Nigerian J. Anim. Sci. 2023, 25 (3): 164-172

Is it economical to supplement rams-fed *Digitaria smutsii* hay with a concentrate mixture at varying levels?

***Madziga, I.I., Lakpini, C.A.M., Osuhor, C.U., and Otaru, S.M.**

National Animal Production Research Institute, Ahmadu Bello University, P.M.B. 1096, Shika – Zaria, Nigeria.

***Corresponding Author:** iimadziga2k@gmail.com, **Phone Number:** +234 70 37063934

Target audience: Small ruminant farmers, Livestock marketers, Researchers, Extension Officers

Abstract

The study was undertaken to evaluate the effect of breed on the economics of feeding D. smutsii hay supplemented with varying levels of concentrate to different sheep breeds. Balami, Uda and Yankasa rams. Ten adult rams aged between 24 and 36 months each of Balami, Uda and Yankasa sheep and averagely weighing 34.20, 35.35 and 31.80 kg, respectively procured from local markets were used. The rams were fed the concentrate at 1 or 2 % of their body weight and the hay fed ad libitum for 90 days. The differences between the daily feed offered and the remainder were recorded and used to calculate the feed intake. The gain in weight was obtained from the difference between the initial and final weights. Cost of feed consumed and income over expenses were determined. Cost of feed consumed and cost incurred showed that it was cheaper to raise Yankasa than Balami and Uda. Selling price was significantly (P<0.05) higher for Uda and Balami than Yankasa. The highest (P<0.05) income over expenses realised was in Balami (₦10,549.72 followed by Uda with ₦6,98154) while the least was in Yankasa (₦4,875.77). Feeding concentrate to rams at 2 % of body weight showed positive indices and satisfactory rates of return indicating that the activity covered its feeding costs. Hence, farmers are recommended to supplement their rams with concentrate mixture containing about 14% CP and 10.52 MJ/Kg DM ME at 2% of body weight in addition to D. smutsii hay as basal diet for greater economic returns.

Keywords: Supplementation, sheep breeds, concentrate levels, returns,

Description of Problem

Agriculture is the bedrock of economic growth, development, food security, and poverty eradication in developing countries. It was regarded as the engine of economic prosperity (1). Nigerian economy before the discovery of oil depended much on its agricultural sector (2). However, agriculture still remains a key component of the Nigerian economy, contributing about 26.95 % of the Gross Domestic Product, GDP in 2020 (3) and employing about 70 % of the active population, but receiving less than 10 % of the annual budgetary allocations (4).

The population of sheep in Nigeria was 53,061,143 million, making it the third most populated species in the country after goats and cattle (5). Balami breed is found mostly in the North-eastern part of Nigeria especially in Borno state. It is a big, predominantly white-coat coloured sheep with a convex facial profile. The ears are large and droopy. The tail is thin and long. The males carry prominent horns while the females are polled. It is perhaps the largest breed of sheep in Nigeria. Mature rams weigh between 45 to 65 kg while ewes weigh 35 to 40 kg (6).

Uda breed is found in the Sahelo-sudan region of Nigeria. It is large, long-legged with convex face. It has a characteristic pied coat – colour pattern of entirely black or brown from the forehead to the lumbar-abdominal girth and white posteriorly. The ears are large, long and pendulous. The rams carry large, wide and spiral horns while the ewes are polled. Matured weight ranges from 30 to 45 kg for ewes it ranges from 35 to 60 kg for rams (6). This Yankasa breed has a typical white coat colour with black patches around the eyes, ears, muzzle and sometimes the feet. The rams carry curved horn and a heavy hairy white mane. Mature weights vary from 25 to 35 kg for ewes and 30 to 40 kg for rams. It is perhaps the commonest breed of sheep in Nigeria as it is found in all areas north of latitude 14^{o} N (6). The major challenge attributed to the Economics of supplementing varying levels of concentrate to fed hay in Nigeria is the lack of adequate and recommended protein intake, which is majorly sourced from animal and animal products (7). Small ruminants play significant role in sustaining livelihood of rural households by cushioning protein shortage experienced by households, settle domestic obligations, and buy back some inputs needed for farming operations, thereby bridging the animal protein demand-supply gap (8, 9). Despite the benefits of small ruminants in serving as source of animal protein amongst others, developing countries of the world Nigeria inclusive have a daily animal protein intake of 9.3g/day that is below the recommended FAO standard of 35g/caput/day (10), a problem caused as a result of low production of livestock (11, 12). In other words, a gap exists in the literature on the existence and magnitude of the economics of supplementing varying levels of concentrate to sheep fed hay. Hence the objective of this study was to evaluate the economics of feeding *Brachiaria decumbens* or *D. smutsii* hay supplemented with concentrate at different levels to Balami, Uda, and Yankasa rams.

