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Studies on Nutrients and Anti-Nutrients of Rumen Digesta from Three Most Domesticated Ruminants in Nigeria

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Abstract: A comparative study was conducted on phytochemical and nutrients assay of three ruminants' rumen digesta between July and September, 2011. Samples of rumen digesta (DRD) were collected at the abattoir from cattle, goat and sheep, coded as DRDC, DRDG and DRDS respectively. These samples were sundried for 5 days prior to laboratory analyses. Result showed that DRDC contained highest values of 19.87 and 34.90% for crude protein and crude fiber (P>0.05) respectively but ash content was 11.12% (P<0.05) while DRDG and DRDS were higher in phytate, phytin phosphorus and oxalate compared to DRDC (P<0.05). There were no significant differences (P>0.05) in the concentration of Alkaloids and Saponins in all the treatments. This experiment has shown that, there is little or no variation in the nutrients composition of these abattoir wastes (DRD). However, their crude protein 18.5 ± 1.0% is comparable with some recognized feedstuffs such as spent grain and wheat offal hence may be of great potential in monogastric diets as source of xanthophylls and dietary fiber.

Key words: Comparative, Rumen-Digesta, evaluation, nutrients, phytochemicals

INTRODUCTION

Nutritive values of browse plants, grasses and forbs as cheapest sources of feed for ruminants have been widely studied. The diversity and distribution of these leafmeals/browse plants in Nigeria have gained attentions of Nutritionist in the North (Saleem *et al*., 1979), Southwest (Carew *et al*., 1980) Middle belt (Ibeawuchi *et al*., 2002) and Southeast (Okoli *et al*., 2003; Ahamefule *et al*., 2006).

However, recent development with monogastric animals studies on the use of leaves from fodder shrubs, legumes and trees are helping farmers in tropical Africa (Ofojekwu *et al*., 1994; Fasakin *et al*., 2001; Esonu *et al*., 2002; Adeniji and Balogun, 2002; Ojobe, 2003). Nevertheless, utilization of undigested forage in rumen of ruminants (rumen digesta) is now gaining attention in poultry (Odunsi, 2003; Esonu *et al*., 2006), rabbits (Dairo *et al*., 2005) and fishes (Abdel-Hakim *et al*., 2008; Agbabiaka *et al*., 2011a, 2011b).

Some of the above works merely mentioned the use of Dried Rumen Digesta (DRD) as a feedstuff without emphasizing the specific ruminant as the source of the DRD. Hence, there have been conflicting results on the nutrients/proximate composition of this slaughter/ abattoir waste turned potential feedstuff for simple stomach livestock and fishes. This study is therefore designed to compare the chemical compositions of three most domesticated ruminants in Nigeria namely, cattle, sheep and goats as a baseline information for animal nutritionists.

MATERIALS AND METHODS

Study environment: This research was conducted at central laboratory, Federal Polytechnic Nekede Owerri, Nigeria on latitude 5° 3[1] and 6° 10[1] North, longitude 6° 40[1] and 7° 41[1] East and altitude of 90 m above the sea level. The annual rainfall is between 192-194 cm while the temperature is between 26-32°C.

Sample collection: Samples of the rumen digesta from goat and cattle were collected from abattoir at Obinze while rumen digesta from sheep was collected from "Ama Hausa" abattoir both at Owerri province between July and August, 2011. They were sundried for 5 days prior to laboratory analyses.

Analytical procedure

Proximate analyses: The proximate composition were analyzed as described by AOAC (2000). All reagents used were of analytical grade and supplied by sigma Co. (St Louis, USA). Each analysis was carried out in triplicate. Crude protein was determined according to micro Kjeldahl method by multiplying Nitrogen content by a factor of 6.25. Crude fat was determined by Soxhlet extraction method while soluble carbohydrate (NFE) was determined by difference (NFE = 100 - [%Ash + %crude fiber + %crude fat + %crude protein]).

Mineral determination: Potassium and Sodium were determined by flame photometric method (FP 640, Jeumeay) while Phosphorus was determined by

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Spectrophotometer (UV - Visible) i.e. Vonado Molybdate yellow method. However, Calcium, Magnesium, Iron, Copper and Manganese were determined using Atomic Absorption Spectrometer (Buck 210, AAS).

