NUTRIENT CONTENT ASSESSMENT OF DIFFERENT VARIETIES OF SOYBEAN FORAGE AS SUPPLEMENTAL ANIMAL FEED IN SEMI-ARID NIGERIA

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ABSTRACT
Forages from seven different varieties of soybean were collected from the research farm of the International Institute of Tropical Agriculture (IITA), Minjibir, Kano Station to study the nutritional content of these forages. The result revealed that the CP, CF, EE, ADF, NDF and ash contents were significantly ($P<0.05$) different in the forages from the different soybean varieties whereas the content of DM was similar among the varieties. Macro (Ca, Mg, K and Na) and micro (Fe) nutrients with the exception of P, analyzed in these forages were significantly ($P<0.05$) lower in all the soybean varieties. It was concluded that adequate mineral supplementation is essential when soybean forages are used as feed resources for livestock and thus, recommended that further research should be carried out to determine minerals that are deficient in other crop residues.
Keywords: Soybean forage, varieties, mineral content, feed resource, assessment

INTRODUCTION
Crop residues are the major feed resources for livestock especially in most of the tropical and sub-tropical countries. They include leaves, stems, roots, chaffs and any other plant part that remain after agricultural crops are grazed or harvested (Adamu *et al*., 2014). Crop residues could also be referred to as harvest residues such as haulms, stovers and straws as well as processed waste such as oil cakes, groundnut shells and rice husks (Balasubrahamanian and Nnadi, 1978). Mineral elements are vital components of animals' metabolic processes (Yusuf *et al.*, 2017) and are essential for production, reproduction, growth and normal physiological functions of the animal's body (Singh *et al*., 1997). They are also important for efficient metabolism of carbohydrates and lipids, building healthy bones and cellular respiration (Yusuf *et al*., 2017). The concentration of macro and micro minerals in crop residues depend on various factors among which are genetic material, species of plant and whether they are leguminous or non-leguminous (Singh *et al*., 1997). Imbalance or deficiencies of minerals in soils or forages result in reproductive problems and low productivity in animals (Yusuf *et al.*, 2017). Mineral deficiencies in livestock are usually manifested by reduced milk yield, reduced water intake, chewing bones, eating soils and increased straying in search of salty plants (Shamat *et al*., 2009). The study was therefore aimed at determining the nutritive contents of forages from different varieties of soybean.

MATERIALS AND METHODS
Description of study site and samples
The study was conducted at the Animal Science Laboratory of Bayero University Kano. Kano state lies on latitude 9^0 30' and 12^0 30' North and longitude 8^0 42' and 9^0 30' East in the semi arid part of Nigeria (Olofin 2007). The mean annual rainfall vary from 600 – 1000mm (KNARDA 2001). All the forages were harvested at 85% pod maturity from the International Institute of Tropical Agriculture (IITA) Research Farm at Minjibir, Kano Station. About 700 g of the harvested samples from each soybean variety were oven dried at 105^0C for 24 h, milled to pass through 1 mm sieve, labelled and stored for proximate and mineral analysis.

Chemical analysis
The samples were analyzed in triplicate for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and ash according to AOAC (2002) procedures. Neutral detergent fibre (NDF) and

acid detergent fibre (ADF) were determined as described in Van Soest *et al*. (1991). The samples were also analyzed for minerals in the laboratory using standard procedures; Sodium, calcium, potassium and magnesium were determined with an automatic atomic absorption spectrophotometer while phosphorus was determined using spectrophotometer after incubation with molybdo-vanadate solution (AOAC, 2004).

Statistical Analysis

Data obtained were subjected to Analysis of Variance (ANOVA) using completely randomized design and means were separated using Duncan Multiple Range Test of SAS (1999).

RESULTS AND DISCUSSION

The result of chemical composition of different varieties of soybean forage is presented in Table 1. All the soybean varieties had similar ($P<0.05$) content of DM. Forages from V_4, V_7 and V_6 had the highest CP amongst the varieties with 18.97, 18.70 and 18.68% which dropped to 10.53% in V_2. The DM value obtained in the present study for the different varieties of soybean forage was higher than DM values reported by Kumar and Garg (1995), Mahakhode (1997) and Mule *et al* (2008), who reported DM value of soybean straw ranging from 88.00 to 93.08%. The value obtained for CP (10.53 – 18.97%) in the present study was higher than CP values reported by Mule *et al.* (2008), Kumar and Garg (1995), and Mahakhode (1997) for soybean straw. Heuze *et al.* (2014) reported that soybean forage has a protein content ranging from 11% to more than 22% DM. The value obtained in this study falls within the range reported by Heuze *et al.* (2014).