Materials and Methods

Study Site

The study was conducted at the Experimental Unit of the Small Ruminant Research Programme of the National Animal Production Research Institute, Shika–Zaria. Shika is situated in the Northern Guinea Savannah Zone of Nigeria between latitudes 11^{o} 8′ 19.56″N and longitudes of 7^{o} 45′51.22″E at an elevation of 640 meters above sea. The zone is characterized by a rainy season that starts in April or May, stabilizes in June and ends in October. The mean annual rainfall is 1100 mm. Maximum temperature ranges from 27^{o}C - 35.0°C recorded in April while the lowest mean minimum temperature of 11.5°C occurs in December–February and the relative humidity is about 72% (13). The dry season begins with a period of dry cool weather called harmattan that lasts from October to January. The harmattan is followed by a dry hot weather from March to May.

Experimental animals and their management

Ten adult rams aged between 24 and 36 months each of Balami, Uda and Yankasa sheep and averagely weighing 34.20, 35.35 and 31.80 kg, respectively procured from local markets were used for the experiment. The age of the animals was determined by dentition and the information obtained from the owners. All the animals were ear-tagged, held in quarantine for 30 days and observed for any health problem. During the quarantine period, animals were drenched with a broad spectrum anthelmintic (Albendazole®) against internal parasites and

sprayed with acaricide (Diazzinole®) against external parasites. They were also covered with long-acting antibiotics as prophylactic against possible infection. Following the quarantine period, the initial body weight of all animals including those obtained from NAPRI was measured. The rams were grouped based on their breed and this served as treatments. All animals were kept in individual pens equipped with a watering bucket and a feeding trough.

Table 1: Chemical composition (%) and cost of *B. decumbens, D. smutsii* hay, maize, maize offal, cottonseed cake

	Ingredients				
Nutrients (%)	***B. decumbens***	***D. smutsii***	**Maize**	**Maize offal**	**Cotton seed cake**
Dry Matter	91.21	94.63	91.18	91.95	91.83
Organic Matter	81.26	83.90	86.76	81.87	89.01
Crude Protein	4.56	5.76	8.31	11.69	28.58
Ether Extract	3.85	4.05	8.03	11.03	11.05
Crude Fibre	64.08	68.89	45.21	53.92	50.21
Neutral Detergent Fibre	44.09	42.21	48.01	45.21	47.23
Acid Detergent Fibre	45.35	43.12	43.27	34.99	42.35
Ash	8.76	8.92	11.02	10.05	4.98
ME (MJ/kg DM)	10.81	11.03	10.69	10.88	11.51
Cost (₦ per kg)	33.79	33.79	75.00	28.00	35.56

The ME values of the experimental feed ingredients were calculated as per Maff (18) as follows: ME= (MJ/kg DM) = 0.012CP +0.031EE +0.005CF+0.014NFE. Where CP = Crude Protein, EE = Ether extract, CF = Crude Fibre, A= Ash, NFE = Nitrogen free extract, Naira =100 Kobo (₦)

Feeds and feeding management

Digitaria smutsii was harvested from sown pasture in NAPRI and used for this experiment as the basal diet. Concentrate mixture (fed at two levels) were used as supplement. The concentrate diet was formulated using maize and maize offal as sources of energy, cottonseed cake served as protein source while table salt and bone meal served as sources of mineral. The concentrate was a mixture of cottonseed cake (39.19 %), maize (37.87 %), maize offal (18.94 %), bone meal (2.50 %) and table salt (1.50 %) obtained from the Institute were compounded and stored properly at the experimental site. Animals were fed the concentrate at 1 or 2 % of their body weight and the hay fed *ad libitum.* All animals had free access to fresh clean water every day.

