Magna Scientia Advanced Biology and Pharmacy
eISSN: 2582-8363
Cross Ref DOI: 10.30574/msabp
Journal homepage: https://magnascientiapub.com/journals/msabp/

(Research Article)

Check for updates

Proximate, microbial and mineral compositions of Millet *Pennisetum gluacuum* L. and sorghum *bicolor* compounded straw feed for ruminant

Bello Muhammed magaji *, Femi Maroof Adams, Azeez Ayodeji Tijani, Bamidele Joshua Awogbemi, Temitope Oluwaranti Alake and Titilope Oluwadamilola Akinola

Department of Production Analytical and Laboratory Management Federal Institute of Industrial Research Oshodi, Lagos.

Magna Scientia Advanced Biology and Pharmacy, 2021, 03(02), 009–014

Publication history: Received on 02 August 2021; revised on 07 September 2021; accepted on 09 September 2021

Article DOI: https://doi.org/10.30574/msabp.2021.3.2.0040

Abstract

The study was aimed for the production and determination of the proximate, microbiological and mineral compositions of Millet *Pennisetum gluacuum* L. and Sorghum bicolor compounded straw feed for ruminant production. The result revealed a pH 5.791 which is suitable for fibre in the feed and promote chewing and rumination processes in the rumen, low percentage moisture content of 1.37 was recorded due to high drying in the field, high percentage fat and crude protein of 4.67 and 6.97 respectively this was as a result of the inclusion of groundnut cake as source of protein and fat in the feed, percentage digestible protein was 3.58, crude fibre value of 27.56 which satisfied the 18% requirement in the diet of ruminants, percentage carbohydrate was 54.2, and estimated energy value (Kcal) 286.95. Microbiological analysis showed a total plate count of 5 $x10^{-4}$ cfu/g, Mould count of 1 $x10^{-3}$ cfu/g, while Yeast, Staphylococcus, Coliform, Shigella, Salmonella and Escherichia coli count were not detected respectively. Mineral composition of sorghum and millet *Pennisetum gluacuum* compounded straw feed showed the presence of Fe, Na, K, Mg, Zn, Cu Mn, and Cr as 120.4189mg/kg, 570.9844 mg/kg, 227.1493 mg/kg, 568.2669 mg/kg, 12.9195mg/kg, 14.0666mg/kg, 62.9926mg/kg respectively and 18.584 mg/kg while Ni and Pb were not detected in the formulated ruminant feed.

Keywords: Millet; Straw; Sorghum; Ruminant

1. Introduction

The reason behind poor performance of livestock in developing countries is the seasonal inadequacy of feed, both in quality and quantity. The deficiencies are as a result of poor saving, supplementation, infrastructure, technical know-how, and poor management, [1]. Advances in technology and science have led to an improved standard of animal living. This has caused an increased demand for food supplies in modern as well as traditional ways. Plant by-products, such as husk, straws and stubbles can be compounded in to animal feed [2]. Sheep, goat and cow with its utility for meat, milk, wool, skins, and manure which formed an important component of rural economy in the Northern Nigeria, through grazing and browsing that formed main resources to meet nutrient requirement. However, the area under grazing lands diminishes due to increase in human population [3].

Straws are being used as a livestock feed ever since the advent of cereal cultivation as they are inevitably produced as cereal by-products. [4] distinguished two major groups of straws as follows: a) Slender straws: rice, wheat, oats; b) Coarse straws: millet, sorghum

Crop residues are post-harvest resources left after primary foods have been detached. It includes all inedible phytomass of agricultural production [5]. Straw are abundantly available in Northern Nigeria, in which about 3 billion tons of straw is produced in the world in 2007, they are becoming more and more valuable as animal feed due to reduction of common

* Corresponding author: Bello Muhammed magaji
Department of Production Analytical and Laboratory Management Federal Institute of Industrial Research Oshodi, Lagos.

grazing land. However, lack of technical knowledge, they are lost or being underutilized [6]. Generally, straws are low in nutrient contents and digestibility [7] the low nutritional value depends on botanical fractions of straws. Thus leaf is much more digestible than stem [8]. The nutrient contained is determined by their stage of maturity at harvest. Thus the earlier the harvest the higher the energy and protein content, digestibility as well as palatability. The difference in digestibility of straw components holds for both temperate (wheat, barley, oats) and tropical straws (maize, sorghum, millet) except for rice; stem and leaf straw are of similar value. Additional energy and protein need to be fed to avoid impaction and ensure the animal requirements are made; supplemented means of vitamins and minerals are incorporated and bowed into complete diet either in the form of mash or pellet forms [9]. The use of straw for numerous Agricultural and non-agricultural activities make it one of the foremost and most olden multipurpose agricultural by-products . Mechanical grinding of lignocellulosic substances, such as wood and corn stover, typically leads to a different particle size, various particle shapes, high specific surface area, and sometimes low cellulose [10].

