International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Use of Dual-Purpose Pearl Millet Stalks in Animal Feed: Development of Rations to Feed Growing Cattle in the Groundnut Basin in Northern Senegal

Talla Lo[1]*, Mamadou Tandiang Diaw[1], Yacine Gueye[1], Abdoulaye Dieng[1], Doohong Min[2]
[1]Department of Animal Productions, National Higher School of Agriculture (ENSA), Iba Der Thiam University (UIDT) of Thiès, Route de Khombole, BP A 296 Thiès
[2]Kansas State University, Department of Agronomy, 2004 Throckmorton Hall; 1712 Claflin Road, Manhattan, Kansas 66506
1*Correspondent: talla.lo@univ-thies.sn

Abstract**—** *Formulation of cost effective livestock feed with the best use of available plant residues is of real interest for increasing meat production, improving the income of agro-pastoralists and fertilizing the soil from the manure produced. However, it is subject to innumerable constraints particularly to the crop dependent small holders farmers to produce and provide adequate amount of nutritious feed for their cattle. To remedy this, it is important to cultivate dual-purpose crops, change feeding habit and feed formulation that can lower the cost of feed and meet the dietary requirement of both human and their cattle. The objective of this study is therefore first of all to assess the animal and economic performances of rations based on dual-purpose pearl millet stalks alone or associated with cowpea haulms through feeding trials carried out in stations and then to disseminate them in peasant environment. The trials were carried out on twelve cattle of the Gobra breed in the growth phase with an average entry weight of 83.9 ± 6.82 kg divided into four batches made up of three animals. Each lot was received a given treatment; ration 1: dual-purpose pearl millet stalks supplemented with cottonseed cake and millet bran in equal parts; ration 2: dual-purpose pearl millet stalks associated with cottonseed meal; ration 3: dual-purpose pearl millet stalks associated with cowpea haulm in equal parts and supplemented with cottonseed cake; and ration 4: dual-purpose pearl millet stalks associated with cowpea haulm in equal parts plus cottonseed cake and millet bran. Significant differences (P <0.05) were observed on average daily gains (ADG) and voluntarily ingested dry matter (VIDM). However, no significant difference was noted on the nutritive value parameters, the overall manure production and the consumption index. The ADGs as well as the VIDM were more interesting in the animals fed on ration 3 and to a lesser extent those fed on ration 4. Economically, ration 3 (du-al-purpose pearl millet stalks associated with cowpea haulm in equal parts and supplemented with cottonseed cake) was the most profitable with a higher profit margin com-pared with other rations.*

Keywords**—** *Average daily gain: bovine fattening: consumption index: growth variables: millet stalks: nutritive value measurements: ration: voluntarily ingested dry matter.*

I. INTRODUCTION

The supply of meat products to the Senegalese population is ensured through two types of circuits, namely imports and national production. The national meet production was recorded 2,845,68 tons in 2019, of which 26.6% consists of cattle meat (FAO, 2021). Currently, Senegal has a herd of more than 16 million heads, the largest part of which is dominated by sheep (7,132,356), goats (6,055,851) and cattle (3,627,858) (DSV, 2019). Gobra zebu (Bos indicus) is one of the popular species of cattle in Senegal particularly raised for meat production because of its growth trend (daily weight gains greater than one kilogram) and wide adaptability (Denis and Valenza, 1971, Fall et al., 1994). However, the scarcity of feed and forage production resources (land, improved seed, technical skills, and veterinary services), limited availability of quality feed, forage, smallholder farmers' low purchasing power of livestock growers are the major challenges for commercial livestock farming in Senegal. These challenges reveal the unsuitable nature of livestock production systems in Senegal, which does not keep up with the speed of population growth. It is to be feared that the current livestock production system and meat production trend will not meet the demand of growing population in the coming decades in Senegal.

One of the fundamental obstacles of meat production in Senegal is the feeding systems. The feeding systems are essentially based on the use of natural rangelands whose poor nutritional value during the dry season (9 months out of 12), does not allow to support intensive growth (Richard et al., 2019). Furthermore, the processed feeds are not accessible to everyone because of their high cost (17 to 20 US dollars per 40 kg bag), the speculation imposed on feed by intermediaries and the lack of animal feed related organizations (ANSD, 2020 and NISDEL, 2004). The conjunction of these aforementioned facts coupled with the less availability of forages and pastures in the summer due to the dry season and decrease in soil fertility due to over exploitation of the land are the major causes of poor animal performance (Sow et al., 2004). Due to that fact, the pastoral system is characterized by a great mobility of farmers (mainly Peulhs) and their herds (cattle and small ruminants often associated).

However, in agropastoral systems, the extension of fields, although a limiting factor for animal husbandry, in return brings crop residues that can be used by animals (Kaboré-Zoungrana, 1995). The exploitation of these agricultural by-products by these animals consolidates the integration between cereal crops and livestock production (Kaboré-Zoungrana et al., 1999). This type of integrated agriculture production system has been common in Senegal for decades (Dugue et al., 2004). Thus, the use of cereal plant residues as fodder could be an alternative to the constraints of feeding livestock even though their use is still not optimal in rural areas

Talla LO, Mamadou Tandiang DIAW, Yacine GUEYE, Abdoulaye DIENG, and Doohong Min, "Use of Dual-Purpose Pearl Millet Stalks in Animal Feed: Development of Rations to Feed Growing Cattle in the Groundnut Basin in Northern Senegal," *International Research Journal of Advanced Engineering and Science*, Volume 9, Issue 1, pp. 30-36, 2024.

