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UTILIZATION OF SUGARCANE SCRAPINGS AS ANIMAL FEED FOR SUSTAINABLE LIVESTOCK PRODUCTION

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ABSTRACT

The common practice in the country during the dry season is feeding of animals with available crop residues. However, there is challenge in reliance on crop residues to sustain animal production, because of low nutritive value. The study aimed at nutritive improvement of crop residues such as sugarcane scrapings for sustainable ruminant animal production. Eighteen healthy growing Yankasa rams, with 15.85 ± 0.49 kg live weight (LW) were used in a completely randomized design to evaluate the inclusion level of urea-molasses ensiled sugarcane scrapings (UMESS) at 0(T1), 30 (T2) and 60% (T3) respectively to replace maize. Dietary effects on nutrient intake, body weight and economics of production were evaluated after 70 days. Crude protein (CP) which ranged from 16.85 to19.41 % DM and total carbohydrate (TC) with range of 69.32 to 82.65 % DM increased as level of UMESS increased. Crude fibre (CF) of T2 (20.65% DM) and T3 (20.52 % DM) were similar (P>0.05) and higher in relative to T1. Intakes of DM, CP, CF and TC increased from 949.24 to 955.01g/d g/d, 159.94 to 184.24 g/d, 180.00 to 197.20 g/d and662.01 to 689.62 g/d respectively as the level of UMESS increased. Body weight gain increased from 5.45kg in T1 to 6.46kg in T3.Total cost decreased from ₦13,277.94 in T1 to ₦13,063.55 in T3. Total returns (₦18,116.00) and net profit (₦5,052.45) of T3were superior in relative to other diets. These results revealed that UMESS can be safely used up to 60% level in replacing maize in a concentrate mixture for growing sheep, without depressing intake, weight gainand improve economic benefits to farmers.

Keywords: Sugar cane scrapings, urea-molasses treatment, silage, animal performance

Introduction

Eighteenth century industrial revolution with its accompanying population growth has drastically increased the demand for food supply. This has consequently influenced the increase in agricultural inputs. Agricultural intensification to meet the food demand of growing population has led to generation of huge tone of agricultural waste; either in form of agro-industrial byproducts or crop residues. According to Obi *et al*. (2016), agricultural waste otherwise called agro-waste is comprised of animal waste (manure, animal carcasses), food processing waste (for instance, only 20% of maize is canned and 80% is waste), crop waste (corn stalks, sugarcane bagasse, drops and culls from fruits and vegetables, pruning) and hazardous and toxic agricultural waste (pesticides, insecticides, herbicides and many more). Globally, 140 billion metric tons of waste is generated every year from agriculture (Oladipo *et al*., 2017), while Nigeria alone generates over 52 million metric tons of agriculture wastes annually accumulate in the city and only 30% of them are collected by the City Council (Owanaba, 2015). Most of these agricultural wastes and crop residues are not properly disposed. For instance, some of these crop residues are burnt or dump into the drainage or river. This constitute nuisance to the environment in forms of air pollution or blockage of water ways leading to flood (Sabiiti, 2011). Tian *et al.* (2016) opined that feeding growing world population while reducing the impact on the environment requires immediate and effective solutions. Sustainable intensification (SI) produces more output(s) through the more efficient use of resources while reducing negative impact on the environment; it provides opportunities for increasing animal and crop production per area while employing sustainable production alternatives that fully consider the three pillars of sustainability (planet, people, and profit).

Sugarcane scraping is one of such agricultural waste generated in large volume in most of the major cities in Nigeria after the consumption of sugarcane. The sugar cane scraping lies waste littering in both urban and rural settlements hereby constituting environmental pollution. It is heaped and burnt from time to time resulting to production of one of the greenhouse gases (CO_2) which is reported to have heat trapping effect contributing to global warming (IPCC 2007). Sometimes, when sugarcane heap is not burnt, it is improperly disposed and swept to block the drainages by the runoff water during rainy season resulting in flooding.

One of the strategies of reducing this environmental menace caused by agricultural wastes is to convert them to useful materials such as animal feed. Research has proved many agricultural wastes as having a great potential as unconventional inexpensive feedstuffs for livestock feeding (Olafadehan *et al*., 2017). The advantage of using sugarcane and its by-products for animal feeding in the tropics has a high yield potential (Ramrez-Cathi *et al*., 2014). Alu, (2012) reported outstanding performance of the quails fed sugarcane enzyme supplemented diets.