Determination of phytochemicals in DRD: Tannic acid concentration (polyphenols) was determined according to Markkar and Goodchild (1996). Phytin and Phytin-phosphate were determined by Young and Greaves (1940) method. Phytin-phosphorus was determined and Phytin content calculated by multiplying the value of Phytin-Phosphorus by 3.55, hence, each milligram of iron is equivalent to 1.19 mg of Phytin-phosphorus. Oxalate was determined according to Day and Underwood (1986). Nevertheless, Alkaloids and Saponins were analyzed by Harbone (1973) and Obadoni and Ochuko (2001) methods respectively.

RESULTS

Result of chemical analyses of the rumen digesta from goat, sheep and cattle are presented on Table 1 and 2 while the result on the anti-nutrients (phytochemicals) is shown in Table 3. The crude protein values were 17.54, 18.25 and 19.56% for goat, sheep and cattle respectively. These values were similar to reports of Esonu *et al.* (2006); Agbabiaka *et al.* (2011a,b). The highest value was recorded from sample taken from cattle while the least was from goat ($p>0.05$). The crude fiber followed same trend with highest value of 34.91% in cattle followed by sheep and goat with values of 31.48 and 30.84% respectively. Ash contents ranged from 7.55% in goat to 11.11% in cattle (Table 1). There was a significant difference between the ash content of cattle ($p<0.05$) but no significant difference was observed between values of DRDG and DRDS ($p>0.05$).

The phytochemical analyses on DRDC, DRDG and DRDS revealed that the phytate, phytin phosphorus and oxalate values were higher in sheep and goat than cattle (Table 3). Nevertheless, DRDC was found to contain highest concentration of phenol than DRDG and DRDS with values of 1.60, 1.12 and 1.52% respectively.

Table 1: Proximate analysis of rumen digesta from cattle, sheep and goat

	Species of animals		
Nutrients	DRDC	DRDS	DRDG
Moisture (%)	17.48	14.32	14.47
Crude protein (%)	19.56^{a}	18.25^{a}	17.54^{a}
Crude fiber (%)	34.91^{a}	31.48^{b}	30.84^{b}
Crude fat (%)	1.69^{a}	3.57^{b}	1.79^{a}
Soluble carbohydrate (NFE) %	32.27^{a}	38.13^{ab}	42.28^{b}
Ash (%)	11.11^{a}	8.57^{b}	7.55^{b}

^{ab}Means within rows with different superscripts are significantly different ($p<0.05$)

Table 2: Mineral composition of Rumen digesta from cattle, goat and sheep

	Nutrients									
SOA	Na	K	Mg	Zn	Mn	Ca	Fe	Cu	Pb	P
DRDC	0.12	2.0	3.2	6.5	2.4	7.0	7.8	3.5	ND	8.7
DRDG	0.14	2.0	3.3	7.2	2.5	9.2	7.4	6.9	ND	9.5
DRDS	0.21	2.3	4.1	7.3	2.2	8.2	6.8	5.3	ND	7.6

SOA = Species of animals

Table 3: Phytochemical analyses of rumen digesta from cattle, goat and sheep

	Species of animals		
Anti-nutrients	DRDC	DRDG	DRDS
Tannic acid (%)	1.60^{a}	1.12^{b}	1.52^{a}
Phytate (mg/g)	4.53^{a}	6.18^{b}	6.39^{b}
Phytin Phosphorus (mg/g)	1.28^{a}	1.74^{b}	1.80^{b}
Oxalate (mg/g)	0.41^{a}	0.61^{a}	0.77^{a}
Saponnin (%)	0.22^{a}	0.21^{a}	0.19^{a}
Alkaloid (%)	0.11^{a}	0.14^{a}	0.13^{a}

^{ab}Means within rows with different superscripts are significantly different ($p<0.05$).
DRDC = Dried rumen digesta from cattle
DRDG = " " " " goat
DRDS = " " " " sheep

DISCUSSION

The relative variation in crude protein content of DRDC and others ($p>0.05$) may be due to the effect of age, season and diversity of vegetation. The amount of lignin and cell wall thickness in plants determine to some extent the nutritional value (Van Soest, 1996). This also explains the distinct variation in crude fiber which is attributed to the morphology and chemistry of plants. Grasses are high in lignin and cell wall than browses (Demment and Van Soest, 1985). However, grasses have high silica content that can increase tooth wear which reduce ability to digest fiber by herbivores hence, the relatively high fiber and ash content found in DRDC (Robbins, 1993).