(Camara, 2007). In this context, pearl millet, which is traditionally grown throughout the Sahelo-Sudanian zone of West Africa, where rainfall deficit limits the cultivation of more demanding food crops such as maize and sorghum, could be one of the solutions of both human and livestock food insecurity. In Senegal, the use of millet straw by cattle has been the subject of many studies, particularly on the nutritional values of the pearl millet stems. Various researchers have recently studied on millet at the National Higher School of Agriculture (ENSA) in Thiès, Senegal. Most of them were, focused mainly on the characterization and evaluation of the effect of nitrogen fertilization techniques and conservation methods on the productivity and feed value of different adapted varieties (i.e., Souna 3 and Thialack 2) and potentially dual-purpose varieties (SL28, SL169, and SL423) of pearl millet (Faye, 2019, Kane, 2018, Lo, 2017). However, there is little information on the development of low cost rations based on millet stalks for feeding cattle, especially during growing and fattening phases. Hence, it is relevant to explore cost effective and nutritious animal feed using available crop by products that has never been practiced in Senegal. The objective of this on station study was therefore to develop feed rations based on dual-purpose pearl millet stalks incorporating concentrates that are accessible and capable of improving the performance of growing cattle.

II. Materials and Methods

2.1. Study zone

The study area corresponds to the Thiès region and is part of a much larger area, the groundnut basin (Map 1) which is located between longitudes 14 ° 15 'and 17 ° 15' west and latitudes 13 ° 60' and 16 ° 15' north in Senegal. It covers the administrative regions of Diourbel, Fatick, Kaolack, Kaffrine, and Thiès (except Mbour) and the departments of Kébémer and Koumpentoum and covers an area of approximately 64,093 km2. The study was carried out at the ENSA, Thiès located between latitude and longitude 14 ° 46'N and 16 ° 57'W. The climate is cold winter and hot and humid summer with an alternation of rainy (July to October) and dry (November to June) seasons. The dry season is humid, windy, and partly cloudy, and hot throughout the year. During the four months of feeding trials, the temperatures measured with a mercury free mini-maxi thermometer varied from 14.2 to 39.3 °C with minimum and maximum values of 13.9 to 28.5 °C and 26.2 to 44.1 °C, respectively. Relative humidity fluctuated between 17% and 87%. The soil is moderately basic sandy clay (Kane, 2018). Annual precipitation is around 400 to 600 mm in the Thiès region (ANSD, 2017). Majority of the farmers in this region is a subsistence type with crop and livestock integrated production systems.

2.2. Plant materials

The fodder used (dual-purpose pearl millet stalks and cowpea haulm) was produced in the experimental fields of the Center for the Application of Agricultural Techniques (CATA) in rainfed cultivation. Two plots of 2,160 m2 (67.5 m × 32 m) were chosen to grow the crops; one was assigned for dual-purpose pearl millet (Pennisetum glaucum) and the other for cowpea (Vigna unguiculata). The dual-purpose pearl millet seeds were obtained from the National Agronomic Research Center / ISRA (Institute of Senegalese Agricultural Research) of Bambey and cowpea (variety 66-35) from ENSA.

Figure 1. The map of Thiès region showing the study location

2.3. Milled feeds

Commercial concentrates were obtained through feed factories and for cotton seed cake and millet bran from the local market. Once received, nutritive value analyzes were also made for their characterization.

2.4. Animals

For the purposes of the study, 16 cattle of the Gobra zebu breed, all male and aged 12 to 18 months (determined by dentition) were purchased at the Bambey cattle market. After identification by ear loop and weighing, 12 animals with an average weight of 83.9 ± 6.82 kg were selected for the performance trial and the 4 others kept as a reserve. After quarantine for about 20 days, the selected animals were de-wormed against external as well as internal parasites. The cattle also underwent an anti infective treatment in order to eliminate any incubation of disease during the tests.

2.5. Experimental methods

2.5.1. Experimental apparatus

The 12 animals selected for carrying out the test were divided into 4 homogeneous batch of 3 animals according to their initial weight (83.9 ± 6.82 kg). The allocation of rations to the different experimental units was made using tables generating random numbers (Dagnelie, 2003) in order to avoid any fluctuations of uncontrolled factors in time and / or space. Each treatment (ration tested) was therefore repeated on the three (3) animals of each batch. The experience is thus uni-factorial (diet) comprising four (4) levels.

2.5.2. Rations tested

The animals in lots 1 and 2 received a basic ration consisting only of chopped dual-purpose pearl millet stems, while the basic ration for lots 3 and 4 consisted of a 50 / 50 mixture of chopped millet stalks and cowpea tops. In the cattle of batches 1 and 4, the feed supplement consisted of a mixture of 50 % cottonseed cake and 50 % millet bran. For lots 2 and 3, only cottonseed cake was used as a supplement (Table 1).

Talla LO, Mamadou Tandiang DIAW, Yacine GUEYE, Abdoulaye DIENG, and Doohong Min, "Use of Dual-Purpose Pearl Millet Stalks in Animal Feed: Development of Rations to Feed Growing Cattle in the Groundnut Basin in Northern Senegal," *International Research Journal of Advanced Engineering and Science*, Volume 9, Issue 1, pp. 30-36, 2024.

TABLE 1. Experimental setup of the test station

Ration	Lot 1	Lot 2	Lot 3	Lot 4
Basic Ration	Millet stalks		Mixture of millet stems (50 %) and cowpea tops (50 %)	
Concentrates				
Cottonseed cake	1 - 1.75 kg	2 - 3,5 kg	2 - 3.5 kg	1 - 1.75 kg
Millet bran	1 - 1.75 kg	-	-	1 - 1.75 kg

2.5.3. Feeding trial

The test took place in 2 phases : an adaptation phase lasting 14 days to accustom the animals to the rations studied to the environmental conditions, followed by the experimental phase, which lasted for 98 days. For better feeding monitoring, and to eliminate any competition between individuals, the animals were kept in tie stalls in the barn, fed and watered individually. The feed was weighed and given two times a day: the first was served in the morning (7 a.m.) and the second in the late afternoon (5 p.m.). Forages and water were offered optional and mineral supplementation provided as per the recommendation of veterinarian.