Sugarcane scrapping which is one of the sugarcane by products is obtained by scraping the outer part of the stem (rind) with a sharp knife to remove the bark on the stem that affords protection to the underlying cells (Ayoade *et al*., 2007). The scraping is done to remove the wax-covered epidermis and prepare the stem for chewing or crushing by machine to extract sugar juice in the sugar industry. Excellent performance and carcass characteristics as well as reduction in production cost and profit maximization were observed when Augustine (2005) investigated the effect of replacement of maize with graded levels of sugarcane scraping meal. The proximate and energy composition of sugarcane scrapings meal (SCSM), according to the findings of Ayoade *et al*.(2007) indicate that dry matter is about 87.6%, crude protein 3.2%, crude fibre 12.7%, Ether extract 2.8%, ash12. 8%, NFE 77.1% and gross energy of about 2.84 Mcal/kg. This composition is of typical roughage (poor quality) feed for livestock. Therefore, possible uses of the sugarcane scrapings required improving its nutritive value. One of the several methods of improving nutritive value of poor quality feedstuff is urea-molasses ensilage. Previous researches (Olafadehan and Adebayo, 2016; Okunade *et al*., 2018) have shown urea treatment is technically feasible and adopted

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at the farm level due to its ease of handling by farmers and potential to enhance fermentation and nutritional properties.This could translate to substantial savings of money in this era of exorbitant prices of livestock feeds and reduction in environmental pollution. Molasses is added to the silage as feed additive to control the fermentation processes to enhance nutrient recovery, improve palatability and silage stability (Oladosu *et al*., 2016).There are no or paucity of information on the feeding value of urea-molasses ensiled sugar cane scraping silage and its economic benefit in sheep production. This study therefore hypothesized that urea-molasses ensiled sugar cane scraping would enhance its nutritive, and its replacement for maize in diets for sheep would improve the performance of the animals and bring better economic returns to the farmers.

Materials and Methods

Experimental site: The study was carried out at Small ruminant unit of teaching and research farm of Federal college of Wildlife Management, New Bussa, Nigeria (latitude: 9^{o} 53' and 10^{o} 00" N and longitudes 4^{o} 31' and 40^{0} 33" E) located in the Guinea Savannah vegetation zone, with a humid tropical climate, mean annual rainfall of about 1,040 mm and mean temperature of 34 °C.

Preparation of test ingredients: Sugarcane scraping (SCS) was procured from local sugarcane vendors. Molasses (16%) and urea 4% were dissolved in 100 liter of water and evenly carefully mixed with 100 kg DM of sugarcane scraping. The mixture was parked in a big drum already lined with polyethylene sheets, compacted very well to make it air tight and then covered with a heavy object placed on the cover for an anaerobic fermentation for 3 weeks. (21 days).Urea-molasses ensiled sugar cane scraping (UMESS)was then aerated overnight under shade to eliminate volatile ammonia gas that causes ammonia toxicity if fed to animals without aeration.

Animal management and diet: Eighteen 6-month intact ram lambs (15.85 ± 0.50 kg LW) was procured from local markets and quarantined for 14 days during which they were treated against internal and external parasites (Ivermectin injection) and antibiotics (Oxytectracycline injection) was administered to reduce stress. The ram lambs were housed in individual rammed floor with bedding materials. The experimental diets comprised three levels of UMESS: 0 (control), 75 and 150 g/kg, substituting 0(T1), 30 (T2) and (T3) 60% maize respectively in the rations (Table 1). The experiment was conducted in a completely randomized design with three treatments and six replications. The rams were balanced for initial body weight (BW). Each animal within each of the treatments were randomly assigned to one of the three dietary treatments. The experiment lasted for 84days (63day feeding trial and 21-day adjustment period). Feeding was done twice daily, at 08:00 and 16:00 h, and water was made available *ad libitum*. Feed intake was determined by difference between the feed served and the feed remnant (refusal) on daily basis, while the growth performance of the animals is determined by weighing at beginning of the experiment and weekly before morning feeding to adjust offered feed and determine the growth performance.

Chemical analyses and calculations: The dry matters (DM), Crude protein (CP), ether extract (EE) and ash contents of diets were analyzed according to the AOAC (2000). Determination of neutral detergent fibre (NDF) and acid detergent fibre (ADF) was according to Van Soest *et al.* (1994). Non-fibre carbohydrates (NFC) and organic matter (OM) were calculated.