The high carbohydrate values recorded for DRDS and DRDG (browsers and mix-feeder) above the grazer (DRDC) is in agreement with reports (Bodmer, 1990; Gordon and Illius, 1994; Owen-Smith, 1997) that forbs and leaves have thinner cell wall with more digestible and rapidly fermentable compound such as sugar, protein and lipids. This also explain why browsing species of ruminants do not have same apparent digestibility coefficient as grazers, hence, browsers have shorter Mean Retention Time (MRT) than grazers which require high fiber diets to promote their longer MRT to enhance greater nutrient extraction via microbial fermentation (Clauss and Lechner-Doll, 2001). Body mass of ruminants also affect the feeding pattern therefore, small size ruminants are suited to obtain energy from browses unlike large herbivores such as cattle, rhinoceros which are better suited to extract energy from high fiber grasses (Demment and Van Soest, 1985). Furthermore, browses are reported to have more toxins such as phenolics, terpenes and alkaloids (Robbins, 1993; Robbins *et al.*, 1995).

REFERENCES

Abdel-Hakim, N.F., M.E. Lashin, A.A. Al-Azab and H.M. Nazim, 2008. Effect of replacing soybean meal with other plant protein sources on protein and energy utilization and carcass composition of Nile Tilapia (*Oreochromis niloticus*). 8th International symposium on Tilapia in Aquaculture.

Adeniji, A.A. and O.O. Balogun, 2002. Utilization of flavor treated blood-rumen content mixture in the diets of laying hens. Nig. J. Anim. Prod., 29: 34-39.

Agbabiaka, L.A., S.A. Amadi, G.O.M. Oyinioye, I.I. Adedokun and C.A. Ekeocha, 2011a. growth Response of African Catfish (*Clarias gariepinus*, Burchell 1822) to Dried Rumen as a Dietary Supplement. Pak. J. Nutr., 10: 564-567.

Agbabiaka, L.A., K.U. Anukam and U.N. Nwachukwu, 2011b. Nutritive value of dried rumen digesta as replacement for soybean in diets of Nile Tilapia (*Oreochromis niloticus*) fingerlings. Pak. J. Nutr., 10: 568-571.

AOAC, 2000. Official Methods of Analysis of AOAC International, 17th Edn., AOAC International, Gaitherburg, MD, USA, Official Methods 920.124, 926.08, 955.30, 2001.14.

Ahamefule, F.O., J.A. Ibeawuchi and C.I. Agu, 2006. Comparative evaluation of some forages offered to goats in Umudike, Southeastern Nigeria. J. Sustain. Agric. Res. (In press).

Bodmer, R.E., 1990. Ungulate frugivores and the browser-grazer continuum. Oikos, 57: 319-325.

Carew, B.A.R., A.K. Mosi, A.U. Mba and G.N. Egbunike, 1980. The potential of browse plants in the nutrition of small ruminants in the humid forest and derived savanna zones of Nigeria. In: Le Houerou, H.N. (Ed). Browse in Africa; the current state of knowledge. International Livestock Centre for Africa, Addis Ababa, pp: 307-311.

Clauss and Lechner-Doll, 2001. Oecologia, 129: 321-327.

Dairo, F.A.S., O.O. Aina and A.R. Asafa, 2005. Performance evaluation of growing rabbits fed varying levels of rumen content and blood rumen content mixture. Nig. J. Anim. Prod., 32: 67-72.

Day, R. and A.L. Underwood, 1986. Qualitative analysis. 5th Edn., Prentice-Hall publication, pp: 701.

Demment, M.W. and P.J. Van Soest, 1985. A nutritional explanation for body-size patterns of ruminant and non ruminant herbivores. Am. Nat., 125: 641-672.