2.6. Variables measured

2.6.1. Animal growth variables

Weight growth performance (weight) was measured using a cattle scale by the double weigh method (two days in a row at the same time and on an empty stom-ach). The weight assigned is the average of the two measurements. The height at the withers and the thoracic perimeter were measured using a measuring tape. These measurements were taken at the start of the experiment and then every 15 days until the end of the trial.

2.6.2. Manure production

The manure produced by each animal was collected and stored every day after cleaning. Every 15 days, a quantification, by weighing the faces after pre drying in the sun, was carried out using a digital scale. The production was expressed in kg of dry manure.

2.7. Calculated variables

Voluntarily Ingested Dry Matter (VIDM): The quantities of VIDM were calculated from the quantities distributed and those possibly refused by the following formula:

VIDM = quantity dispensed - quantity refused

They were expressed in kg of VIDM / 100 kg of body weight and per kg of metabolic weight.

Average Daily Gain (ADG): The ADG was calculated by the following formula:

ADG = {final weight (kg) -initial weight (kg)} / duration of feeding (days)

Consumption index (CI): It represents the amount of feed ingested to achieve a growth of one kilogram (Kg). It was calculated from the following formula:

CI = total amount of feed ingested (kg dry matter) / body weight gain (kg)

2.8. Chemical analysis

The chemical analysis of the pearl millet stalks and the cowpea tops were carried out immediately after harvest and then repeated every fifteen day in order to assess the effect of the preservation technique (in the shade) on forage nutritive value. The concentrates were also tested immediately after purchase and then every fifteen days thereafter. The manure was pooled on a pro rata basis consisting of two samples taken in the same experimental unit for a period of one month. The analysis focused on Nitrogen (N). Chemical analyses of dual-purpose pearl millet stalks and cowpea tops as well as those of concentrates (cottonseed cake and millet bran) were carried out at the ENSA laboratory according to the official methods of the Association of Official Agricultural Chemists (AOAC, 1995).

2.9. Economic analysis

The economic balance sheet was prepared based on the assessment of costs and operating income associated with the feeding trial.

2.10. Data processing and analysis

The data were analyzed using SAS program (Statistical Analysis System, 2000) via the Generalized Linear Model (GLM). Separations of means were carried out based on the results of the analysis according to a correlation matrix presented at the significance level of 1 % and 5 %.

III. RESULTS

3.1. Chemical composition of materials and rations

Overall, the results of the chemical analysis of the raw materials (Table 2) show a very large variability in the chemical composition of the products used.

The contents of neutral detergent fiber (NDF), acid detergent fiber (ADF) and crude fiber (CB) were found significant variations for all raw materials, except for millet bran where the greatest variability was noted with the contents of organic matter (OM) and total nitrogenous matter (TNM).

TABLE 2. Average chemical composition (% DM) of the raw materials used in the formulation of the rations.

Raw materials	DM	OM	CF	NDF	ADF	TNM	FM
Millet stalks	95.09 ±0.52	90.78 ±0.45	42.77 ±1.64	75.14 ±2.91	50.26 ±1.74	6.12 ±0,45	nd
Cowpea haulm	94.66 ±0.54	91.88 ±0.37	37.21 ±1.56	61.62 ±1.56	44.1 ±1.47	15.96 ±0.65	nd
Cotton meal	93.72 ±0.23	95.47 ±0.08	32.8 ±0.58	68.49 ±1.55	43.04 ±0.65	25.14 ±0.51	11.24 ±0.46
Millet bran	92.96 ±0,30	84.97 ±2.84	8.68 ±0.82	67.86 ±0.88	12.48 ±0.66	16.14 ±1.27	5.99 ±0.65

DM : Dry Matter; OM : Organic matter; CF : Crude Fiber; NDF : Neutral Detergent Fiber; ADF: Acid Detergent Fiber; TNM :Total Nitrogenous Matters; FM : Fat Matter; nd: not determined.

3.2. Chemical composition of manure

The quality of the manure, assessed through its nitrogen content, showed no significant difference (P = 0.411), according to the different feed rations studied (Figure 2). However, the manure of the animals which received the cottonseed meal alone as concentrate showed the highest nitrogen contents (2.62 % and 2.57 % for batches 2 and 3, respectively). They are followed by lot 4 (2.24 %) and lot 1 (2.17 %).

Talla LO, Mamadou Tandiang DIAW, Yacine GUEYE, Abdoulaye DIENG, and Doohong Min, "Use of Dual-Purpose Pearl Millet Stalks in Animal Feed: Development of Rations to Feed Growing Cattle in the Groundnut Basin in Northern Senegal," *International Research Journal of Advanced Engineering and Science*, Volume 9, Issue 1, pp. 30-36, 2024.

