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THE COST BENEFIT ANALYSIS OF INCORPORATING FUNGUS TREATED CASTOR SEED CAKE (FTCSC) (*Ricinuscommunis*) IN THE DIET OF (WAD) GOAT

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Abstract
The cost benefit analysis of incorporating fungus (Aspergillusniger) treated Castor seed cake (Ricinuscommunis) inthe diet of West African dwarf (WAD) goat was evaluated in a seven week feeding trial. A total of twelve (12) goats weighing 3.93kg- 6.53kg were randomly allotted to four dietary treatments A, B, C, and D with three goats each comprising a treatment in a Completely Randomized Design (CRD). Treatment A which was the control group had no inclusion of Fungus treated Castor Seed Cake while Treatments B, C and D had 15, 20 and 25% of Fungustreated Castor Seed Cake respectively. Weekly weight gain and daily feed intake were recorded while the cost of feed was also determined. Results of feed conversion ratio (feed: gain), cost/kg feed, cost of total feed consumed, cost/kg weight gain, net benefit and cost benefit ratio were significantly different (p<0.05). Additionally, thecosts of feeding was better in the fungus treated groups compared to the control diet. There was no mortality nor health implication in all the groups suggesting the safety of incorporating castor seed cake in the diet of goats. It can be concluded that incorporation of fungus treated Castor seed cake in the diets of goats should be encouraged among goat farmers.

Key words: *Castor Seed Cake, cost- benefit,fungus treated, (WAD) goat*

ntroduction
West African dwarf goats belongs to the group of small animals (Ruminants) made up of the sheep, goat, liamasand alpacas. These animals are so described or named as a result of their physiology of feed, digestion and comparative small body size, compared to cattle and buffalo. Goats are particularly important as they are widely domesticated and are closer to man than others livestock are found in large numbers and can adapted to different ecological zones.(Lebbie, 2004).

Goats are known to thrive on low quality feeds. (e.g. crop by products; rice straw, cassava peels, orange peels, rice bran, cocoa pod) and perform well on cheap feeds made from agro industrial by- products (wheat offal, wheat bran brewer dried grain, rice bran, cocoa bean shell etc.). These by-products are identified as good nitrogen sources for ruminants. The population of goats in sub-Saharan Africa (SSA) is estimated at 147 million. The arid and semi-arid zones together hold the majority (64%) of the goat populations of SSA. However, the arid zone holds 12% more goats than the semiarid, which contains 26% of the goats. The humid and the high land zones account for about equal proportions of the population of goats (9 and 10%, respectively) (Lebbie, 2004).

The Castor plant, *Ricinuscommunis*, is a species of flowering plant in the spurge family*, Euphorbiaceae*. Its seed is the castor bean which, despite its name, is not a true bean. Castor plant is indigenous to the southeastern Mediterranean Basin, Eastern Africa, and India, but is widespread throughout tropical regions (Oliveria,*et al.*, 2015). Although monotypic, the castor oil plant can vary greatly in its growth, habitat and appearance. It is a fast-growing, suckering perennial shrub which can reach the size of a small tree (around 12 metres / 39 feet). If sown early, under glass, and kept at a temperature of around 20 °C (68 °F) until planted out, the castor oil plant can reach a height of 2–3 metres (6.6–9.8 ft.) in a year. The flowers are borne in terminal panicle-like inflorescences of green or, in some varieties, shades of red. The oil from the castor seed is colourless or faintly yellow, almost odorless, viscid liquid, having a taste at first bland but subsequently avid and nauseating. It is fixed and dries very slowly, having a specific gravity, 0.958. It is slightly dextrorotatory, about + 4.301. It has are fractive index, 1.4790 to 1.4805 and solidifies at -10˚ C to - 18˚C. Its acidity is expressed as oleic acid which is 1.5 percent. The oil extracted from the seed have been used in small doses in clinical setting for numerous medical conditions such as liver and gallbladder disturbances, abscesses, headaches, appendicitis, epilepsy, hemorrhoids, constipation, diarrhea, intestinal obstructions, skin diseases, hyper-activity in children and to avert threatened abortion in pregnant women . Traditionally, the Ebira people in Kogi State of Nigeria use it for skin diseases (acne,warts,eczema,rashes, benign skin growth etc.) purgative, heal irritated or inflamed nipples and to aid delivery in delayed expectant mothers. Although, much has been documented on the uses of castor oil, the report has not shown on its antimicrobial activity poses and in the manufacture of cosmetics (Momoh*et al*., 2012). Most of the world's castor oil is produced in India, China and Brazil, but India ranks first in castor seed (*Ricinuscommunis*) production with an annual availability of 1.644million tonnes (FAO, 2014) .

