formulated from a mixture of ingredients, including cereal grains, cereal by-products, fats, plant protein sources, animal byproducts, vitamin and mineral supplements, crystalline amino acids and feed additives. These are assembled on a least-cost basis, taking into consideration their nutrient contents as well as their unit prices (Ravindra , 2012) The predominant feed grain used in poultry feeds worldwide is maize. This is mainly because its energy source is starch, which is highly digestible for poultry. In addition, it is highly palatable, is a high-density source of readily available energy, and is free of anti-nutritional factors. The metabolizable energy value of maize is generally considered the standard with which other energy sources are compared (Atteh, 2000). The competition for grains, particularly maize, by man, animal and industry has caused severe grain supply problems in the world market, with dramatic price increases. Hence, it makes economic sense to find cheap alternatives for maize in poultry diets. Efforts to extract more nutrients from feedstuffs both conventional and non-conventional have been a focus for research for decades. There are many vegetable and animal products that can be used as feed ingredients for poultry. Poultry cannot digest fibre found in roughage, seeds, grains and fruits. Products that are high in fibre can make up only a small percent of the feed. Since many plant products also contain anti-nutrients the amount of these feed stuffs that can be fed is also limited. Dietary fibre is the part of plant material consisting mainly

of cellulosic and non-cellulosic polysaccharides, and a non-carbohydrate component, lignin. These components are highly resistant to hydrolysis by digestive enzymes and cannot, therefore, be digested or absorbed in the blood stream. Yet fibre plays an important role in poultry diets, if applied properly (Lee *et al*, 2003). Products that are high in fibre are thought to have anti-nutritive activities in poultry and result in depressed nutrient utilization and poor growth. Fibre utilization by monogastric livestock hays recently gained interest for various reasons, primarily to promote constant passage of materials through the gut and to stimulate growth (Grieshop *et al*, 2001). The nutritional functions of fibre in the animal body include keeping the digestive system healthy for proper function, aiding and speeding up the excretion of waste and toxic materials from the animal body (Jorgensen *et al*, 1996). Dietary fibre components undergo a limited conversion to substance available for absorption in poultry and could be degraded only by exogenous enzymes. The addition of enzymes to address arabinoxylan linkages of Non Starch Polysaccharide (NSP) viscosity can improve gut health, feed efficiency, improve fecal quality and facilitate the use of lower cost feed ingredients (Danisco, 2006) . The benefits of using livestock feed enzymes is to increase the availability of starches and proteins which are enclosed within fibre-rich cell walls and to increase the availability of phosphorus from phytate. In recent times more effort has been directed towards harnessing and utilizing by-products and wastes which are not directly utilizable by man and take advantage of the convertible mechanism of animal organ to convert what is seen as a waste into wholesome animal product for human consumption using

enzymes. Peter and Hoffman(2002) reported a bright future to be opening up as enzyme become a practical tool offering the possibility of replacing expensive raw material with cheaper ones. There is the need to educate poultry farmers on the efficacy of enzyme supplementation on the utilization of high fibre chicken diet, it is therefore essential to analysis the cost benefit of replacing maize with rice husk with different types of commercial enzymes to ensure that farmers maximize profit for the money spent on poultry business..

Materials and methods

One hundred and ninety-two (192) one-day old unsexed Arbor acres chicks were used for this experiment. The experiment was carried out at University of Ilorin and the ambient temperatures during the period of study were 26.6°C (morning), 33.1°C (afternoon) and 30.7°C (evening) with corresponding relative humidity of 72%, 40% and 52% respectively. The experimental diet consisted of a 2 × 4 factorial combination of replacement of maize with rice husk and types of enzymes. The birds were housed in an electrically heated battery cage and were fed the experimental diet shown in Table 1, from day old to 8 weeks of age. Rice husk was added at 0 or 25% inclusion level at the expense of maize in the control diet. Each of these was undertaken in the presence of no enzyme 0E (0ppm) or with different types of enzyme at recommended level, which are 100E (100ppm of Nutrase xyla), 150E (150ppm of Roxazyme G) and 350E (350ppm of Grindazyme). Thus there were 8

treatments, each with 3 replicate cages of 8 chicks. Experimental diets and water were supplied *ad libitum*, the birds were subjected to routine vaccination programme, birds were weighed at the beginning of the trial and there after every week. A nutrient digestibility trial was undertaken when the birds were 3weeks old. Weighed quantities of feed were supplied and excreta collected over a 72hours. The excreta samples were weighed, oven dried at 70°C and weighed again to determine their dry matter. Dried excreta were ground prior to chemical analyses. Nutrient digestibility was calculated using the formula below:

$$ND = \frac{\text{Nutrient intake} - \text{Nutrient output}}{\text{Nutrient intake}} \times 100$$

ND = Nutrient digestibility

Nutrient intake = weight of dry feed intake × coefficient of nutrient in feed

The diets and samples of oven-dried residues were subjected to proximate analysis using the method of the A.O.A.C. (2008). Crude protein was determined using the kjeldahl procedure. Ether extract was determined by subjecting the samples to petroleum ether (b.p.60-80°C) extraction in a soxhlet apparatus. Crude fibre of the samples was determined by the method described by Cullison (1982) All the data were subjected to Analysis of Variance using the model for factorial design and the significant differences between means were compared using Duncan's Multiple Range Test (Duncan,1955). The cost of each ingredient used was taken into consideration for the cost benefit analysis.