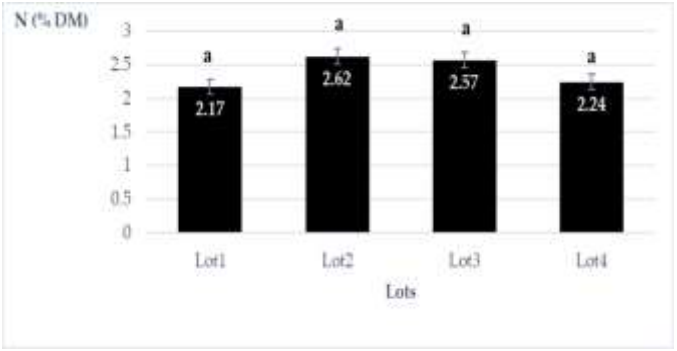

Figure 2. Nitrogen content of manure from growing cattle fed with millet stalks (Lots 1 and 2) or combined in equal parts with cowpea haulm (Lots 3 and 4) with a 50% mixture as a complement cottonseed meal and 50% millet bran (Lots 1 and 4) or cottonseed meal. The mean value with same letter (a) is not significantly different at 5% level of significance

3.3. Evolution of weight and daily weight gain in growing cattle

Statistical tests have shown that there is no significant difference (P = 0.103) (Figure 3) in the weight development of the different batches of treatments. However, significant differences were noted during the last test period from the 90th to the 105th day. The animals of the different batches showed a similar weight gain until the 6th half of the test, a period from which a higher growth was noted in the animals of lot 3 which received the basic ration consisting of a mixture of equal amount of millet stalks and cowpea tops and supplemented with cottonseed cake. It followed those of lot 4 (basic ration consisting of a mixture of dual-purpose pearl millet stalks and cowpea tops). Lots 1 and 2 recorded the lowest and more or less identical performance, especially at the end of the test.

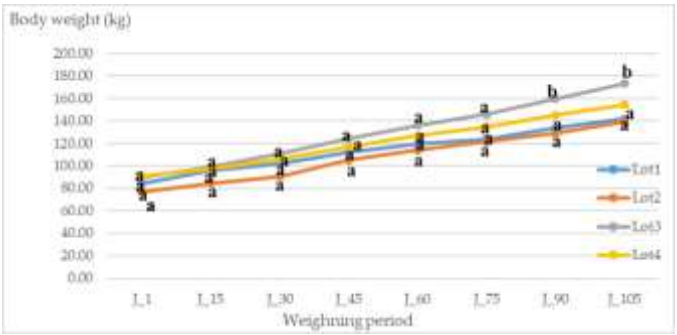

Figure 3. Weight gain of growing cattle fed with dual-purpose pearl millet stalks (Lots 1 and 2) or associated in equal amount with cowpea haulm (Lots 3 and 4) and complement with a 50 % mixture of cottonseed cake and 50 % millet bran (Lots 1 and 4) or cottonseed cake alone (Lots 2 and 3).

In terms of average daily weight gains (ADG), statistical tests detected a significant difference (P = 0.009) between the lots (Figure 4). The highest ADGs were recorded with lot 3 (852 g/d) followed by lot 2 and lot 4 which gave almost similar performance with respective averages of 636 g/d and 642 g/d. The animals of lot1, which were fed with millet stalks as basic ration and supplemented with cottonseed meal and millet bran exhibited the lowest weight growth performance with an ADG of 586 g/d.

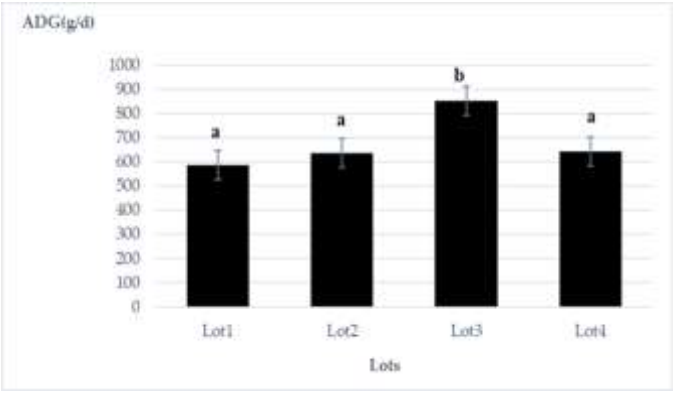

Figure 4. ADG of growing cattle fed on the basis of dual-purpose pearl millet stalks (Lots 1 and 2) or associated in equal parts with cowpea haulm (Lots 3 and 4) with as a complement a mixture of 50% cotton meal and 50% millet bran (Lots 1 and 4) or cottonseed meal alone (Lots 2 and 3). The mean value with same letter is not sig-nificantly different at 5 % level of significance.

3.4. Alimentary consummation

The consumption of dry matter during the entire test period was significantly influenced by diet (P = 0.018). The greatest ingestions were noted in the animals of lot 3 with an average of 58.25 kg during two week period followed by lot 4 with an average consumption of 54.34 kg. Unlike the ADG, the average daily consumption of the subjects of lot 1 is higher than that of lot 2 (46.79 kg and 40.71 kg, respectively).

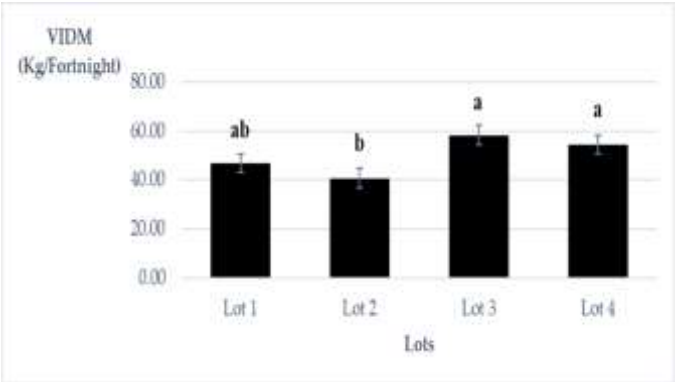

Figure 5. Average consumption per fifteen growing cattle fed with millet stalks (Lots 1 and 2) or combined in equal parts with cowpea haulm (Lots 3 and 4) with as a complement a mixture of 50% of cotton meal and 50% millet bran (Lots 1 and 4) or cotton meal alone (Lots 2 and 3). The mean value with same letter is not significantly different at 5% level of significance.