Castor (*Ricinuscommunis*) has remained the most important non-edible oilseed crop of the arid and semi-arid regions (Oni*et al*, 2012). Reports on feeding of castor seed meal showed that it has huge potential as a tropical feed resource because of its high nutrient profile (Ani and Okorie, 2009; Akande*et al*., 2012). The vast quantities of defatted meal generated from oil processing industries particularly in Asia and Africa are capable of reducing the cost of feeding of farm animals. However, its use as animal feed has been largely restricted because of inherent toxins. The plant was listed as an undesirable substance in the Annex of Directive 2002/32/EC; however, more data on nutritional and toxicological effect of castor were needed to consider a full risk assessment of the plant (Anandan*et al.,* 2005). The purpose of this study, therefore, was to examine the economic implication of using fungus treated castor seed cakeas feed ingredient in the diet of West African dwarf goat as the raw castor seed cake detriment goat's health.

Materials and Methods

The experiment was carried out at the Teaching and Research Farm of the University of Ilorin, Kwara State, Nigeria. While, laboratory analysis was done at the Animal Production Laboratory, Faculty of Agriculture, University of Ilorin, Ilorin, Kwara State.The castor oil seeds that were used in this study was obtained from Ogbomosho in Oyo State, Nigeria. They were milled and the oil extracted using mechanical press and chemical (using petroleum ether). The oil was extracted using cold extraction method.

The husks of the collected Castor seeds were removed, the seeds obtained after the removal were milled and the oil extracted using hydraulic press. Theremnant oil in the cake was extracted using petroleum ether through cold extracting method. The cake obtained was autoclaved at 121º C, 15psi for 30 minutes to get rid of any microbes that could be present in the cake. The fungus usedwas*Aspergillusniger,*it was obtained (collected from moldy bread cultured on Potato Dextrose Agar (PDA) to get a pure growth) from Department of Crop Protection, University of Ilorin, Nigeria. The culture was sub-cultured on Petri-dishes containing PDA.

10g of Potato Dextrose Agar (PDA) was mixed in a conical flask. The flask was corked using a cotton wool. After agitation, the mixture formed a suspension. In order to ensure homogenous mixture, the content of the conical flask was slightly heated on a bursen burner for 2-3 minutes and shaken intermittently to prevent burning or carbonation. The homogenous mixture formed was sterilized by autoclaving at 121^{0}C for 15 minutes. The conical flask was removed and allowed to cool and its content formed a clear yellow gelatinous solution of PDA. The PDA was then poured into some sterilized Petri dishes.

A Petri-dish of pure cultured of *Aspergillusniger* was used to inoculate the sterilized PDA medium using wire loop, sterilized in Bursen burner flame till it was red hot. It was used to take small quantity of *Aspergillusniger* into freshly prepared medium. The inoculated medium was covered with aluminum foil, cello taped and incubated.

The inoculated Petri dish was allowed to incubate for 120 hours (5 days) at room temperature during which the *Aspergillusniger* colonized the medium.The castor seed cake was autoclaved, cooled and then inoculated with the fungus (*Aspergillusniger*) and later incubated at room temperature. The fungus was expected to have colonized the substrate after about 7 days and the growth was terminated by oven drying the cake at 70˚C for 24hours. The dry sample was used in formulating the feed as shown in Table 1.

