Assessing the nutritional status of Bunaji bulls fattened on varying inclusions of groundnut haulms and maize offal using some blood metabolites

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Abstract

An experiment was conducted to evaluate the effect of inclusion levels of groundnut haulms (GH) and maize offal (MO) on some blood metabolites from twenty Bunaji bulls. The bulls were divided into four groups in a completely randomized design. They were fed signal grass (Brachiaria decumbens) hay ad libitum and concentrate diets containing groundnut haulms (GH) and maize offal (MO): 80:20% GH: MO, 60:40% GH: MO, 40:60% GH: MO and 20:80% GH: MO, respectively. The animals were fed the diets over a period of 90 days and their nutritional status ascertained from the serum metabolic profile.

Keywords: Groundnut haulms, maize offal, packed cell volume, blood metabolites, bunaji bulls

Introduction

Hammond (1992) stated that monitoring of blood urea nitrogen or milk urea nitrogen is a technique that can be use for measuring protein and energy status in cattle from biological samples obtained at strategic times relative to production cycles, feeding changes, and seasonal availability of forage. This can be used together with procedures such as body weight measurement and body condition scoring to more accurately assess the nutritional status of cattle. Serum concentrations of metabolites such as glucose, cholesterol, Non-esterified fatty acids, blood urea nitrogen, creatinine, total proteins albumin, globulin and minerals are commonly used to assess the nutritional status of cattle (Ndlovu *et al.,* 2007). They give an immediate indication of an animal's nutritional status at that point in time (Pambu-Gollah *et al.,* 2000). The use of blood metabolites in assessing the nutritional status of cattle is widespread in the dairy industry (Doornenbal *et al.,* 2005). The fact that feed constitutes about 70-80% of the variable cost of fattening cattle (Deaville *et al.,* 1994, Okoruwa, *et al.,* 2005) and the high competition between man and livestock for conventional feedstuff, farmers in West Africa are reported to feed their cattle mostly on stovers of maize, sorghum, millet and rice straw as basal diet, while cowpea and groundnut haulms are fed as protein supplement (Adegoke and Abioye, 2016). Other agricultural by-products such as brans of cereals grains, oil seed cakes which are by-products of agro-processing are also fed to livestock as energy, protein and

mineral supplement (de Leeuw, 1997). It is imperative to assess the nutritional status of our indigenous cattle which are fed on these items to ascertain their nutritional status. Information on the use of blood metabolites to assess the nutritional status of our indigenous cattle in Nigeria is reported to be scarce (Madziga *et al.,* 2013). The objective of this study was to determine blood metabolites concentrations for Bunaji bulls fattened on crop residue (groundnut haulms) and agro-by- product (maize offal) so as to develop a feeding strategy to optimize their use and maximize economic returns to the farmer.

Materials and methods

Study site

The study took place at the National Animal Production Research Institute (NAPRI) Ahmadu Bello University, Shika-Zaria, Nigeria between April-July 2012. Shika is located within the Northern Guinea Savanna ecological zone of Nigeria between Latitudes 11 and 12^0N and Longitudes 7 and 33^0E at an altitude of 640m above sea level. The zone has one wet season from June to October. Mean annual rainfall is about 1041mm. The physical properties of the soil in the zone is a well-drained sandy loam soil with a clay fraction consisting mainly of kaolinite and small quantities of illite, deficient in nitrogen and phosphorus (Kowal,1968).

Animals management and treatments

Twenty Bunaji bulls with average live weights of 196±0.5 kg and aged between 24 to 36 months were used for the trial. The bulls were divided into four groups of five animals and the groups balanced by weight. Each animal served as a replicate in a completely randomized design. The groups were allocated to the four dietary treatments in the trial. The bulls were de-wormed with Albendazole 2500mg (Eagle Chemical Co. Ltd chungchongnamdo, Korea) and dipped in acaricides Amitix (Amitraz 12.5% by Alfasan) to control endo- and ecto-parasites a week to commencement of the trial. Bulls were individually penned and fed ration made up of groundnut haulms (GH) and maize offal (MO): 80:20% GH: MO, 60:40% GH: MO, 40:60% GH: MO and 20:80% GH: MO respectively. Urea was added to the various treatments at 0.94, 1.09, 1.20 and 1.30% respectively to correct the wide variation of crude protein content of the supplements (Table1). The bulls were adjusted to the feed and pens for 14 days and subsequently fed for 90 days period. The body condition score of the bulls were taken by three independent scorers at the beginning and the end of the study using the scale of 1 to 9 procedure described by Nicholson and Butterworth (1986) and the average of the three scorers recorded.