Partial budget analysis: The partial budget analysis was performed to determine the profitability of the experimental feeding by considering the main component cost. Net profit (NP) was calculated as the amount of money left when total variable costs (TVC) were subtracted from the total returns (TR).

$$NP = TR - TV$$
$$\Delta NP = \Delta TR - \Delta TV$$
$$MRR = NP / TVC$$

Statistical Analysis: The collected data were subjected to the General Linear Models of SAS (SAS, 2012, version 6.3, SAS Institute Inc., Cary NC, USA) as a completely randomized design. When significant differences were observed among treatment means, they were separated by Duncan Multiple Range Test. Comparisons with $p < 0.05$ were considered significant and all statements of statistical differences were based on this level unless noted otherwise.

Results and Discussion

Chemical composition of the experimental diet

There were variations in chemical composition of the experimental diets except for the %DM (Table 1). Observed Crude protein steadily increased significant (P<0.05)from 16.85 to 19.41 %DM and TC (69.32 – 82.65 %DM) respectively as UMESS increased. There was similarity between CF in T2 (20.52 %DM) and T3 (20.65 %DM) but higher than that of T1 (18.94 %DM). The increase in CP as level of UMESS increased may be as a result additional UMESS which had more available NH_3-N, as a result of more urea hydrolysis during urea-molasses ensiling (Nisa *et al.*, 2007).These results are in accordance with those obtained by Tiwari *et al.* (2013).The CP composition of control diet and UMESS based diets met requirement of 16-18 % DM recommended for growing sheep (MLA, 20072011). The decrease fibre content was in agreement with Samsudin *et al.* (2013), Sheikh *et al*.(2017) and Haque*et al*. (2018). It is assumed that the decrease in the fiber content may have been due to the increased activity of microorganisms during the ensiling (Lunsin *et al*., 2018). The generally high TC indicates that all the diets contained reasonable amount of soluble or readily fermentable carbohydrate. However, higher TC contents in UMESS based diets relative to T1 may be as result of additional molasses which is excellent source of soluble carbohydrate. The results indicate the effectiveness of urea-molasses ensiling in improving nutritive value of control diet (T1). This result corroborates with that of Olafadehan and Okoye (2017) who fed urea-ammoniated cowpea husk to goats.

Table 1: Chemical composition of experimental diets (% DM)

Nutrient	Diets			
	T1	T2	T3	SEM
Dry matter	94.36	94.17	94.06	1.42
Crude protein	16.85^{c}	18.29^{b}	19.41^{a}	0.34

Ether extract	9.07[a]	5.38[b]	3.03[c]	0.50
Ash	4.76	4.83	4.91	0.18
Crude fibre	18.94[b]	20.52[a]	20.65[a]	0.38
Nitrogen free extract	50.38[c]	60.85[b]	62.77[a]	0.54
Total carbohydrate	69.32[c]	81.5[b]	82.65[a]	0.45

[abc...] *Means in the same row with different superscripts differ significantly (P<0.05).*

Feed and nutrient intakes of rams fed urea-molasses ensiled sugarcane scrapings

Average dry matter intake (DMI) (g/day/animal) as well as crude protein intake (CPI) (g/animal/day) as well as Total carbohydrate intake (TCI) during growth trial were presented in Table 2. The DMI during the growth trial were 961.01,952.82 and 909.24for T1, T2 and T3, respectively. Similar (p>0.05) feed consumption among the diets was observed and thus implies parallel palatability, fibre digestibility and digesta flow rate through the gastro-intestinal tract. Sugarcane scraping is very low in protein and minerals, thus fermentation with molasses (fermentable energy source) and urea (protein source for microorganism) resulting into energy and protein synchronization probably optimized rumen environment and improved DM intakes. Similar results were reported (Can *et al.*, 2004; Karimi *et al.*, 2014; Okunade *et al*, 2018).The CPI (g/d/animal) observed in the present study was significantly (p<0.05) higher in UMESS diets (174.27 and 176.48g/d respectively) relative to UMESS0T1 (161.93 g/d). The CPI increased as level of UMESS increased in the diets. Higher value of CPI observed in sheep under UMESS diets (UMESS30T2 and UMESS60T3) due to availability of total mixed ration which might have supplied balance nutrition for ruminal microbes (Hogue *et al.*, 2018). Fibre intake and TCI followed the same trend with CPI and are adequate for proper digestion and nutrient utilization in ruminant animals (NRC, 2007). Similar results were also reported by (Gunun *et al.*, 2013; Sheikh *et al.*, 2017;Hogue 2018).Increase in nutrient intakes (CPI, CFI and TCI respectively) UMESS based diets is a function of increased palatability, fibre digestion and digesta flow rate (Olafadehan *et al.*, 2017) in UMESS based diets relative to UMESS0T1. However, UMESS60T3had the highest nutrient intakes (CPI, CFI and TCI).The result indicates that UMESS can replace maize in diet for sheep without adverse nutrient intake. It also suggested that UMESS can replace maize up to 60% in the diet of growing sheep.