The cooled oven-dried castor seed cake was used in the formulation of feed in replacement of Soyabean cake at inclusion levels of 15%, 20% and 25% respectively. Other feed ingredients were of fixed proportions. Four experimental diets were formulated in which diet A was the control (without castor seed cake), while diets B, C and D contained 15%, 20% and 25% of *Aspergillusniger* treated castor seed cake respectively in replacement of Soyabean cake.

Table1: Composition (g/100g) of the Experimental Diets.

Ingredients (%)	Diet A	Diet B	Diet C	Diet D
	Control	(15%)	(20%)	(25%)
Cassava wastes	50.00	50.00	50.00	50.00
Rice husk	28.00	28.00	28.00	28.00
Soyabean	20.00	17.00	16.00	15.00
Castor seed cake	0.00	3.00	4.00	5.00
Vitamin premix	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00

Twelve weaned goats were bought and randomized against the experimental diets with three animals per treatment in a Completely Randomized Design model. The goats were housed in individualcages and taken care of intensively for one week for acclimatization. Feed and water were supplied to them *ad libitum*. Feeding of experimental diets was carried out for seven weeks.

Records taken include daily feed intake, weekly body measurement and mortality. At the expiration of the experiment, these records were used to evaluate economic indices such as cost/kg feed, cost of total feed consumed per goat, cost/kg weight gain, revenue from sales, net benefit, cost benefit ratio and cost of feed per goat in relation to total variable costs.

The cost/kg feed was obtained by adding the cost of procuring the various feed ingredients in a particular treatment and dividing with the total feed consumed in that treatment. Cost of total feed consumed was calculated by multiplying total feed consumed in each treatment with the cost/kg feed. The cost/kg weight gain was obtained by multiplying the cost/kg feed with feed conversion ratio (feed: gain). The net benefit or profit index was obtained as revenue less the production cost. Cost benefit ratio was obtained by dividing the net benefit by the revenue while the cost of feeding was obtained by dividing cost of feeding with total variable costs multiplied by 100.

All calculations involving costs were based on variable costs since housing and equipment were provided on the farm. The data collected were subjected to Analysis of Variance (ANOVA) (Steel and Torrie, 1980) and treatment means were compared using Duncan's Multiple Test (DMRT) as modified by Gomez and Gomez, (1984).

Results and Discussion

The results of cost benefit analysis (Table 2) showed that the total feed cost, cost of weight gain and profitability index improved as the level of fungus treated castor seed cake increased in the diets. Significant differences ($p<0.05$) were observed in all the economic parameters evaluated except on revenue. The results also showed that the cost of feeding the goats decreased as the inclusion of fungus treated castor seed cake increased in the diets. The cost of feeding of the control group accounted for 1.75% while those for 15%, 20% and 25% fungus treated castor seed cake inclusion accounted for 1.73%, 1.62% and 0.63% respectively. Increase in the level of fungus treated castor seed cake in the dietsresulted in a significant ($p<0.05$) decrease in the cost per kg of feed.

The cost (N) per kg feed for Treatments A (control), B, C and D were 68.10, 66.60, 66.10 and 65.60 respectively. It was found that diet containing 25% fungus treated castor seed cake (treatment D) had the lowest cost per kg feed while Treatment A (control) with 0% fungus treated castor seed cake had the highest cost per kg feed. This was due to the lower cost of fungus treated castor seed cake(#100/kg) compared to soybean meal (N150/kg) and rice husk (N19.20/kg) in the diets as at the time of this study and this has a lot of cost implications in the use of these diets. This shows that fungus treated castor seed cake could be a good protein source at inclusion of 15% level of (FTCSC) and it was in consonance with the findings ofGarg*et al*, (2005)who used groundnut cake to replace soybean in sheep's diet and obtained positive economic results. The goats on the control Treatment had the highest cost per kg weight gain (#4057.40) and other groupshadN3093.57, N3329.47 and N2173.33 for treatments B, C and D respectively. Weight gain is an important production index. Using the figures of 24.49g/day and 16.33g/day of gain for the control (0%FTCSC) and 25%FTCSC supplemented diet it was noted that a tremendous opportunity to reduce input cost while maintaining similar weight gains. The results obtained from this study showed that the inclusion of FTCSC as soyabeansubstitute reduced costs. This was an agreement with the findings of Nagalakshmi andDhanalakshmi, (2015), who used castor seed cake in lamb diets and reported better performance in lambs fed castor seed cake.

