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Extent of availability of major nutrients from selected Cereal Crop Residues to dairy ruminants as an alternative Dry Season Forage in Northern Uganda.

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Abstract

This work aimed at determining the availability of major nutrients from cereal crop residues (CRs) of maize, rice and sorghum to dairy ruminants in Northern Uganda. The major nutrient composition of the CRs was determined to establish their potential as alternative dry season forage resources for dairy animals. The CRs were selected based on crop economic importance and availability at the on-set of the dry season in randomly selected sub-counties of Lira, Otuke and Kole districts. Five samples of each CR were obtained from 20 farmer's fields immediately after harvesting of each crop. Chemical analyses measured included Dry matter (DM), Crude protein (CP), Acid detergent fiber (ADF), Neutral detergent fiber (NDF), Digestible energy (DE), Organic matter digestibility (OM dig), Calcium (Ca), and Phosphorous (P). Fresh maize stover (MSF) had the highest CP (70.5g/kg DM), DE (11.3 MJ/kg DM), and lowest lignifications (49g/kg DM). Rice straw (RS) had a CP (42.1g/kg DM), lowest DE (6.9MJ/kg DM) and OM dig (506 g/kg DM). Dry maize stover (MSD) had the highest lignifications (76.0 g/kg DM) and low OM dig (543 g/kg DM) and sorghum stover (SS) had the lowest CP (40.0 g/kg DM) and a very low DE (7.1MJ/kg DM). The low CP levels and high levels of lignification limit the digestibility of the CR. However, their CF digestibility can be improved using an energy rich by-product, molasses (12.7MJ/kg DM) while the CP limitation due to ligfications can be improved through urea treatment.

Key Words: Maize stover, Sorghum stover, Rice straw Chemical composition and Digestibility

Academic discipline sub-disciplines

Natural science

Subject classification

Agriculture, livestock nutrition

Type (approach)

Sampling experimental survey

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1. Background

In northern Uganda, achieving the expended output necessary to meet prospective demand for foods of animal origin is still a daunting challenge. Like in other developing regions, this has been attributed to the ever increasing human population, urbanization and growth in income (Parthasarathy et al., 2005). Among the major constraints to ruminant livestock production across the developing regions, nutrition is by far the most important factor especially in the dry season (ILRI, 1995). Sorghum, rice and maize are the major cereal crops grown abundantly in rain fed areas of Northern Uganda. These cereals leave large quantities of residues after grain harvesting a consequence of universal availability and widespread use (economic importance). By the year 2005 the northern region was able to produce 6,000, 239,000 and 34,000 metric tons of rice, maize and sorghum respectively (UBOS 2006) and this translates into 279,000 metric tons of straw. The residues are available in the dry season when the ruminant feeding challenge hits its peak hence the high potential to bridge the nutritional gap.

However, it is well recognized that cereal crop residues are of low nutritive value (Sundstol and Owen 1984) because of fibrous in nature, bulky and more of lignin content. But, when these straws/crop residues are suitably processed physically and incorporated into complete diet or total mixed rations either in mash or pellet form, they can be successfully used for optimum growth and milk production from ruminant animals (Reddy *et al*. 2003). The level of incorporation of crop residues in the complete diet is influenced by the nutrient quality of crop residue (Anandan *et al.,* 2010).

1.1 Objectives

To determine the nutritional quality of major cereal crop residues (CR) of maize, rice and sorghum to dairy ruminants

To contribute to the development and transfer of technology that is truly appropriate to mixed crop/livestock production systems in northern Uganda.