Experimental design and treatments

There were six treatments in a 2×3 factorial arrangement in a completely randomized design (CRD) with five replicates in each treatment. One factor was the breed with three breeds of sheep (Balami, Uda and Yankasa) and the second factor was level of concentrate feeding – 1 or 2 % of body weight.

Cost benefit analysis

Cost benefit analysis was performed to evaluate the economic advantage of the different treatments by using the procedure

of Upton (14). The partial budget analysis involved the calculation of variable costs and benefits. At the end of the fattening trial, the rams were sold on hoof based on their body weight at N800.00 per Kg liveweight. The difference between the cost price of rams in each treatment before and selling price after the experiment was considered as total return (*TR*) in the analysis. For the calculation of the variable costs, the expenditures incurred on various feedstuffs were taken into consideration. The cost of the feeds was computed by multiplying the actual feed intake for the whole feeding period with the prevailing market price as at the time the study was conducted. The prevailing price of the feeds at the time of feed purchasing including the transportation cost incurred to move them to the experimental site were recorded. Cost benefit analysis method measures profit or loss, which is the difference between gains and expenses for the proposed change and includes calculating net return (NR), i.e., the amount of money left when total major variable costs (TVC) - cost of feeds and animals were subtracted from the total returns (TR): NR = TR-TVC:

Total variable costs included the costs of major inputs that changed due to the change in production. This included the cost of animals and feed consumed. The change in net return (ΔNR) was calculated by finding the difference between the change in total return (ΔTR) and the change in total variable cost (ΔTVC). The selling price of the rams was on weight basis i.e ₦800.00 per kg of live weight as the rams were sold on hoof.

Result

Effect of breed on economics of feeding *D. smutsii* hay supplemented with concentrate at 1 or 2 % of body weight of the rams is presented in Table 3. Results showed differences in the performance of the rams. Cost of total feed consumed, and cost incurred showed that it was cheaper to raise Yankasa than Balami and Uda. Selling price was significantly ($P<0.05$) higher for Uda and Balami than Yankasa. The highest ($P<0.05$) income over expenses realised was in Balami (₦7,977.58 followed by Uda with ₦6,073.00) while the least was in Yankasa (₦3,734.76).

In Table 4, the result of effect of level of concentrate indicates that total cost of feed consumed, and cost incurred was lower for animals fed 1 % level of concentrate than those fed 2 %. However, the selling price of the rams and income over expenses were more economical in rams raised on 2 % concentrate level than those on 1 %. Table 5 shows the result of interaction between breed and concentrate level. The result indicates that it was cheaper to raise Uda and Yankasa rams on 1 % level than the rams on 2% and Balami on both levels based on total cost of feed consumed and cost incurred. Nevertheless, the selling price was higher in Uda and Balami fed concentrate at 2 % of body weight than their counterparts raised on concentrate at 1 % of body weight. The least was realised in Yankasa fed 1 %. Income over expenditure was ₦5, 645.95 when Balami was fed concentrate at 1 % of body weight but when it was fed the concentrate at 2 % of body weight, the income rose to almost twice (₦10,815.69) the income obtained on those fed 1 % level of concentrate. This trend was observed in all the breeds. The highest income over expenditure was obtained in Balami fed 2 % level of concentrate while the lowest value obtained was in Yankasa fed 1 % level of concentrate with ₦2,611.99.