However, Audi*et al*,. (2005) stressed that an essential practices in evaluating a ration for farm animals is its cost in terms of returns obtained for products. The cost of feeding for the control group as observed in this study was 1.75% and it was higher compare with treated group. Diniz*et al.*, (2010) reported that feed accounts for 70-80% of the total variable cost of animal production in Nigeria and other developing countries. The high cost of feed has been largely traced to increasing costs of cassava waste, rice husk and soybean, which are the main conventional sources of energy and protein respectively. (Ukanwoko, *et al*., 2012).

The inclusion of FTCSCat 15%, 20% and 25% levelswill save 0.02%, 0.13% and 1.12% respectively of the concentrate in the feed mixture. In summary, FTCSC mixed concentrate feed cost less than the conventional concentrate ingredients presently available in the market. Since profit is a single index determining the economic value of keeping animals (Kosgey*et al*., 2004), the profitability index in this study varied among treatments but it is more profitable to feed 15% of the FTCSC treated group than any other groups. These results showed that the level of profit in goats production enterprise depends largely on cost of goats, level of test ingredients used, time of feeding trial, price of feed ingredients and the demand for goats among others. Considering all these factors, profitability index may therefore vary from location to location, season to season as dictated by demand of consumers for goat meat. Therefore there was no record of goats ill health for the period of experiment.

Table 2: Economics of Production of partial replacement of soybeans with fungus treated castor seedcake

PARAMETERS	TREATMENT			
	A(Control)	B	C	D
Mean initial weight @49 days	5.12	5.13	4.53	3.93
Mean final body weight (kg)	6.32	6.66	5.86	4.73
Mean weight gain (kg)	1,20	1.53	1.33	0.80
Weight gain g/day	24.49	31.22	27.14	16.33
Total feed consumed (kg)	1.43	1.44	1.36	0.53
Feed conversion ratio (feed: gain)	59.58	46.45	50.37	33.13
Cost/kg feed (#)	68.10	66.60	66.10	65.60
Cost of total feed consumed (#)	97.38	95.90	89.90	34.77
Cost/kg weight gain (#)	4057.40	3093.57	3329.47	2173.33
Cost of goat(#)	5000.00	5000.00	5000.00	5000.00
Operational cost (#)	458.33	458.33	458.33	458.33
Revenue(#1300/kg)	8216.00	8,658.00	7618.00	6149.00
Production cost (TVC)(#)	5555.71	5554.23	5548.23	5493.10
Net benefit/Profitability index	2660.29	3103.77	2069.77	655.90
Cost benefit ratio	0.32	0.36	0.27	0.11
Cost of feeding (%)	1.75	1.73	1.62	0.63
Mortality (%)	0	0	0	0

Conclusion

Of all inclusion levels of fungus treated castor seed cake, 15% inclusion level performed best in terms of weight gain without compromising performance and lowering production costs. Goat keepers are therefore advised to take the advantage of maximum economic gain obtained by complimentary responses of goats fed 15% of partial replacement of soyabean by fungus treated castor seed cake (FTCSC).

From the results, however, it can be concluded that inclusion of fungus treated castor seed cake was not detrimental to the health of the animals and economical.

Recommendations

Fungus treated castor seed cake is recommended at 15% inclusion level. However, care should be taken to make sure that the feed formulated is well balanced and can meet all nutritional requirements of the animals. It can therefore be recommended that Fungus treated castor seed cake can be used in the formulation of goatdiets.