Esonu, B.O., F.C. Iheukwumere, O.O. Emelanom, M.C. Uchegbu and E.B. Etuk, 2002. Performance, nutrient utilization and organ characteristics of finisher broiler fed *Microdesmis puberula* leaf meal. Livestock Res. Rural Dev., 14: 15. http.www.cipar.org.co/lrrd14/6/eson.146.htm.

Esonu, B.O., U.D. Ogbonna, G.A. Anyanwu, O.O. Emelanom, M.C. Uchegbu, E.B. Etuk and A.B.I. Udedibe, 2006. Evaluation of performance, organ characteristics and economic analysis of broiler finisher fed dried rumen digesta. Int. J. Poult. Sci., 5: 1116-1118.

Fasakin, E.A., A.M. Balogun and O.A. Fagbenro, 2001. Evaluation of sundried water-fern, *Azolla Africana* and Duckweed, *Spirodela polyrrhiza* in practical diets for Nile Tilapia (*Oreochromis niloticus*) fingerlings. J. Appl. Aquac., 11: 83-92.

Gordon, I.J. and A.W. Illius, 1994. The functional significance of the browser-grazer dichotomy in African ruminants. Oecologia, 98: 167-175.

Harbone, J.B., 1973. Phyto chemical methods. Chapman and Hall Ltd., pp: 49-188.

Ibeawuchi, J.A., F.O. Ahamefule and J.E. Oche, 2002. An assessment of the value of the browsed plants in Markudi, Nigeria. Nig. Agric. J.,33: 128-135.

Markkar, A.O.S. and A.V. Goodchild, 1996. Quantification of Tannins. A laboratory manual. International Centre for Agric. Research in Dry Areas (ICARDA). Aleppo, Syria. IV: pp: 25.

Obadoni, B.O. and P.O. Ochuko, 2001. Phytochemical studies and comparative efficacy of the crude extracts of some homostatic plants in Edo and Delta States of Nigeria. Global J. Pure Appl. Sci., 8b: 203-208.

Odunsi, A.A., 2003. Blend of bovine blood and rumen digesta as a replacement for fishmeal and groundnut cake in layer diets. Int. J. Poult. Sci., 2: 58-61.

Ofojekwu, P.C., I.R. Keke, G.N. Asala and J.C. Anosike, 1994. Evaluation of water Hyacinth (*Eichhoma crassipes)* and groundnut cake as dietary components in feeds for *Oreochromis niloticus* (L). Acta Hydrobiologia, 36: 227-233.

Ojobe, T.O., 2003. Studies on the effects of indigenous plants materials as feed in fish Production. Ph.D. Thesis. Department of Zoology. Univ. of Jos.

Okoli, I.C., C.S. Ebere, M.C. Uchegbu, C.A. Udah and I.I. Ibeawuchi, 2003. A survey of the diversity of plants utilized for small ruminant feeding in South eastern Nigeria. Agric., Ecosyst. Environ., 96: 147-154.

Owen-Smith, N., 1997. Distinctive features of the nutritional ecology of browsing versus grazing ruminants. In: Proc. of the 1st International Symposium on Physiology and Etiology of Wild and Zoo Animals. Berlin, Germany, pp: 176-191.

Robbins, C.T., 1993. Wildlife Feeding and Nutrition. Academic Press, Inc. San Diego, Cal.

Robbins, C.T., D.E. Spalinger and W. Van Hoven, 1995. Adaptation of ruminants to browse and grass diets: Are anatomical-based browser-grazer interpretations valid? Oecologia, 103: 208-213.

Saleem, M.A., O.M. Oyatogun and H.R. Chheca, 1979. Nutritive value of browse plants in the Sudan Savanna of North West Nigeria. Nig. J. Anim. Prod., 6: 3-7.

Van Soest, P.J., 1996. Allometry and ecology of feeding behavior and digestive capacity in herbivores: A review. Zoo Biol., 15: 455-479.

Young, S.M. and J.S. Greaves, 1940. Influence of variety and treatment on phytic acids content of wheat. Food Resour., 5: 103-105.