Table 2: Ingredient, chemical composition and cost per kg of concentrate diet

Ingredients	(%)	Cost (₦per kg)
Maize	37.87	26.13
Maize offal	18.94	13.07
Cottonseed cake	39.19	27.04
Bone meal	2,50	1.72
Table Salt	1.50	1.03
Total	100	68.99
Chemical composition		
Dry matter	92.78	
Organic matter	81.23	
Crude protein	13.63	
Ether Extract	17.15	
Crude fibre	27.40	
Acid detergent fibre	45.95	
Neutral detergent fibre	56.27	
Ash	11.55	
ME (MJ/kg DM)	10.52	

The ME values of the experimental feed ingredients were calculated as per Maff (18) as follows: ME= (MJ/kg DM) = 0.012CP +0.031EE +0.005CF+0.014NFE. Where CP = Crude Protein, EE = Ether extract, CF = Crude Fibre, A= Ash, NFE = Nitrogen free extract

Table 3: Effect of breed on the economics of feeding *D. smutsii* haysupplemented with concentrate at different levels to Balami, Uda and Yankasa rams

	Breed		
Parameters	Balami	Uda	Yankasa
Cost of concentrate consumed (₦)	4,422.26	4,324.98	3,993.14
Cost of hay consumed (₦)	2,280.15	2,172.02	1,956.10
Cost of total feed consumed (₦)	6,702.41	6,497.64	5,949.24
Total cost incurred (cost of feed + cost of animal) (₦)	30,902.42	33,047.00	29,889.24
Weight gain (Kg)	14.70	13.25	10.23
Selling price (₦)	39,120.00	38,880.00	33624.00
Income over expenses (₦)	8,217.58	5,833.00	3,734.76

Naira (100 kobo = ₦), Kilogramme (Kg), Total cost incurred (cost of animals, cost of concentrate and cost of hay), Selling price (₦ 800.00/Kg live weight), Income over expenses divide by Weight gain (IOE/WtG)

Discussion

The result of the cost benefit analysis of fattening of the three breeds of sheep on *D. smutsii* hay supplemented with concentrate at 1 or 2 % of body weight showed increase in total feed intake as well as weight gain. Cost incurred on feeding was lower in Yankasa rams than Uda and Balami. The total cost incurred also followed the same pattern. Although it was cheaper to raise Yankasa based on total cost incurred on feeding due to its smaller size that warranted

consuming less feed, selling price and income over expenditure were better in Balami and Uda as a result of their bigger frame size and heavier weights. The total cost of feed consumed and total cost incurred was lower in animals fed concentrate at 1 % of their body weight than those on 2 % body weight with and for total cost of feed consumed and total cost incurred respectively.

The financial return was apparently better in rams fed concentrate at 2% of body weight (₦8, 119.96) than those fed concentrate at 1% of body weight (₦3,924.25). The income over expenditure for Balami, Uda and Yankasa supplemented with concentrate at 1% of body weight went up when they were supplemented with concentrate at 2% of body weight. This increase was 47.80, 61.31 and 46.43% for Balami, Uda and Yankasa rams, respectively depicting that it is more cost effective to supplement the rams with concentrate at 2 % of their body weight notwithstanding the higher cost incurred in raising them. For all the breeds generally, an average income of 107.71% when supplemented with concentrate at 2% of their body weight was realised. Balami rams outperformed the other breeds by 20.66 and 54.92% implying that it is more economical to raise Balami than Uda and Yankasa. The finding in the current study underscores the result obtained by Madziga *et al.* (15) when they raised Balami Uda and Yankasa rams on *Digitaria smutsii* or *Brachiaria decumbens* hay and found out that Balami rams had superior performance in terms of final weight gain, average weight gain and income realized over expenditure above Uda and Yankasa rams.

It was observed that feeding concentrate at 2% of body weight was economically viable, by providing a higher profit as compared to feeding concentrate at 1% of body weight. The low profit obtained as a result of feeding the latter was expected as it could not satisfy the animals for them to have put on considerable weight. It was therefore, understandable that interaction existed between breeds and concentrate level. Rams of all the three breeds fed concentrate at 2 % of their body weight were more economical than their respective counterparts fed at 1% of body weight.