References

Akande, T,O and A.A. Odunsi, 2012.Nutritive Value and Biochemical Changes in Detoxified Cstor Kernel Cake Based Diets. *Afr.J.Biotechnol.,* 11: 2904-2911

Anandan, S., Kumar, G. A., Ghosh, J., andRamachandra, K. S.(2005).Effect of different physical and chemical treatments on detoxification of ricin in castor cake. *Animal Feed Science and Technology, 120(1), 159-168.*

Ani, A.O. and Okorie, A.U. (2009).Response of Broiler Finishers to Diets ContainingGraded Levels of Processed Castor Oil Bean (Ricinuscommunis) meal. *J. Anim. Physical Anim. Nutr*., 93: 157-164.

Audi, J.,M. Belson, M. Patel, Schier and J. Osterloh, (2005). Ricin Poisoning: A Comprehensive Review JAMA., 294: 2342-2351

Diniz, L.L.,.Filho S.C.V,Campos J.M.S., .ValaderesiR.F.D and SilvaL.D.,(2010). Effects of Castor Meal on the Growth Performance and Carcass Characteristics of Beef Cattle.*Asian-Aust.J. Anim. Sci.*, 23:1308-1318.

FAO., 2014. Castor Seed Production.Statistical Database of the Food and Agricilture Organization of the United Nations.

Garg, A.K., Singh, P.,Sastry, V.R.B. andAgrawal, D.K.(2005). Replacement effect of Groundnut-cake with Castor bean-Meal *(Ricinuscommunis*) in Concentrate mixture of Adult Sheep.*Indian J. Anim. Sci.,* 75:688-690.

Gomez, K.A and Gomez, A.A. (1984). Statistical procedure for Agricultural Research 2nd ed. London: John Wiley and Sons Inc.

Kosgey, I.S., Van Arendonk,. J.A.M.and Baker, R.L.(2004), Economic values for traits in breeding objectives for sheep in the tropics: impact of tangible and intangible benefitsLivest. Prod. Sci., 88 pp. 143-160.

Lebbie, S. H. B. (2004). Goats under household conditions.*Small Ruminant research*, 51(2), 131-136.

Momoh, A. O., Oladunmoye, M. K., andAdebolu, T. T. (2012). Evaluation of the antimicrobial and phytochemical properties of oil from castor seeds (Ricinuscommunislinn). *Bull. Environ. Pharmacol. Life Sci, 1(10), 21-27.*

Nagalakshmi, D., andDhanalakshmi, K. (2015). Effect of Feeding Castor Seed Cake Based Diets on Growth, Nutrient Utilization, Immune Response and Carcass Traits in Lambs. *Asian Journal of Animal Sciences*, 9, 293-305.

NRC, (1981)**.**Natural Resources Conservation Service PLANTS Database.USDA. Nutrient Requirements of Goats.*12 National Academy of Science, Washington,DC., USA., pp: 1-10.*

Oliveria, C.H.A., SilvaA.M., Van Tilburg M.F. and . FernandesC.C.L (2015).Growth, Testis, Size, Spermatogenesis, Semen Parameters and Seminal plasma and Sperm membrane Protein Profile During the Reproductive Development of Male Goats Supplemented with De-oiled Castor Cake. *Reprod. Toxicol*., 53:152-161.

Oni, A. O., Arigbede, O. M., Sowande, O. S., Anele, U. Y., Oni, O. O., Onwuka, C. F. I., and Aderinboye, R. Y. (2012). Haematological and serum biochemical parameters of West African Dwarf goats fed dried cassava leaves-based concentrate diets.*Tropical animal health and production, 44(3), 483-490.*

Steel, R. G. D., and Torrie, J. H. (1980).Principles and Procedures of Statistics. 2nd ed. New York: McGraw-Hill.

Ukanwoko, A.I., &Ironkwe, M.O. (2012). Growth performance and haematological values ofWest African Dwarf (WAD) goats fed *Leucaena, Gliricidia* and cassava leaf meal-cassava peel based diets. *International Research Journal of Agricultural Science and Soil Science*, 2(3), 98-101.