3.5. Feed efficiency

Analysis of the results showed no significant difference (P = 0.550) in the feed efficiency of the different rations during the entire study period. However, ration 1 (30 % pearl millet stalk + 35 % cottonseed meal + 35 % millet bran) presented the lowest consumption index (CI): (3.82) against 6.80 for ration 4. Rations 2 and 3 gave almost similar CIs of 5.68 and 5.17, respectively.

3.6. Animal growth variables

The multiple regression model integrating Thoracic Perimeter (TP) and Height at the Withers (WH) was adopted. Thus, the precision of the regression was better with adjusted coefficients of determination (R2) of 91 % on all the data and

Talla LO, Mamadou Tandiang DIAW, Yacine GUEYE, Abdoulaye DIENG, and Doohong Min, "Use of Dual-Purpose Pearl Millet Stalks in Animal Feed: Development of Rations to Feed Growing Cattle in the Groundnut Basin in Northern Senegal," *International Research Journal of Advanced Engineering and Science*, Volume 9, Issue 1, pp. 30-36, 2024.

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

an R, which was very close to 1 (0.95). This justifies the choice and the proposal of a biometric formula integrating the two parameters TP and WH.

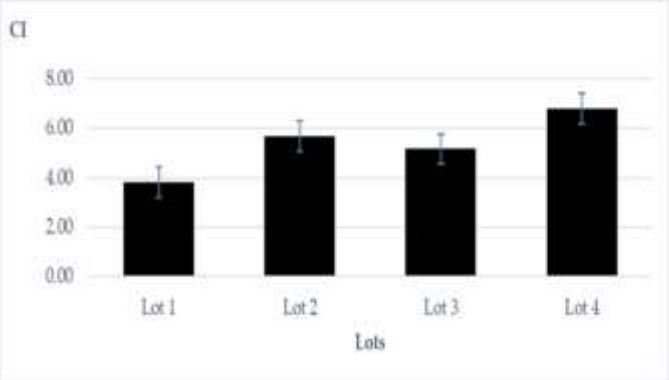

Figure 6. Average consumption index of rations based on millet stalks (Lots 1 and 2) or associated in equal proportions with cowpea haulms (Lots 3 and 4) with as a complement a mixture of 50% cotton cake and 50% millet bran (Lots 1 and 4) or cottonseed meal alone (Lots 2 and 3). The mean value with same letter is not significantly different at 5% level of significance

LW = 1.135 * WH + 2.536 * TP -287.547 (LW: live weight)
R2 = 91% and Sr = 7.65 (residual standard deviation)

The thoracic perimeter as well as the height at the withers were not significantly influenced by the ration. Lots fed the same basic ration showed similar TP values. The TP values of lots 1 and lot 2 were found 112.92 and 112.13 cm whereas lots 3 and 4 were 117.63 and 117.25 cm, respectively. Regarding WH, the highest average was noted with batch 3 (103.08 cm) followed by batch 1 (100.87 cm), batch 2 (99.33 cm), and finally batch 4 (99.04 cm).

3.7. Manure production

No significant difference (P = 0.166) was noted on the total production of manure during the entire experimental phase. However, for all batches the average dry manure production during the test is above 100 kg. It was 173.49 kg for lot 3, 170.05 kg for lot 4, 157.54 kg for lot 1 and 108.72 kg for lot 2.

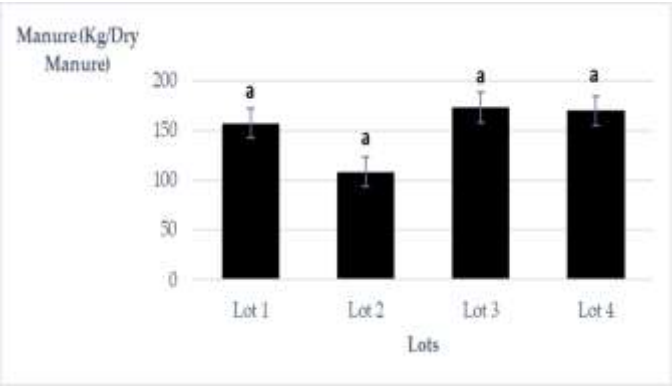

Figure 7. Total manure production from growing cattle fed with millet stalks (Lots 1 and 2) or associated in equal proportions with cowpea haulm (Lots 3 and 4) with as a complement a mixture of 50 % of cotton meal and 50 % millet bran (Lots 1 and 4) or cotton meal alone (Lots 2 and 3). The mean value with same letter is not significantly different at 5% level of significance.

3.8. Economic analysis

The average selling price of animals was $2.66 per kg live.

Table 3 shows that the ration of the animals of lot 3 had a higher profit margin ($347.59) which was more than $ 26 per animal and per month than the rations of other three lots. This ration also had the highest rate of return. It is followed by ration 4 ($232.45) than rations 1 and 2 with profits of $94,365 and $103.69, respectively. However, the margin on variable cost of ration 3 represents more than three times than that of ration 2 and more than double of ration 1. Concerning two rations based on stems alone, ration 1 presents a higher rate of return and profit margin because their production costs were lower than those of ration 2.