An important cost-effectiveness was substantiated in all the breeds underscoring an increased advantage in Balami rams than Uda and Yankasa rams. Despite the high cost of feeding incurred in rams fed concentrate at 2% of body weight, the diet showed higher net revenue relative to those that received concentrate at1% of body weight. Feeding concentrate at 2% of body weight showed positive indices and satisfactory rates of return compared to the concentrate fed at 1% of body weight, indicating that the activity covered its feeding costs. This was confirmed in the trend of final weight and average daily weight gains, emphasizing the treatments with greater level of inclusion in the diet.

In this context, Barros *et al.* (16) evaluated the profitability of Suffolk sheep production on pasture and in feedlot, and observed that the profitability ranged from 5.09% to 11.95%, respectively. In this research, the profitability of the rams ranged between 86.67% and 91.57% for those rams fed concentrate at 2% of body weight above their counterparts fed concentrate at 1% of body weight. Profitability depends on several factors, including the breed, with great variation in relation to sex, age and category and availability of the by-product. Moreover, Vieira *et al*. (17) investigated the profitability of feedlot lambs receiving detoxified castor bean cake and found negative profits.

Table 4. Effect of concentrate level on the economics of feeding *D. smutsii* hay supplemented with concentrate at different levels to Balami, Uda and Yankasa rams

	Concentrate level	
Parameters	1%	2%
Cost of concentrate consumed (₦)	2,666.46	5,826.90
Cost of hay consumed (₦)	2,263.59	2,008.48
Cost of total feed consumed (₦)	4,930.05	7,835.38
Total cost incurred (cost of feed + cost of animal) (₦)	29,826.72	32,732.44
Weight gain (Kg)	7.40	18.05
Selling price (₦)	33,680.00	40,736.00
Income over expenses (₦)	3,853.28	8,003.56

Naira (100 kobo = ₦), Kilogramme (Kg), Total cost incurred (cost of animals, cost of concentrate and cost of hay), Selling price (₦ 800.00/Kg live weight), Income over expenses divide by weight gain (IOE/WtG)

Table 5: Interaction effect of breed and concentrate level on the economics of feeding *D. smutsii* hay supplemented with concentrate at different levels to Balami, Uda and Yankasa rams

	Concentrate level					
	1 %			*2 %*		
	Breed					
Parameters	Balami	Uda	Yankasa	Balami	Uda	Yankasa
Cost of concentrate consumed (₦)	2,770.63	2,723.73	2,505.72	6,073.88	5,926.24	5,480.56
Cost of hay consumed (₦)	2,423.42	2,206.48	2,142.29	2,136.54	2,137.22	1,751.67
Cost of total feed consumed (₦)	5,194.05	4,930.21	4,648.01	8,210.28	8,063.46	7,232.23
Total cost incurred (cost of feed + cost of animal) (₦)	29,394.05	31,480.21	28,588.01	32,410.28	34,618.46	31,172.23
Final weight (Kg)	43.80	43.50	39.00	53.70	52.00	45.06
Weight gain (Kg)	7.70	7.30	7.20	21.10	16.80	13.26
Selling price (₦)	35,040.00	34,800.00	31,200.00	42,960.00	41,600.00	36,048.00
Income over expenses (₦)	5,645.95	3,319.79	2,611.99	10,549.72	6,981.54	4,875.77

Naira (100 kobo = ¦), Kilogramme (Kg), Total cost incurred (cost of animals, cost of concentrate and cost of hay), Selling price (¦ 800.00/Kg live weight), Income over expenses divide by Weight gain (IOE/WtG).

Conclusion and Application

1. Supplementing varying levels of concentrate to Balami, Uda and Yankasa rams fed *Digitaria smutsii* hay plays significant role in the livelihoods of households in generating income as shown in these findings. Its production is profitable and can meet the challenge of Balami, Uda and Yankasa rams who are being fed *Digitaria smutsii* hay.
2. Feeding concentrate at 2% of body weight showed positive indices and satisfactory rates of return compared to the concentrate fed at 1% of body weight, indicating that the activity covered its feeding costs. This was confirmed in the trend of final weight and average daily weight gains, emphasizing the treatments with greater level of inclusion in the diet.
3. Cost of total feed consumed and cost incurred showed that it was cheaper to raise Yankasa than Balami and Uda but in terms of returns, reverse is the case.