Table 2: Nutrient intake of Sheep fed Urea-molasses ensiled sugar cane scraping based diets

Intakes (g/d)	Diet			SEM
	T1	T2	T3	
Dry matter	949.24[c]	952.82[b]	955.01[a]	0.62

Crude protein	159.94[c]	174.27[b]	185.36[a]	1.04
Crude fibre	180.00[c]	195.52[b]	197.20[a]	0.30
Total carbohydrate	658.01[c]	776.34[b]	785.32[a]	0.29

[abc...] *Means in the same row with different superscripts differ significantly (P<0.05)*

Comparative cost advantage of replacing of maize with UMESS in rams diets:

The comparative cost analysis was used to calculate the potential profitability of the experimental feed (Table 3). The results indicate lowest cost of feeding (₦ 3,167.21/animal)in T3 while the highest (₦3,760.03/animal) was recorded in T1. The decrease in cost of feeding (₦/animal) seem to be as a result of decreasing trend in cost of feed (₦/kg) and total feed consumed (kg/animal) as level of UMESS increased. Average total cost incurred ranged from (₦12,778.33) in T3 to (₦13,371.15) in T1. The difference was as a result of variations in variable cost (₦/animal). These results corroborate findings of previous studies (Okunade *et al*., 2018) where urea ensiled threshed sorghum tops were used to replace GNC in the diet of sheep. Abera *et al*. (2018) also reported comparable results when they fed maize stover treated with urea or urea molasses to Hararghe highland sheep. Both average total returns and average net profit/animal indicated that ram fed T2 and T3 had higher profitability than the control diet T1.However, highest average total return (₦18,116.00/animal) and average net profit (₦5,337.67/animal) were obtained for T3 respectively. These results were as reflection of differences in average total weight gain/(kg) and average by products sale. Higher average total returns and average net profits of T2 and T3 relative to control diet T1 show that these diets were economically superior and of better quality (Olafadehan *et al*., 2017) than the control diet T1.The greater average total returns of UMESS compared with maize thus reflected its enhanced nutritive value as a feed for sheep, and lower price. Therefore, the results of this study shown replacement of maize in the concentrate fed to Yankasa sheep with urea-molasses ensiled sugarcane scrapings is potentially more profitable and economically beneficial. In addition, utilization of sugarcane scrapings in animal feed reduced environmental pollution associated with indiscriminate dumping of sugarcane scrapings.

Table 3: Cost advantage of replacement of maize with UMESS in sheep diets

Variable	Diet		
	T1	T2	T3
Average purchase price*(₦ /animal)	7,000.00	7,000.00	7,000.00
Average cost/kg feed* (₦/Naira)	52.07	50.23	48.57
Average feed consumed (kg)	70.41	71.00	71.07
Average cost of feeding* (₦)	3,666.81	3,570.78	3,452.43

Average cost of labour/ animal* (₦)	2,500.00	2,500.00	2,500.00
Medication*(₦)	111.12	111.12	111.12
Average total cost*(₦)	13,277.93	13,181.90	13,063.55
Average total weight gain/(kg)	5.45	5.87	6.46
Average cost/kg of mutton* (₦)	2,000.00	2,000.00	2,000.00
Average value of mutton* (₦)	10,900.00	11,740.00	12,920.00
Average by products sale*(₦)	4,500.00	4,863.00	5,196.00
Average total returns* (₦)	15,400.00	16,603.00	18,116.00
Average net profit/animal (Naira)	2,122.07	3,421.10	5,052.45

*At the time of the study

Conclusion

Replacement of maize with urea-molasses ensiled sugarcane scraping in the diet of sheep is not only economically viable option in practical sheep diets, but reduced environmental pollution. The study shows that urea-molasses ensiled sugar cane can be used up to 60% in a practical low cost sheep ration without any adverse effect on feed consumption, body weight of rams. Further studies on the effect of dietary inclusion of 100% urea treated ensiled sugarcane scrapings, as a complete replacement for maize, in sheep ration on other indices of animal performance such as digestibility; ruminant fermentation and nitrogen utilization are recommended.

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