TABLE 3. Economic analysis of feeding rations provided to each lot of animals

	Lot 1	Lot 2	Lot 3	Lot 4
Variable cost				
Acquisition of animals	674.99	674.99	674.99	674.99
Animal feed	226.87	266.19	302.36	256.80
Watering	3.61	3.61	3.61	3.61
Veterinary costs	72.90	75.06	72.90	80.10
Total variable cost	978.37	1019.84	1053.86	1015.50
Fixed cost	185.65	185.65	185.65	185.65
Total expenses	1164.02	1205.49	1239.51	1201.15
Revenue				
Manure	8.51	5.87	9.37	9.18
Animal sale	1139.72	1118.30	1394.19	1240.17
Total revenue	1148.23	1124.16	1403.55	1249.35
Margin / Lot	169.86	104.32	349.69	233.85
Margin / animal	56.62	34.77	116.57	77.95
Rate of return	0.15	0.09	0.25	0.19
Break-even point	1254.99	2000.57	745.13	991.83

1 US dollar equivalent to 555.56 West African CFA

IV. Discussion

4.1. Weight growth

The ADG achieved by lots 1 to 4 were 586 ;636 ; 852 and 642 g/d, respectively. These performance differences noted with in batch could be due to the energy value and protein which differed from one ration to another (Sawadogo et al., 1991). The low ADG observed in animals fed 30% millet stalk, 35% cottonseed cake, and 35% millet bran can be explained by the repetitive diarrhea noted in one animal from this batch. This even resulted in low or even negative ADGs at certain periods of the experiment. The quality of the millet seemed questionable due to the contamination of sand and impurities on it. This was confirmed by other rations with the same type of forage; all containing it recorded the lowest ADGs.

The results obtained for rations based on millet stalks alone supplemented with cottonseed cake (636 g/d) are similar to those reported by Fall et al. (1994) who found ADGs ranges from 632 to 645 g/d for rations based on molasses rice straw and supplemented with cake and rice bran and from 681 to 672 g/d for diets made up of millet stalks molasses, peanut cake and millet bran. Dia (1996) also found ADGs ranges from 458 to 569 g/d for animals aged 1.5 to 2.0 years and fed with baked bread, cottonseed, rice bran and green grass. These results are aligned with those obtained with the ration based on millet stems and supplemented with cottonseed meal and

Talla LO, Mamadou Tandiang DIAW, Yacine GUEYE, Abdoulaye DIENG, and Doohong Min, "Use of Dual-Purpose Pearl Millet Stalks in Animal Feed: Development of Rations to Feed Growing Cattle in the Groundnut Basin in Northern Senegal," *International Research Journal of Advanced Engineering and Science*, Volume 9, Issue 1, pp. 30-36, 2024.

millet bran. Regarding rations incorporating cowpea haulms as basic forage, our results agree with those of Fall et al. (1997) who found performances in the range of 738 and 808 g/d. Buldgen et al. (1990) also reported ADGs of 800 g/d during the rainy season.

4.2. Alimentary consummation

The quantities of average dry matter ingested during the experiment were 3.29 kg DM /100kg of live weight, 3.19 kg DM / 100kg of live weight, 2.92 kg DM / 100 kg of live weight and 2.74 kg DM / 100kg of live Weight, for lots 3, 4, 1 and 2, respectively. The differences in intake noted between the lots could result from the palatability of certain constituents of the diets. Dieng (1984) and Nanema (1998) suggested that the cowpea haulm, combined with straw, increases ingestion. This could justify the higher ingestions noted in the lots fed with a ration containing cowpea haulm.

However, they are not in line with the standard daily consumption standards for a Gobra zebu which is around 2.5 kg DM per 100 kg body weight. Our voluntary consumption results are slightly lower than those of Wade (2016) who reported an average intake value of 3.9 ± 0.68 kg DM per 100 kg body weight in a bovine fattening experiment. In addition, Buldgen et al. (1990) obtained from 2.7 to 3.3 kg DM per 100 kg of body weight during fattening trials of bull calves and adult males of the Gobra breed from agro-industrial by-products molasses in Senegal. Likewise, Valenza et al. (1971) reported between 3 and 3.5 kg DM intake per 100 kg body weight for different composition of the ration. These data are consistent with the various results found during our study.

4.3. Consumption index

The CI values found in our study are lower than those reported by Valenza et al. (1971) which is10.23 for a ration composed of a homogeneous mixture of peanut shell and other concentrate. Calvet et al. (1972) and Calvet et al. (1973) reported CI of 9.1 and 7.21 respectively for a study carried out on the zebu Gobra. On the other hand, the values obtained during our test for batches 2, 3 and 4 (5.68, 5.17 and 6.80, respectively) are slightly different from those found by Lhoste (1973) who found 6.2. According to studies conducted by Valenza et al. (1971) and Buldgen et al. (1990), the low CI indicate that the nature of growth is mainly based on meat and not fat.

4.4. Amount of manure produced

The dry manure production was recorded 139.80, 104.21, 136.55, and 144.72 kg / 100 kg body weight from batch 1, 2, 3, and 4, respectively. Related to the MF per day, these values are equivalent to respective productions of 3.50, 2.60, 3.40, and 3. 60 kg/d. These values found comply with the accepted standards, which are of the order of 10 kg per day and per Tropical Livestock Unit (UBT), i.e. 4 kg / 100kg body weight. Our results agree with those obtained by Sow et al. (2004) who reported 7.82 kg/d/TLU or 3.12 kg / 100 kg body weight. However, they were lower than those found by Fall et al. (1997) (5.4 kg) at Keur Seck in the department of Bambey. As for the quality of the manure, its nitrogen content was slightly higher than that reported by Mallouhi and Bioyara (1997) which was 1.96 % nitrogen. This difference could be due to the presence of stems in the manure and exposure to the sun.

4.5. Growth Measurements

The results, on the predicted equations, showed that the thoracic perimeter is the best estimator of the body weight. For the batches taken individually or as a whole, the equations integrating the thoracic perimeter gave the large coefficients of determination and the small residual standard deviations. This is in line with the experiments of (Chollou et al., 1978, Kashoma et al., 2011). However, this formula should be used with caution, as the estimation of body weight by feed ration formulas depends on age, breed among others.