Table 1: Composition of Experimental Diets

Ingredients	Diets							
	1	2	3	4	5	6	7	8
* Fixed Ingredients	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Rice husk	–	–	–	–	25.00	25.00	25.00	25.00
Maize	50.00	50.00	50.00	50.00	25.00	25.00	25.00	25.00
¹ 0E	0ppm	-	-	-	0ppm	-	-	-
² 100E	–	100ppm	–	–	–	100ppm	–	–
³ 150E	–	–	150ppm	–	–	–	150ppm	–
⁴ 350E	–	–	–	350ppm	–	–	–	350ppm
Analyzed nutrient content								
Dry matter	88.21	89.45	89.86	89.63	86.75	87.65	87.72	87.92
Crude protein(%)	19.42	19.46	19.56	19.91	20.65	20.70	20.77	20.76
Crude fat (%)	9.20	9.25	8.35	8.40	10.25	10.33	10.65	10.77
Crude fibre (%)	6.05	5.95	5.90	5.75	10.05	10.10	10.07	10.12
ME (MJ/Kg)	14.15	14.21	14.25	14.22	11.25	11.30	11.35	11.31
Lysine	0.91	0.92	0.91	0.93	0.82	0.83	0.83	0.82
Methionine	0.73	0.74	0.73	0.73	0.65	0.69	0.69	0.68

*Made up of groundnut cake 26.80%, blood meal 3.00% palm kernel cake 3.00%, fish meal 2%, maize milling waste 10%, bone meal 2.35%, oyster shell 0.25%, salt 0.25%, palm oil 2.00%, Dimethionine 0.10%, broiler vitamin/mineral premix 0.25

¹0E (0ppm) ²100E (100ppm of Nutrase xyla), ³150E (150ppm of Roxazyme G), ⁴350E (350ppm of Grindazyme)

Results and Discussion

Table 2 showed the effect of replacing maize with rice husk with or without different types of enzyme supplement on the economics of feed and broiler production. Supplementation of the control diet with different types of enzymes increased the cost of producing feed i.e. no saving in the cost of producing 1Kg of feed. However there were ₦59.55, ₦59.69 and ₦59.45 reductions in the cost of raising 1Kg of broiler on supplementation of the control diet with 100E, 150E and 350E respectively. It could be observed that as 25% of the maize is replaced with rice husk with no enzyme, there was ₦20.25 saving in the cost of producing 1Kg of feed relative to the control

diet and ₦59.50 reduction in the cost of producing 1Kg of broiler, which is profitable. However, diet with rice husk supplemented with enzymes showed ₦109.52, ₦109.52 and ₦109.18 reductions in the cost of raising 1Kg of broiler on supplementation with 100E, 150E and 350E respectively. Reductions in the cost of raising 1Kg of broiler on supplementation with enzymes were profitable. Enzymes have made it possible to enhance the capacities of broilers to consume and utilize indigestible feed resources and also improve the utilization of the relatively digestible ones at a small cost to farmers with improved profitability (Atteh, 2013) The result of this trial showed that with enzyme

supplementation, it is possible to reduce the proportion of maize in the broiler diets by up to 25% inclusion of rice husk without a detrimental effect on the performance of the birds since the amount of savings was associated with improve weight gain and feed/gain ratio with enzyme supplementation as shown in Table 3. Rice husk contains non-starch polysaccharides that reduce the utilization of nutrients such that the substitutions of rice husk for maize increases the viscosity of the digestive contents and interfere with digestion and absorption of nutrients. As fibre content of diets increases, density of the diets decreases. The inclusion of fibre in feed dilutes energy concentration of diets. Hence, for birds to keep a constant energy level they have to change their feed intake. The rice husk also filled up the birds' crop quickly due to its bulkiness and thereby decreasing feed intake. However, the addition of the different types of enzymes increased the feed intake by helping the birds to digest rice husk, which is fibrous faster. When 25% of maize was replaced by rice husk, the feed/gain ratio increased, meaning that the feed was not efficiently utilized. This is thought to be related to reduce nutrient digestibility associated with increased crude fibre content of the diets with rice husk addition without enzyme supplementation. Replacement of maize with rice husk without enzyme supplementation caused a reduction in weight gain, this resulted from the fact that the birds consumed less feed and less energy was released. Supplementation of the diets with the different types of enzymes improved BDG digestion, made more energy to be available to the birds; this increased the weight and at the same time improved feed efficiency. However, this experiment showed that addition of enzyme does