Blood sampling

About 10mL of blood was collected at the beginning and end of the trial via jugular vein puncture from all the bulls. Half of each sample collected (5mL) was emptied in to vacutainer tubes containing the anti coagulant ethylene diaminetetracetic acid and was used to measure the packed cell volume using heamatocrit and total protein were determined using refractometer as described in the routine laboratory procedures (Coles, 1979) The remaining half was spun in a centrifuge for 10-15 minutes at 1000-2000 ($\leq$ 1300) relative centrifugal force and the plasma harvested and used for the analysis of blood metabolites(urea nitrogen, glucose, create nine, albumin, cholesterol and minerals).

Biochemical analysis

Blood sample was analyzed at the chemical pathology laboratory, Ahmadu Bello University Teaching Hospital for urea nitrogen level using the procedure of

Archer and Robb (1925).

Statistical analysis

All data generated from study were subjected to analysis of variance using the general linear model procedure of SAS (2002) to study the response of the animals to measured parameters. Significant levels of difference among treatment means was separated using least significant difference at 5 and 1%.The model used for the analysis was:

$$Y_{ij} = \mu + T_i + eij$$

Where μ = Overall means

Ti = effect of i^{th} treatment (i=1, 2, 3, 4)

eij= random error (The random effect assumed to be normally distributed with mean zero and equal variance ^{2} i.e $\Sigma \sim N(0, {}^2_I)$

Results and discussion

The chemical composition of the individual feed ingredients is presented in Table 1. The crude protein (CP) content of the individual feed ingredients ranged from 4.44% for *Braciaria hay* to 14.19% for groundnut haulms. The CP content of *Brachiaria* used for this study agrees with the report by Sampaio *et al.*(2010) and was below the 7-8% required for maintenance of body weight of cattle and therefore, can be regarded as a low quality feed (Leng, 1990).

Table 1: Chemical composition (%) of individual feed ingredient (% DM Bases)

	Experimental diets		
	Signal grass Hay	GH	MO
Dry matter	96.13	95.14	95.65
Crude protein	4.44	14.19	12.56
Crude fibre	37.86	28.64	13.13
Ether extract	2.28	8.59	11.64
Organic matter	89.33	88.96	90.91
Neutral detergent fibre	71.10	44.95	26.71
Acid detergent fibre	55.04	34.95	9.54
Ash	5.81	6.18	4.74
ME(MJ/kg DM)	11.38	10.78	11.74

GH =Groundnut haulms MO = Maize offal ME= Metabolisable energy

ME values of feed ingredients and experimental diets were calculated as per Alderman and Cottrill (1985) as follows:

ME (MJ/kg DM)=11.78 + 0.00654CP + (0.000665EE)2 - CF(0.00414EE) – 0.0118A where DM=Dry Matter, C= Crude Protein, EE= Ether Extract, CF= Crude Fibre, A= Ash

The CP content of GH was within the range reported by Adegbola (2002) and Addass *et al. (2011*), but higher than the value of (11.22) reported by Lakpini and Adu (1987). The CP content of maize offal (MO) (12.65%) was in agreement with the report by Vantsawa *et al.* (2007). The chemical composition of concentrate supplements is presented in Table 2. The dry matter content of supplemental diets ranged from 94.29 to 95.71%.and the CP content ranged from 16.25-16.43%. The values were higher than 13-15% CP requirement of beef cattle (Rutheglen, 1995, Aduku, 2005). Metabolizable energy (MJ/Kg DM) values of the treatment diets which ranged from 10.89 to 11.19 MJ/Kg met the minimum ME requirement of 10.3MJ/Kg DM for beef cattle (Rutheglen, 1995).

Packed cell volume (PCV) and blood metabolites

Mean values of packed cell volume and blood metabolites are presented in Table 3. Packed cell volume (%) differed ($p<0.05$)

Table 2: Ingredients and chemical composition of the concentrates with inclusion levels of groundnut haulms and maize offal (%)

	Inclusion levels of GH and MO (%)			
Nutrients	80: 20	60: 40	40: 60	20: 80
Groundnut haulms	80.00	60.00	40.00	20.00
Maize offal	19.06	38.91	58.80	78.70
Urea	0.94	1.09	1.20	1.30
Total	100.00	100.00	100.00	100.00
Chemical composition				
Dry matter	95.71	95.20	94.46	94.29
Crude protein	16.38	16.41	16.43	16.25
Crude fibre	24.94	21.17	17.01	13.53
Ether extract	8.17	10.71	11.15	12.15
Organic matter	88.16	94.78	94.99	95.81
Neutral detergent fibre	40.04	36.46	31.08	32.21
Acid detergent fibre	30.30	22.21	19.75	15.91
Ash	11.84	5.22	5.01	4.19
ME (MJ/Kg DM)	10.98	10.89	11.04	11.16