Simple technologies, such as chopping feeds, increase animal productivity and reduce fodder waste. Both intake and rumen digestion of chopped feeds are higher than the un-chopped [11]. Animals use a considerable amount of energy in chewing forages, while chaffing saves this energy and diverts it for productive purposes. Continuous mixing of rumen contents improves the intimacy between ingested feed particles and the microbial population, which is essential for optimal fibre digestion.

Cattle and sheep need at least 15 different minerals for good health and productivity in some countries the most economically important trace elements are copper (Cu), selenium (Se), cobalt (Co) and iodine (I). Zinc (Zn) and manganese (Mn) deficiencies are much less important.

2. Material and methods

2.1. Material Collection and pre-treatment

The Materials Millet *Pennisetum gluacuum* L. Sorghum bicolor straw, Maize grains, oil seed residue (Groundnut cake) and salt ware purchased from Aliero town, Aliero Local Government, Kebbi State. The collected straw were screened to removed foreign matter such as sticks, nylons, papers and plastics, etc, The straws were packed using rope while groundnut cake, maize grains are stored in clean nylon bag prior to homogenizing.

2.2. Processing of ingredients

Millet *Pennisetum gluacuum* L. Sorghum bicolor straw, maize grains and groundnut cake was grinded at ambient temperature separately, each was weighed in a ratio of 50:50:10:10 using a weighing balance and transferred in to a Mixer, 2% salt was added, then mixed for few minutes, the mixed product was store in to a nylon bag prior analysis.

2.3. Microbial Analysis

Salmonella, Shigella agar, Violent Red bile agar, Nutrient agar, *Staphylococcus* agar, Potato Dextrose Agar each were prepared according to manufacturer specification. 1g of sample were taking and inoculated in to 9ml of sterile distilled water, this was use for serial dilution (10^{-1}, 10^{-3} and 10^{-5}) and was inoculated in to petri dishes using pour plate. The media of isolation were prepared on each plate and were incubated at 370c for 24-48hrs. [12].

2.4. Chemical Analysis

Proximate parameters (moisture, protein, carbohydrate, fats, crude fibre and ash) were determined using the Association of Official Analytical Chemists, 15th edition [13] method. Nitrogen content of the samples was determined by the Kjedhal method. The weight difference method was used to determine moisture and ash content while crude fat was determine using the above method with petroleum ether as solvent. The carbohydrate content was determined by calculation using the difference method %Carbohydrate = [100-%(protein + fat + moisture + ash+ fiber)]. Digestible crude protein was calculated using the equation: %DCP = 7.87 x log CP – 3.06 [14] while energy value was estimated using the equation, Energy Value = (4 x protein + 9 x fat + 4 x Carbohydrate)

Minerals composition was measured by spectrometric methods using Shimadzu AA-7000 Atomic Absorption Spectrophotometer.

3. Results

Table 1 Physicochemical and Proximate Composition of millet *Pennisetum gluacuum* and Sorghum, compounded Straw Feed for ruminant

Variable	Composition
pH	5.791
Moisture	1.37%
Fat	4.67%
Protein	6.97%
Digestible protein	3.58%
Ash	5.51%
Crude fibre	27.56%
Total carbohydrate	54.2%
Energy value (Kcal)	286.95

Table 2 Microbiological Analysis of Millet *Pennisetum gluacuum* and Sorghum Compounded Straw Feed for ruminant

S/N	Variable	Result
1	Total plate count (CFU/g)	$4x10^{-3}$
2	Mould count (CFU/g)	$1 x10^{-3}$
3	Yeast count(CFU/g)	Nil
4	*Staphylococcus* count (CFU/g)	Nil
5	*Coliform* count (CFU/g)	Nil
6	*Shigella* count (CFU/g)	Nil
7	*Salmonella* count (CFU/g)	Nil
8	*Escherichia coli* count (CFU/g)	Nil

Key, Nil: Not available

Table 3 Mineral/heavy metal composition (Mg/kg) of Millet *Pennisetum gluacuum* and Sorghum Compounded Straw Feed for ruminant

SN	Variable	Concentration (mg/kg)
1	Fe	12.4189±0.0002
2	Na	570.9844 ± 0.0003
3	k	227.14493 ± 0.0008
4	Mg	568.2669 ± 0.0016
5	Zn	12.9195 ± 0.0003
6	Cu	14.0666 ± 0.0003
7	Mn	62.9926 ± 0.0003
8	Ni	Not detected
9	Cr	18.58441 ±0.0002
10	Pb	Not detected