enhanced the performance of the birds in terms of weight gain as shown in Table 3. Table 4 showed the effects of the dietary treatment on nutrient digestibility. There was no significant effect of treatments on fat digestibility ($P>0.05$). Increase in dietary level of rice husk at the expense of maize caused a significant increase in feed intestinal transit time ($P<0.05$), however there was no significant effect of the type of enzyme on this parameter. Increase in dietary level of rice husk in the absence of supplemented enzyme caused significant decrease in protein and fibre digestibility. Some authors (Atteh,2000; Peter and Hoffman, 2002) reported that increasing fibre concentration of feed causes decreased digestibility of all nutrients, reduced weight and increased faecal bulk as observed in this experiment, there was reduced weight gain, fibre act as a diluents agent which lower nutrient concentration and the effect of this indigestible fraction of carbohydrates can be observed on the anatomy of the digestive tract, the transit time, water losses bringing about poor digestion in monogastric animal. However, this experiment showed that addition of enzyme does enhanced the performance of the birds in terms of weight gain. Enzyme supplementations efficiently break down the arabinoxylan in feed, thereby resulting in a decrease in intestinal viscosity, improved availability of nutrients. Enzyme allows improved performance or a more efficient use of cheap low quality carbohydrate-sources without adversely affecting animal performance (Fasuyi, 2010). Fibre has been included in experimental diets for monogastric animals for many years primarily to promote constant passage of materials through gut; fibre reduces the digestibility time of feed in the gut not allowing intestinal secretions to

act on the feed. Lee *et al.*, (2003) reported that increasing fibre concentration of feed causes decreased digestibility of all nutrients, reduced weight and increased faecal bulk as observed in this experiment, there was reduced weight gain, fibre act as a diluents agent which lower nutrient concentration and the effect of this indigestible fraction of carbohydrates can be observed on the anatomy of the digestive tract, the transit time, water losses bringing about poor digestion in monogastric animal (Jorgensen *et al.*, 1996). Enzyme supplementations efficiently break down the arabinoxylan in feed, thereby resulting in a fast decrease in intestinal viscosity, improved availability of nutrients. Enzyme allows improved performance or a more efficient use of cheap low quality carbohydrate-sources without adversely affecting animal performance.

Feed enzymes have been in use in poultry diets, most feed enzymes are known to attack the arabinoxylan linkages of non-

starch polysaccharide thereby breaking them into smaller units (Grieshop, *et al.*2001). The additions of enzymes help to address the non-starch polysaccharide viscosity, which leads to improve feed efficiency and facilitate the use of lower cost, feed ingredients (Lazaro et al, 2003). There is no hard and fast rule as to the ingredient that goes into a particular feed i.e.to get a feed that will ensure maximum production of quality production per unit of feed consumed at least possible cost (Atteh, 2000). The inclusion of rice husk in the diets reduced the cost of producing broilers and hence increased profit, one of the economic benefits of using livestock feed enzymes is the opportunity to reduce feed cost, whilst maintaining animal performance (Danisco, 2006) so it is important that returns are maximised through use of adequate diets. Feed formulation is central operation, ensuring that feed ingredients are economically used for optimum growth of chickens.

Table 2: Cost benefit analysis of replacing maize with rice husk with or without enzymes.(₦)

Diets	Cost per Kg of feed (₦)	Saving cost relative of control (₦)	Feed cost raising 1Kg of broiler	Reduction in cost of raising 1Kg broiler
1	370.69	0	900.05	0
2	380.00	-9.31	840.50	59.55
3	380.00	-9.31	840.36	59.69
4	380.74	-10.05	840.60	59.45
5	350.44	20.25	840.55	59.50
6	350.75	19.94	790.53	109.52
7	350.75	19.94	790.53	109.52
8	350.84	19.85	790.87	109.18

Table 3: Effects of dietary levels of rice husk supplemented with types of enzymes on birds performance.

Dietary treatment	Feed intake (g/bird/day)	Weight gain (g/bird/day)	Feed/gain
Level of rice husk(A)	*	*	*
0	65.30 ^b	23.71 ^b	2.75 ^a
25	58.20 ^a	18.33 ^a	3.18 ^b
Types of enzyme(B)	*	*	*
0E (0ppm)	58.50 ^a	21.92 ^a	2.67 ^b
100E (100ppm)	63.50 ^b	24.72 ^b	2.56 ^a
150E (150ppm)	63.20 ^b	24.66 ^b	2.56 ^a
350E (350ppm)	63.80 ^b	24.96 ^b	2.56 ^a
A x B	*	*	*
S.E.M.	5.30	1.70	0.53

NS: Non-significant

* Means within the same column followed by different superscript are significantly different (P< 0.05).