2. Materials and methods

2.1. Sample collection for chemical analysis

Sorghum, maize, rice CRs were collected from 3 districts (Lira, Kole and Otuke) in northern Uganda in randomly selected sub counties. Five samples of each CR were obtained from 20 farmers' fields in a 'W' pattern immediately after harvesting of each crop. The CR samples were taken and chopped into short lengths (2-5cm) and dried under sunshine for 12 hours. CR samples were dried at 60^0C for 48 hours and ground using a laboratory mill (Wiley mill) to pass through 1mm sieve screens for laboratory analysis

2.2. Chemical analysis and energy values

Samples of dried CRs were oven dried at 105 ^{0}C to constant weight, milled and stored in air tight, sealed polythene bags prior to chemical analysis. The dried milled CRs sample were analyzed for DM, Crude protein (CP), ether extracts (EE), Calcium Ca and phosphorous and total ash according to the procedure of AOAC (1990). The ash component was determined by igniting 2gm of CRs sample in a muffle furnace at 600^oC for 4 hours the residue after burning in the furnace was the ash. Nitrogen content was determined by the micro-kjeldahl technique using the Markham's distillation apparatus and CP calculated as (6.25×N). NDF was determined by the Van Soest and McQueen (1973) methods as the residue after the reflux with 0.5m H_2SO_4 (TetraoxosulphateVI acid) and acety/trimethy/ammonium bromide. ADF was determined by the Van Soest (1963) method as the residue after extraction with boiling neutral solutions of sodium lauryl sulphate and EDTA. Digestible energy (MJ/kg DM) was estimated as; DE =2.4237xdigestible crude protein (kg/kg DM) + 34.116 x digestible crude fat (kg/kg DM) + 17.300 x digestible carbohydrates (kg/kg DM) – 0.766 x sugar (kg/kg DM).

2.3. Statistical Analysis

Data were subjected to ANOVA in a CRD using the SAS program General Linear Model (GLM) procedure (SAS 9.1, 2005). Treatment means were compared by Duncan test of the software. Treatment means were separated using LSD. Mean differences were considered significant at (P<0.05).

3. Results

Table 1. Nutrient composition of the crop residue

CR	% CP	% EE	GE (MJ/kg DM)
RS	4.2^c	1.40^a	16.2^b
MSF	7.5^a	1.03^{ab}	18.23^a
SS	4.0^c	1.00^b	17.93^a
MSD	4.3^c	1.00^b	18.83^a
MC	5.1^b	0.97^b	19.06^a

LSD: EE =0.39, CF = 2.64, CP = 0.47, P = 0.18, GE=1.18

Means with the same letter in the column are not significantly different.

Fresh maize stover (MSF) contained the highest CP and lowest in sorghum stover which was not significantly different from dry maize stover (MSD) and rice straw (P<0.0001).

The crude fat (EE) content was highest in rice straw and lowest in maize cobs (MC) (P<0.148) with no significant difference with sorghum stover and dry maize stover.

The gross energy was highest in maize cobs which was not significantly different from that of dry maize and sorghum stovers and slightly lower in rice straws (P<0.0002).

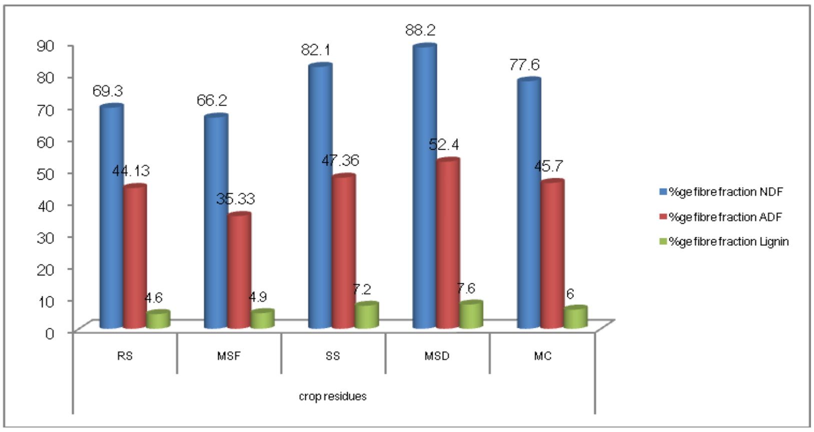

Fig 1.Fiber fractions of the crop residues

Dry maize stover was found to have the highest lignification level, ADF and NDF among the three CRs, while rice straw had the lowest lignification level, ADF and NDF (fig 1).