References

1. Bein, M. A. and Serhan C. (2017). The relationship between the relative GDP share of agriculture and the unemployment rate in selected central and eastern European countries. *Agric. Econ. – Czech, 63, 2017 (7): 308– 317*.
2. Nweze, C. (2017). Making agriculture the mainstay of economic growth. The
3. Simona Varrella, (2021). Contribution of Agriculture to GDP in Nigeria 2019-2020, Statista.
4. Abu, O. (2012). Food Security in Nigeria and South Africa: Policies and Challenges. *Journal of Human Ecology*, 38(1): 31-35.
5. Abubakr, M.M (2022). https://sciencenigeria.com/fg-to-support-northeast-livestock-subsector-with-free-vaccines/
6. Dairo, F. A. S., Afolabi, A. and Sanusi, J. (2018). ANP 302. Ruminant animal production. National Open University of Nigeria. Course guide. Pp 16-22.
7. Musa, U. D. (2015). Analysis of Consumption Expenditure on Animal Protein by Households in Kaduna Metropolis, Kaduna State, Nigeria. M.Sc. Thesis, Agricultural Economics, Ahmadu Bello University, Zaria, Nigeria.
8. Oladimeji, Y. U., Abdulsalam, Z., Ajao, A. M. and Abdulrahman, S. (2017). Profit efficiency of broiler production among public servant household heads in Kwara State, Nigeria: a coping strategy. *Samara Journal of Agricultural Education*, 2(2), 1- 8.
9. Yusuf, A., Aruwayo, A. and Muhammad I. R. (2018). Characterization of small ruminant production systems in Semi- Arid Urban areas of Northern Nigeria. *Journal of Applied Science, Environmental Management*, 22 (5): 725-729.
10. Esobhawan, A.O., Ojo, S.O. and Ikhelao, E.E. (2008). Profitability, input elasticity and returns to scale in agriculture production in Lagos State. *Proceedings of the 14th Annual Conference of Agriculture in Nigeria. Wetlands* FUTA, Akure. 21st May, (2008). Pp. 219 – 222.
11. Umunna, M.O, Olafadehan, O.A. and Arowana, A. (2014). Small Ruminant Production and Management Systems in Urban Area of Southern Guinea Savanna of Nigeria. *Asian Journal of*

Agriculture and Food Science, 2 (2):107-114.

12. Girei, M. I. and Ayoola, J. B. (2017). Socio- economic factors influencing small ruminant production in Adamawa state; policy implications for livestock transformation in Nigeria. *International Journal of Scientific and Engineering Research*, 8(3):1261-1272.
13. IAR (Institute for Agricultural Research) (2017). Meteorological Centre, Ahmadu Bello University – Zaria.
14. Upton, M. (1979). Farm Management in Africa. The principles of production and planning Oxford University Press, Great Britain. pp. 282-298.
15. Madziga, I.I., Lakpini, C.A.M., Osuhor, C.U., Otaru, S.M. and Anosike, F.U. (2022). economics analysis of feeding *Brachiaria decumbens or Digitaria smutsii* hay to Balami, Uda and Yankasa rams. *Federal University Dutsin - Ma Journal of Agriculture and Agricultural Technology*, 8 *(1) :323-328.*
16. Barros, C.S., Monteiro, A. LG., Poli, C.H.E.C., Dittrich, J.R., Canziani, J.R.F. and Fernandes, M.A.M. (2009). Profitability of production of sheep to cut in grazing and in confinement. *Revista. Brazilian. Zootecnica*, 38**:**2270-2279.
17. Vieira, M.M.M., Cândido, M.J.D., Bonfim, M.A.D., Severino, L.V., Khan, A.S. and Silva, R.G. (2012). Bioeconomic analysis of the replacement of soybean meal by castor bean for sheep in confinement. *Revista. Agropec. Scientific Semiarid*, 8:7-15.
18. MAFF (1975). Ministry of Agriculture Fisheries and Food. Nutrient Requirements of Ruminants. Technical Bulletin 33. Ministry of Agriculture Fisheries and Food, London: HMSO.