Table 4: Effect of dietary level of rice husk with enzyme supplementation on nutrient digestibility and feed intestinal transit time (FITT)

Dietary treatment	Dry matter (%)	Protein (%)	Fat (%)	Fibre (%)	FITT(hrs)
Level of rice husk (%)		*	*	*	*
0	88.34	64.80	84.00	43.70	2.25
25	89.34	60.42	83.20	35.60	2.40
Types of enzyme	NS	*	NS	*	NS
0E	88.35	63.81	82.62	48.50	2.29
100E	88.44	68.30	84.20	56.00	2.27
150E	88.42	68.20	84.21	56.00	2.26
350E	88.44	68.30	84.20	56.21	2.27
Rice husk × enzyme	NS	*	NS	*	NS
S.E.M	0.77	1.50	0.82	1.56	0.14

*Means within the same column followed by different subscript are significantly different (P<0.05)

NS: Non-significant

Conclusion

Availability and price of maize are influenced by competition between man, industry and livestock. Hence it makes economic sense to find cheap alternatives for

maize in poultry diets and since there is no competition between animals and man for rice husk as it is not consumed by man, considering its cheapness, vast output and utilization with enzyme supplementation by

broiler. Rice husk supplemented with any of the commercial enzyme used in this experiment will therefore go a long way to solve the problem of high cost of feed in the poultry industry.

References

- A.O.A.C (2008). Official Methods of Analysis: Association of Analytical and Applied Chemists (18th edition) Washington D.C. USA.
- Atteh, J. O. (2013). Feeding livestock for optimum profit. Keynote paper presentation at the first ASAN/NIAS (Kwara State Chapter) workshop on feeds and feeding milling held on 18th-19th June, 2013 at Kwara Hotel, Ilorin, Kwara State.
- Atteh, J. O. (2002). Principles and practices of livestock feed and manufacturing. Ilorin; Adlek printers.
- Atteh, J. O. (2000). Use of enzyme to improve nutrient value of wheat: inclusion and enzyme supplementation. A paper presented on 2-day seminar on array of tailor made biotechnical improver for flour milling and baking industry. Sheraton Hotel Lagos, May 2-3, 2000.
- Cullison, A. E. (1982). Feeds and feeding (3rd ed.) Reston Publishing Company Inc. Reston Virginia 22090.
- Danisco, D. (2006). Benefits of enzymes, animal nutrition U.K. info.animalnutrition@danisco.com, www.danisco.com/animalnutrition
- Duncan D. B. (1955). Multiple range and multiple F – tests Biometrics 11, 1-42.
- Fasuyi A. (2010). Effect of cellulase/ glucanase/ xylanase enzymes combination on nutrients utilization of vegetable meal (*Amaranthus cruentus*) fed as sole dietary protein source in rat assay. International Journal of Food Science and Technology, 2010; 45:683-689.
- Grieshop, C. M., Reese, D. E. and Fahey, G. C. (2001). Non-starch polysaccharides and oligosaccharides in swine nutrition; Pg. 107 in swine nutrition A.J. Lewis and L.L. Southern Eds. CRC Press, Boca Raton FL.
- Jorgensen H.Z., XinQuan K.E., Krudse B.O. and Zhao X.Q. (1996) The influence of dietary fibre source and level on development of the gastrointestinal tract digestibility and energy metabolism in broiler chickens. Br. J. Nutr., 75 : 379-395.
- Lazaro, R., Gracis, M., Medel, P. and Mateos, G. (2003). Influence of enzyme on performance and digestive parameters of broilers fed rye-based. *Poult. Sci.* 82, 132-140.
- Lee J.J., Sally A.R. and Jerry S. (2003). Feeding by-products high in concentration of fibre to non-ruminants. A paper presented at the third National Symposium on alternative feeds for livestock and poultry held in Kansas City MO on November 4, 2003.
- Peter, R.J. and Hoffman, D. B. (2002). Effect of enzyme in poultry feed. WATT Publication. (October ed.) pg. 3.
- Ravindran, V. (2012), Poultry feed availability and nutrition in developing countries Monogastric Research Centre, Institute of Food,

Nutrition and Human Health, Massey University, Palmerston North, New Zealand.

Selle J. and Ravindran, V. (2007) Microbial phytase enzyme in poultry nutrition. A Review Anim. Feed Sci. Technol.;(35):1-41.

World Bank Report (2007). International assessment of agriculture and technology for development. World Bank, Washington, DC.