Table 2. Ca and P composition of the crop residues

CR	Ca	P	Ash
RS	2.73[b]	0.93[b]	17.60[a]
MSF	2.70[b]	1.90[a]	7.20[c]
SS	3.13[a]	0.63[c]	7.80[b]
MSD	2.80[b]	0.77[c]	7.30[c]
MC	1.40[c]	0.70[c]	4.13[d]

LSD: Ca=0.2779, P=0.1819, Ash=0.6088

Means with the same letter in the column are not significantly different.

Sorghum stover had the highest Ca levels and lowest observed in the maize cobs (P<0.0001). Highest phosphorous levels were obtained in fresh maize stover and lowest in sorghum stover with no significant difference from dry maize stover and its cobs (P<0.0001). Total ash was highest in rice straw and lowest in maize cobs (P<0.0001) with no significant deference between fresh maize stover and dry maize stover (table 2).

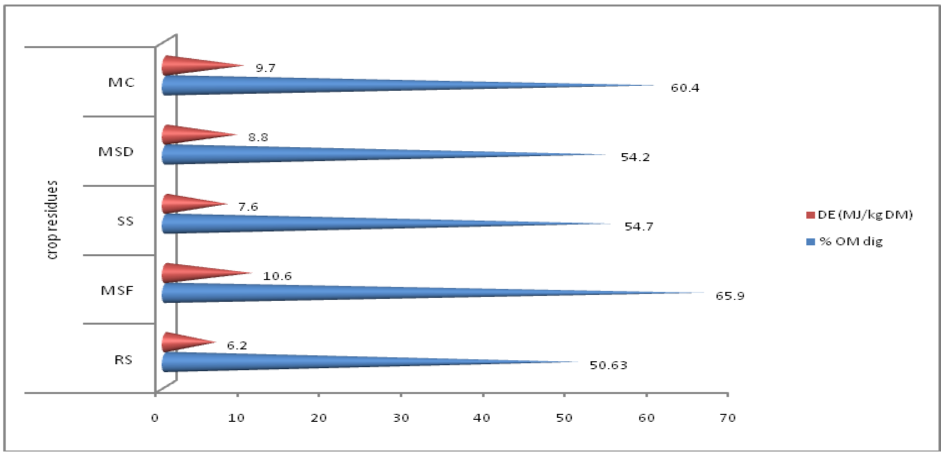

Fig 2. Organic matter and digestible energy of the CRs

Fresh maize stover had the highest organic matter digestibility and digestible energy while the lowest OM digestibility and digestible energy obtained with rice stover (figure 2)

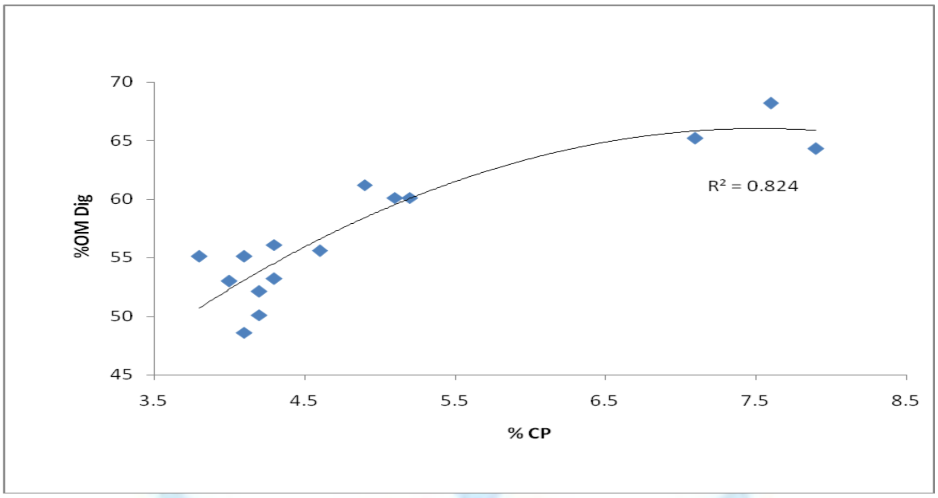

Figure 3 Relationship between CP and OM dig

OM dig increased to a maximum with increase in CP, maximum organic matter digestibility was obtained in fresh maize stovers and minimum value obtained in rice straws (figure 3).