Table 1: Chemical composition (%) of different varieties of soybean forage

	Different varieties of soybean forage							
Parameters	V_1	V_2	V_3	V_4	V_5	V_6	V_7	SEM
DM	97.61	97.18	96.80	96.83	97.09	97.49	96.54	0.15
CP	13.20^{c}	10.53^{d}	16.35^{b}	18.97^{a}	16.82^{b}	18.68^{a}	18.70^{a}	0.83
CF	39.85^{b}	42.88^{a}	30.78^{e}	28.43^{f}	37.13^{c}	29.61^{e}	33.51^{d}	1.41
EE	5.10^{a}	3.69^{cd}	3.74^{cd}	5.14^{a}	4.12^{bc}	3.14^{d}	4.56^{ab}	0.20
ADF	51.80^{a}	50.92^{ab}	49.75^{bc}	42.32^{e}	43.30^{de}	49.56^{c}	43.75^{d}	1.04
NDF	69.19^{a}	58.14^{c}	60.39^{b}	52.48^{d}	59.83^{bc}	61.93^{b}	60.99^{b}	1.29
Ash	11.53^{c}	9.09^{de}	11.77^{c}	16.41^{a}	8.11^{e}	9.37^{d}	12.87^{b}	2.73

^{a,b,c,d,e,f}: means in the same row with different superscript are significantly ($P<0.05$) different. V=Variety, V_1=TGx 1448_2E, V_2=TGx 1835_10E, V_3=TGx 1904_6F, V_4=TGx 1951_3F, V_5=TGx 1951_4F, V_6=TGx 1955_4F, V_7=TGx 1987_62F, DM=Dry Matter, CP=Crude Protein, CF=Crude Fibre, EE=Ether Extract, ADF=Acid Detergent Fibre, NDF=Neutral Detergent Fibre, SEM=Standard Error of Mean.

The result of mineral content of the different varieties of soybean forage is presented in Table 2. The results obtained were significantly ($P<0.05$) different. Forages from V_2 and V_7 had the highest calcium with 900.00mg/kg and 866.70mg/kg. V_2 had the highest value of magnesium (500.00mg/kg) while potassium content was similar in all the varieties of soybean forage except V_7 (313.70mg/kg) and V_1 (147.10mg/kg). Sodium level was highest (118.10mg/kg) in V_6 and lowest (64.50mg/kg) in V_3, V_4 and V_7. V_3 has the highest (246.40mg/kg) phosphorus level while Iron content of the different varieties of soybean forage was also generally low with significantly ($P<0.05$) higher values in V_1 (12.83mg/kg) and V_7 (12.83mg/kg). Animals' performance can be grossly affected especially when there is mineral deficiency, excesses or an imbalance of one or more minerals (Ukanwoko and Nwachukwu, 2017). Results obtained for Ca, Mg, K and Na were lower than values obtained by Njidda *et al* (2013). Ca requirement of 1.2 – 2.6g/kg was recommended by Khan *et al* (2006) with higher requirements for lactating cattle and sheep. 2.0g/kg DM of Mg was suggested by Minson (1990) whereas exceptionally low Mg concentration was reported by Jumba *et al* (1996) in Kenya. Khan *et al* (2005) recommended K level of 10g/kg for ruminants under stress. The phosphorus content of the different varieties of soybean forage reported in this study was in agreement with the range (0.0171-0.305mg/kg) reported by Adamu *et al* (2014) whereas Fe content was lower than 50mg/kg DM reported by Khan *et al* (2009). The exceptionally low contents of minerals observed in the present study is not unusual as Alhassan (1989) stated that crop residues are inherently low in crude protein, readily fermentable energy and essential minerals and vitamins.

Table 2: Mineral content (mg/kg) of different varieties of soybean forage

	Mineral content (mg/kg)					
Parameters	Ca	Mg	K	Na	P	Fe
V_1	150.00^{c}	400.00^{ab}	147.10^{c}	96.80^{b}	214.30^{ab}	12.83^{a}
V_2	900.00^{a}	500.00^{a}	598.00^{a}	96.80^{b}	185.70^{ab}	4.20^{b}
V_3	783.30^{ab}	200.00^{b}	500.00^{a}	64.50^{c}	246.40^{a}	4.20^{b}
V_4	650.00^{b}	400.00^{ab}	617.70^{a}	64.50^{c}	205.40^{ab}	4.20^{b}
V_5	600.00^{b}	300.00^{ab}	578.40^{a}	96.80^{b}	153.60^{b}	8.33^{b}
V_6	616.70^{b}	400.00^{ab}	490.20^{a}	118.10^{a}	150.00^{b}	4.17^{b}
V_7	866.70^{a}	300.00^{ab}	313.70^{b}	64.50^{c}	175.00^{ab}	12.83^{a}
SEM	55.84	32.97	38.43	14.31	10.24	1.82

^{a,b,c}: means in the same column with different superscripts are significantly (P<0.05) different, V=Variety, V_1=TGx 1448_2E, V_2=TGx 1835_10E, V_3=TGx 1904_6F, V_4=TGx 1951_3F, V_5=TGx 1951_4F, V_6=TGx 1955_4F, V_7=TGx 1987_62F, SEM=Standard Error of Mean.

CONCLUSION AND RECOMMENDATION

From the results, it is apparent that only phosphorus content was adequate in the forages from the different varieties of soybean whereas Ca, Mg, Na, K and Fe were deficient. This suggests that adequate mineral supplementation is essential when soybean forages are used as feed resources for livestock. Further research should be carried out to determine minerals that are deficient in other crop residues as minerals are vital components of an animal's metabolic process.

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