4. Discussion

Proxalte composition of Millet *Pennisetum gluacuum* L. and Sorghum bicolor compounded straw feed for ruminant is shown in table 1 above. The pH was 5.791 which are suitable for fibre in the feed and promote chewing and rumination processes in the rumen as reported by [15]. The low moisture content 1.375% was recorded which was due to reduced moisture content by it drying on the field and on storage processes, which was in agreement with the findings of Willcock, [16] and Sain, Broadbent [17] who reported that development of microorganisms is practically stopped when the water content in straws are minimal. The higher digestible crude protein 3.58% irrespective of the crop is explained by the higher crude protein values this satisfied the digestible crude protein maintenance requirements of (1.5 to 3.3%) for small ruminants weighing 10 to 40kg as reported by [18] The percentage crude fibre value of 27.56% , the crude fibre values differed significantly from 27.54 to 47.34% , the crude fibre recorded satisfied the 18% minimum requirement in the diet of ruminants. The % Ash content was 5.51% which satisfied the body weight of 2.5-3 kg DM / 100 kg live weight (LW), 2. 8-3 kg Dm /100kg live weight in stage of lactation and 1.6-2 kg DM / 100 kg live weight in mammary break period respectively, the total carbohydrate 54.2% from this work is within the range recorded for Dusa which was 58.88% as reported by Abagala *et.,al* [19].

Table 2; shows the microbiological analysis of the compounded straw feed which revealed a total plate count of $4x10^{-3}$ cfu/g, Mould count of $1 x10^{-3}$ cfu/g, while Yeast, *Staphylococcus, Coliform, Shigella*, *Salmonella* and *Escherichia coli* count were not detected respectively. Therefore occurrence of microorganisms in straw formulated feed depends mainly on the moisture content. pH level is one of the most important factors in the rumen environment because fibrolytic bacteria are very sensitive toward pH change. Erdman 1988 stated that the value of 6.0 to 7.0 is considered as optimum activity of rumen microbial population for their growth. Straw feed is a bit more resistant against occurrence of microbiological agents due to it reduced moisture content. Maintaining a low level of microorganisms in biomass is also important in terms of minimizing the health risks associated with exposure of service staff to them and pollutant emissions into the environment.

Mineral content of sorghum and millet compounded straw feed are presented in table 3; above, The results shows the presence of Fe, Na, K, Mg, Zn, Cu Mg, and Cr at different concentration while Ni and Pb were not detected in the feed. The Iron was within the range of 52mg/kg to 643mg/kg recommended in most of the straw by-products as reported by Animal Resources Information System [20]. The content in the feed was 120.4189 mg/kg which was above the critical level, this was due to higher Fe content of the soil as well as higher up take of Fe from the soil. Gowda *et al [21]* reported 592 ppm of Fe in paddy straw and Yadav *et al.,* [22] reported 530 ppm Fe in wheat straw. Copper (Cu) content was 14.0666 which were within the range of 10-20 mg / kg is recommended for dairy cows. Zinc is involved in many biochemical processes and a deficiency affects a wide range of body functions such as deterioration of hair or wool texture, stiff joints and thick, scaly, cracked skin are accompanied or preceded by poor growth. The value of 12.9195mg/kg was below the Average requirements by EU on July 20, 2016 which was 120 mg/kg for all class of animal [23] Manganese (Mg) is an important trace element which is essential for the correct functioning of several enzyme systems within the body the value 62.9926 mg/kg of manganese from this work met the recommended value of 50mg/kg of DM (beefandamb.ahdb.org.uk). Potassium (K) value was recorded as 227.1493 mg/kg which was high than 122.86 mg/Kg in millet and 122.43 mg/kg of sorghum stover, this is as a result of inclusion of different mineral source such as groundnut cake, maize grains etc in the feed. Magnesium (Mg) was recorded to be high of to 568.269 mg/kg which varied significantly from 10.00 mg/Kg in sorghum chaffs to 231.95 mg/ Kg in millet stover as reported by Rashid [24].

5. Conclusion

This study resolved that millet and sorghum compounded straw feed if supplemented with protein and mineral sources will give the required nutritional value for the ruminant animal production.

Compliance with ethical standards

Acknowledgments

A big thanks to analytical marketing division for making the work successful as well as food safety and quality management division (FIIRO).

Disclosure of conflict of interest

All authors (Bello, Femi, Azeez, Bamidele, Temitope and Titilope) declared that, no conflicts of interest regarding the publication of this paper.

References

[1] FAO/IAEA. Development and field evaluation of animal feed supplementation packages Proceedings of the final review meeting of an IAEA Technical Co-operation Regional AFRA Project organized by the Joint Division of Nuclear Techniques in Food and Agriculture, Cairo, Egypt. 2000; 25–29.