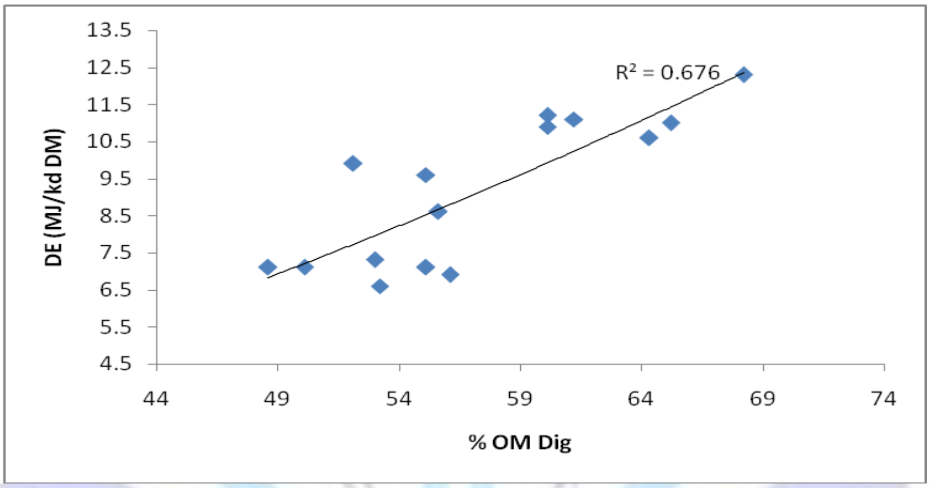

Figure 4 Relationship between OM dig and DE

An exponential relationship was observed between Organic matter digestibilty and DE among the crop residues and their anatomical fractions (figire 4).

4. Discussion

The crop residues have high fibre fractions as the major carbohydrate components some of which are complexed with lignin. In all CRs CP is the first limiting nutreint because it affects the population and activity of the rumen microbes which are the primary drivers of fibre digestion. Improving on the CP of the residue therefore will improve the energy availablity through improving the micro organsms' populations hence organic matter digestibility. The level of liginification negetively affects organic matter digestibilty a conquence of lignin cellulose and cellulose complexing, so alkaline treatment which helps in breaking the glucosidic linkages betwween cellulose and lignin and hemicellulose and lignin can be used to improve on the enegry availabilty of the crop residues.

5. Conclusion and Recommendation

The enormous amount of crop residue left on the farm after harvest which can be used as feed resources ruminant animals are underutilized. These residues which can be used by ruminants if the most limiting nutrients (CP and DE) are improved upon. Threre is also need for blending higher energy ingredients like mollases and high nitrogen ingredients like urea and protein suppliments like soybean to inprove on the crop residue usabilty. This can be achived through haylage formation and urea treatment followed by total mixed ration formulations especially for regions struck by relatively longer dry seasons.

6. Acknowledgements

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Biography

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Education background

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2013-to date	Makerere University	Msc Animal nutrition
2008-2009	Kyambogo University	PGDE Agriculture Education
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1999 - 2000	Kyambogo College School	Uganda Advanced of Education
1995 – 1998	Kyambogo College School	Uganda Certificate of Education
1989 - 1994	Kamuli Primary School	Primary Leaving Examination

Working experience

Period 2003 – 2003

Place of work; Mubende district

Position; Research coordinator on factors affecting Goat production

2005 to 2012

NAADS facilitator (Service provider) on goats and poultry production Muduuma sub county Mpigi District

2012 to Date

Animal production Scientist NgettaZARDI

Leadership

2001 to date Makerere University Farmers Association

2001 to date Makerere University Association of Agriculture Students

2012 to date National Agricultural Research Organization scientists' forum

Languages

English, Luganda, Lusoga, Swahili and Langi

Personal skills

Interpersonal

Enjoy working as a team

Sociable

Competences

- Working under minimum supervision
- Good communication skills
- Computer literate- Ms Word, Excel, Power point, Access, Gens tat, Electronic mailing and internet.
- Feed formulation using modern methods like linear programming and solver
- Qualitative and quantitative research data analysis and synthesis
- Experimental designing budgeting
- Proposal writing