4.6. Economic performance

The profit estimated in this study were fluctuated from $34.3 to to $115.85per animal are more or less similar to the findings of the study conducted by Sow et al. (2004) who reported profits ranging from $49.74to 115.94. Buldgen et al. (1993) also obtained average profit margins of $47.95 / bovine for trials conducted in the rainy season by villagers on natural rangelands of the Senegalese groundnut basin by the villagers and $37.04/ bovine for the trials in the dry season in Touba-Peyckouk.

The profits obtained during this trial may seem low but it should not be forgot-ten that in rural areas, millet stalks remain available and the labor is often family members, which considerably reduces production costs and increases net profit.

V. CONCLUSIONS

In this study, it was a question of highlighting the effect of 4 rations based on dual-purpose pearl millet stalks and supplemented with cottonseed cake alone or combined with millet bran. Statistical analysis revealed those rations have significant differences on the ADGs and VIDM of the different batches of animals. On the other hand, there was no significant difference for the quality and quantity of manure, the consumption index, as well as the growth measurements. At the same time, the evaluation of the animal performance / cost ratio showed that ration 3 (mixture of equal parts of cowpea tops and dual-purpose pearl millet stalks + cottonseed cake) proved to be the most interesting. Thus, it should be noted that this promising ration deserves special attention for possible extension in rural areas because it not only increased the ADG (over 800 g/d) but also decreased the cost of production.

Furthermore, it is also important to point out that the ration of 30% of dual-purpose pearl millet stalks + 35% of cottonseed cake + 35% of millet bran would potentially remain an alternative in case of the scarcity of cowpea haulm in some countries. Moreover, cowpea haulms are often shipped to urban areas to support the rearing of small ruminants. In addition, it has the lowest energy content. The findings of this study suggest that that crop residues (i.e., dual-purpose pearl millet stalks and cowpea haulms) formulated with accessible concentrates can make a significant contribution to meat production in Senegal.

Talla LO, Mamadou Tandiang DIAW, Yacine GUEYE, Abdoulaye DIENG, and Doohong Min, “Use of Dual-Purpose Pearl Millet Stalks in Animal Feed: Development of Rations to Feed Growing Cattle in the Groundnut Basin in Northern Senegal,” *International Research Journal of Advanced Engineering and Science*, Volume 9, Issue 1, pp. 30-36, 2024.