GH =Groundnut haulms, MO = Maize offal, ME = Metabolisable energy (MJ/Kg DM)
ME values of feed ingredients and experimental diets were calculated as per Alderman and Cottrill (1985) as follows:
ME (MJ/kg DM)=11.78 + 0.00654CP + (0.000665EE)2 - CF(0.00414EE) – 0.0118A where DM=Dry Matter, C= Crude Protein, EE= Ether extract, CF= Crude Fibre, A= Ash

Table 3: Packed cell volume (PCV) and blood metabolites of Bunaji bulls fattened on diets containing groundnut haulms and maize offal

	Inclusion levels of GH and MO (%)				
Parameters	80 : 20	60 : 40	40 : 60	20 : 80	SEM
Initial PCV	23.05^{b}	26.80^{a}	25.40^{ab}	28.20^{a}	1.46^{*}
Final PCV	25.86^{b}	32.40^{a}	30.60^{a}	31.80^{a}	1.54^{*}
Total protein(g/dl)	67.20^{ab}	70.80^{a}	67.80^{a}	66.40^{b}	0.71^{*}
Albumin (g/L)	39.00^{b}	42.80^{a}	38.80^{b}	36.20^{b}	0.66^{*}
Cholesterol (mmol/L)	3.12^{b}	3.14^{b}	3.44^{a}	3.16^{b}	0.10^{*}
Urea (g/100ml)	3.96^{a}	3.84^{a}	3.72^{b}	3.04^{c}	0.09^{*}
Glucose (mmol/L)	4.94^{b}	5.12^{ab}	5.34^{a}	5.30^{a}	0.17^{*}
Calcium (mmol/L)	2.34^{b}	2.36^{b}	2.36^{b}	2.41^{a}	0.02^{*}
Phosphorus (g/L)	0.99^{a}	0.92^{b}	0.89^{b}	1.00^{a}	0.02^{*}
Creatinine (mmol/L)	69.80	69.60	71.40	71.40	1.57^{ns}
Triglycerides (mmol/L)	0.96	0.90	0.90	0.86	0.06^{ns}

^{ab} Means with different superscripts along the row differ significantly (P< 0.05)
ns = not significant; *=P <0.05; SEM= standard error of means; PCV = Packed cell volume
GH= groundnut haulms, MO= maize offal

between treatment at the beginning of the trial and increased with increase inclusion of MO at the end of the trial. Packed cell volume values observed in this study ranged from 23.05 to 32.40% (Table 3). They were within normal values reported for cattle (Etim, *et al.,* 2013, Merck Veterinary Manual, 2012) and in agreement with values reported for finishing steers fed mixed diets (Cummins *et al.,* 2009). The normal PCV values observed signified that CP intake was adequate for all treatment groups. This was in agreement with report by Coppock *et al.* (1985) and Oyedipe *et al.*

(1984) that showed that reduction in CP intake resulted in depressed PCV in zebu cattle.

The total protein (TP) values reported in this study rose with increase in maize offal inclusion at 60: 40% and 40: 60% but declined at 20: 80% inclusion level.

The values were consistent with the range of 6.4- 8.38/100mL and 67.54g/L reported for cattle (Kapale *et al.,* 2008, Alberqhina and Piccion, 2011). Blood urea nitrogen ranged from 3.04 to 3.96g/100ml and was significantly ($P<0.05$) higher for the bulls on 80: 20, 60: 40 and 40: 60% GH: MO inclusion than those on 20: 80%. Blood urea nitrogen (3.04-3.96 g/100mL) values in this study were lower than 8.50-15.83mg/100ml reported by Lamidi *et al.,* (2007) for Bunaji bulls fattened on diets containing sundried broiler litter as replacement for cottonseed and 6.3-25.0mg/100mL by Orskov *et al.* (1988) for animals on diet containing adequate protein. The values reported in this study suggest efficient use of protein by bulls. Blood glucose is said to be of moderate diagnostic value in the assessment of nutritional status of cattle owing to its moderate variability in the blood (Ndlovu *et al.,* 2007). Blood glucose values in this study increased with increase maize offal inclusion and were slightly higher than values reported by Mapiye *et al.* (2010) for Nguni and local crossbred cattle. Blood glucose, α-hydroxy butyrate, non-esterified fatty acids and cholesterol are indicators of energy status (Nishimwe *et al.,* 2014). Calcium values reported in this study also were within values reported by Mapiye *et al.* (2010)

Conclusion

From the result of this study, it showed that crude protein content of groundnut haulms and maize offal was 14.19 and 12.56% respectively, while the concentrate mixtures supplied 16.25-16.43% CP and 10.89-11.16 ME (MJ/Kg DM). However, packed cell and total protein values increased with inclusion level of maize offal in the diets. The study also showed that increase in maize offal in the diets encouraged microbial utilization of available nutrients that was translated to higher weight gain and meat yield.

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