[2] Ranjhan SK. Agro-industrial by-products as components of livestock rations in animal nutrition in the tropics, New Dehli, India: Vikas Publishing House PVT Ltd. 1993; 222–258.

[3] Singh P. Range land and their improvement in India. Annals of Arid Zone. 1995; 34: 157 - 161.

[4] Prasad CS, Sampath KT, Shivaramaiah MT, Walli TK. Dry matter intake, digestibility and supplementation of slender and coarse straws-a review, in: K singh, J.B schiere (eds.) feeding of ruminants on fibrous crop residues. Indian council of agricultural research, New Delhi. 1993; 88-203

[5] Berazneva J. Economic value of crop residues in African smallholder agriculture, A Paper Presented at the Agricultural and Applied Economics Association's (AAEA) and CAES Joint Annual Meeting held at Washington, DC on 4 – 6 August 2013; 25.

[6] Badve VC, Nisal PR, Joshi A, Kumar A. Sorghum and pearl millet stover Hand book for straw feeding systems, New Delhi. 1995; 367–377.

[7] Owe E, Kategile JA. Straw in practical rations for sheep and goats, IN: Straw and Other Fibrous By-products as Feed. Elsevier, Amsterdam. 1984; 454-486.

[8] Ramazin M, Orskov ER, Tuah AK. Rumen degradation of straw. 2 botanical fractions of straw from two barley cultivars. 1986; 43: 271-278.

[9] Reddy GVN, Reddy MR. Effect of processing on the nutritive value of eight crop residues and two forest grasses in goats and sheep, Asian Australasian Journal of Animal Science. 2003; 5: 295-299.

[10] Karinkanta P, Ämmälä A, Illikainen N, Niinimäki J. Fine grinding of wood, overview from wood breakage to applications. Bioenergy. 2018; 113: 31–44.

[11] Owen E, Smith T, Makkar H. Successes and failures with animal nutrition practices and technologies in developing countries: A synthesis of an FAO e-conference. Animal Feed Science and Technology. 2012; 174(3-4): 211-226.

[12] Tiani AA, Famotemi AC, Orji FA, Abimbola FB, AdAms FM, Aba E. Antimicrobial susceptibility of bacteria isolated from abattoir eatery and hospital effluents International Journal of Advance Research in Biotechnological sciences. 2017; 4(1): 142-156.

[13] Association of Official Analytical Chemists. Official Methods of Analysis of the Association of Official Analytical Chemists 15th Edition, Washington D.C., USA. 2006.

[14] Hagger RJ, Ahmed MB. Seasonal production of Andropogon gayanus II, Seasonal Changes in Digestibility and Feed intake. Journal of Agricultural Science. 1970; 57: 369-373.

[15] Sang YS, Bean PA, Seib J, Perdersen, Shi YC. Structure and functional properties of sorghum starches differing in Amylose content, Journal of Agriculture and Food Chemistry. 2007; 56: p 680-685

[16] Willcock J, Magan N. Impact of environmental factors on fungal respiration and dry matter losses in wheat straw Journal of Stored Products Research. 2000; 37: 35–45

[17] Sain P, Broadbent FE. Moisture absorption, mould growth, and decomposition of rice straw at different relative humidities. Agronomy Journal. 1975; 67: 759–762.

[18] Yami A. Sheep and Goat Production Handbook for Ethiopia, Produced by Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP) Edited by Yami, A. and Merkel, R.C. 2011; 347.

[19] Abagale SA, Apaseku J, Dawda S, Abagale MD, Abi LA. biochemical relevance of sorghum and millet produced in the kasena-nankana districts of ghana, and some of their by-products to food, nutrition, health and wealth of the people international Journal of Chemistry and Materials Research. 2013; 1(2): 14-24.

[20] Animal Feed Resources Information System - INRA CIRAD AFZ and FAO 2016

[21] Gowda NKS, Prasad CS, Ramana JV, Shivaramaiah MT. Mineral status of soil, feeds, fodders and animals in coastal agri-eco zone of Karnataka. Animal Nutrition Feed Technology. 2001; 1: 97-104.

[22] Yadav PS, Mandai AB, Dahiya DV. Feeding pattern and mineral status of buffaloes in Panipat district of Haryana state. Animal Nutrition Feed Technology. 2002; 2: 127-138.

[23] Animal Nutrition Association. Maximum Nutrient Values in Small Ruminant (sheep and Goat Feeds. Canada. 2018.

[24] Rashid M. Goats and their nutrition, manitoba agriculture food and rural initiatives www.manitobagoats.ca Extracted on June 14, 2016. 2008