REFERENCES

[1]. ANSD (2020). Agence Nationale de la Démographie et de la Statistique Situation Economique et Sociale du Sénégal 2017-2018. Ministére de l'Economie du et de la coopération. Dakar : s.n., 235-243.
[2]. AOAC 1995. Méthodes officielles d'analyse, 16e édition. Association of official analytical chemists. Washington DC, USA.
[3]. BULDGEN, A., LEMAL, D. & STEYAERT, P. 1990a. Engraissement de taurillons et de mâles adultes de race Gobra à partir de sous-produits agro-industriels mélassés au Sénégal. Tropicultura, 8, 107-111.
[4]. BULDGEN, A., LEMAL, D. & STEYAERT, P. 1990b. L'engraissement de taurillons et de mâles adultes de Gobra avec des produits agro-industriels tels que la mélasse au Sénégal. Tropicultura, 8, 107-111.
[5]. BULDGEN, A., PIRAUX, M., DIENG, A. & COMPÈRE, R. 1993. Mise au point de techniques d'embouche bovine villageoise dans le bassin arachidier sénégalais. Revue Mondiale Zootechnie, 76, 27-34.
[6]. CALVET, H., VALENZA, J., FRIOT, D. & WANE, A. 1973. La graine de coton en embouche intensive. Performances comparées des zébus, taurins et des produits de leur croisement. Revue d'élevage et de médecine vétérinaire des pays tropicaux, 26, 349-362.
[7]. CALVET, H., VALENZA, J., ORUE J. & CHAMBON, J. 1972. L'engraissement intensif des zébus peuls sénégalais (Gobra) : Engraissement de mâles entiers ou castrés en zone rizicole Revue d'élevage et de médecine vétérinaire des pays tropicaux, 25, 85-96.
[8]. CAMARA, A. 2007. Diagnostic fourrager pour l'amélioration des productions animales dans le bassin arachidier du Sénégal : Cas de Niakhar. Dakar Interstate School of Veterinary Science and Medicine.
[9]. CHOLLOU, M., DENIS, J.-P. & GAUCHET, D. 1978. Calcul d'une formule barymétrique adaptée au zébu gobra.
[10]. DAGNELIE, P. 2003. Principes d'expérimentation : planification des expériences et analyse de leurs résultats, Presses agronomiques de Gembloux.
[11]. DENIS, J. & VALENZA, J. 1971. Extériorisation des potentialités génétiques du Peulh zébu sénégalais (Gobra). Revue d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, 24, 409-418.
[12]. DIA, A. 1996. Etude technico-économique de l'embouche bovine paysanne dans le bassin arachidier sénégalais. Université de Thiès.
[13]. DIENG, A. 1984. Utilisation des sous-produits agricoles et agro-industriels disponibles le long du fleuve Sénégal. Mémoire de fin d'études, faculté des sciences agronomiques de Gembloux, Belgique.
[14]. DUGUE, P., VALL, E., LECOMTE, P., KLEIN, H. & ROLLIN, D. 2004. Evolution des relations entre agriculture et élevage dans les savanes d'Afrique de l'Ouest et du Centre. Un nouveau cadre d'analyse et d'intervention pour améliorer les modes d'intervention et favoriser l'innovation. Oléagineux, 11, 268-276.
[15]. DSV 2019. Rapport d'activité annuel. Ministère de l'agriculture et de l'alimentation. Direction des services vétérinaires.
[16]. FALL, S., TRAORÉ, E., CISSÉ, M., KOREA, A., SÈYE, B., FALL, A. & DIOP, A. Système d'alimentation pour la production intensive de viande au Sénégal. Essai de pré vulgarisation de rations d'embouche. Convention SRA-CRDI./3 P, 1994. 0200.
[17]. FALL, S., TRAORÉ, E., N'DIAYE, K., N'DIAYE, N. & SÈYE, B. M. 1997. Utilisation des fruits de Faidherbia albida pour l'alimentation des bovins d'embouche paysanne dans le bassin arachidier au Sénégal. Recherche sur l'élevage pour le développement rural, 9, 19p.
[18]. FAO 2021. Données FAOSTAT : Produits de la culture et de l'élevage. Organisation des Nations Unies pour l'alimentation et l'agriculture. Retrouvé le 27 septembre 2021 sur http://www.fao.org/faostat/en/#data/QCL.
[19]. FAYE, M. 2019. Aptitude à l'ensilage (avec et sans additifs) des tiges de mil (Pennisetum glaucum) de la population SL423 potentiellement à double usage (avec et sans additifs) en comparaison avec la variété homologuée Souna et digestibilité des produits sur ovins. Université de Thiès.
[20]. KABORÉ-ZOUNGRANA, C., TOGUYENI, A. & SANA, Y. 1999. Ingestibilité et digestibilité dans le foin de mouton de cinq graminées tropicales. Revue de l'élevage et de la médecine vétérinaire dans les pays tropicaux, 52, 147
[21]. KABORÉ-ZOUNGRANA, C. Y. 1995. Composition chimique et valeur nutritionnelle des plantes herbacées et ligneuses des pâturages naturels soudanais et des sous-produits du Burkina Faso. Université de Ouagadougou, Burkina Faso.
[22]. KANE, L. 2018. Influence de la fertilisation azotée, de l'association mil / niébé et des techniques de conservation sur la valeur nutritionnelle des tiges de mil au Sénégal. Université de Thiès.
[23]. KASHOMA, I., LUZIGA, C., WEREMA, C., SHIRIMA, G. & NDOSSI, D. 2011. Predicting body weight of Tanzania shorthorn zebu cattle using heart girth measurements (Prévision du poids corporel des bovins zébus de Tanzanie à l'aide des mesures de la circonférence du cœur). Consulté le 25 septembre 2021 sur http://www.lrrd.org/lrrd23/4/kash23094.htm.Livestock Research for Rural Development, 23, 1-8.
[24]. Lhoste,P. (1973). Embouche intensive de jeunes males: Comparaison des taurillons et bouvillons de trois races.233-236 pp
[25]. LO, T. 2017. Étude de la digestibilité des parties inférieures et supérieures des tiges de trois populations de mil potentiellement du-al-use (SL28, SL169 et SL423) en comparaison avec celles des variétés Souna 3 et Thialack 2 chez le mouton Peulh-Peulh. Département d'ingénierie agricole, Université de Thiès.
[26]. MALLOUHI, N. & BIOYARA, J. 1997. Effet de Leucaena Ieucocephala, des fientes de volaille ou du fumier de bovins sur la productivité du maïs cultivé. Tropicultura, 15, 67-70.
[27]. NANEMA, S. L. 1998. Optimisation des résidus de culture associés aux sous-produits agro-industriels dans l'alimentation des ruminants. Institut du développement rural.
[28]. PNDL 2016. Plan national de développement de l'élevage. Ministère de l'élevage et de la production animale. Retrouvé le 25 septembre 2021 sur http://bameinfopol.info/IMG/pdf/pnde-versiondef_dec2017.pdf.
[29]. NISDEL 2004. Situation et perspectives du sous-secteur de l'élevage. Nouvelle initiative sectorielle pour le développement de l'élevage, Ministère du développement agricole, Bureau du ministre délégué chargé
De l'élevage, Dakar, Sénégal. Retrouvé le 24 septembre 2021sur https://www.bameinfopol.info/IMG/pdf/NISDEL.pdf
[30]. RICHARD, D., ALARY, V., CORNIAUX, C., DUTEURTRE, G. & LHOSTE, P. 2019. Dynamique des élevages pastoraux et agropastoraux en Afrique intertropicale, éditions Quae.
[31]. SAWADOGO, G., OUMAROU, A., SENE, M. & DIOP, M. 1991. Effets des mauvaises conditions de pâturage et du type d'alimentation sur certaines valeurs biochimiques du zébu Gobra au Sénégal. British Veterinary Journal, 147, 538-544.
[32]. SOW, F. D., AMINATA, B. & MALONEY, M. 2004. L'embouche paysanne, un exemple d'adaptation de l'élevage traditionnel à la nouvelle situation agricole dans le bassin arachidier du Sénégal. Cahiers Agricultures, 13, 211-219 (1).
[33]. VALENZA, J., CALVET, H. & ORUE, J. 1971. Engraissement intensif de zébus Peulh sénégalais (Gobra). 3e partie : mâles entiers ou castrés-3 à 5 ans, et boeufs-7 à 9 ans. Revue d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, 24, 597-634.
[34]. Wade, C. (2016a). Analyse des flux d'azote en milieu paysan: Cas des systèmes agro- pastoraux du bassin arachidier du Sénégal. (ENSA), Mémoire de Fin d'Etude .59p+Annexes.

Talla LO, Mamadou Tandiang DIAW, Yacine GUEYE, Abdoulaye DIENG, and Doohong Min, "Use of Dual-Purpose Pearl Millet Stalks in Animal Feed: Development of Rations to Feed Growing Cattle in the Groundnut Basin in Northern Senegal," *International Research Journal of Advanced Engineering and Science*, Volume 9, Issue 1, pp. 30-36, 2024.