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

Agbabiaka, L.A., F N. Madubuike and S.A. Amadi
1Department of Animal Science and Fisheries, Imo State University, Owerri, Nigeria
2Department of Fisheries Technology, Federal Polytechnic, Nekede, Owerri, Nigeria

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 leafy/forbs/browses 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; Ahamfeule et al., 2008).

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; Adeniyi and Balogun, 2002; Ojobe, 2003). Nevertheless, utilization of undigested forage in rumen of ruminants (rumen digesta) is now gaining attention in poultry (Odusni, 2003; Esonu et al., 2003), rabbits (Dairo et al., 2005) and fishes (Abdel-Hakim et al., 2009; 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' and 6° 10' North, longitude 6° 40' and 7° 41' East and altitude of 80 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
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 (1989). 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. (2008); 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 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.

**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 Ilius, 1984; 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 (Clausen and Schermer-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, browsers are reported to have more toxins such as phenolics, terpenes and alkaloids (Robbins, 1993; Robbins et al., 1995).

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

<table>
<thead>
<tr>
<th>Species of animals</th>
<th>DRDC</th>
<th>DRDS</th>
<th>DRDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>17.48</td>
<td>14.32</td>
<td>14.47</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>19.56</td>
<td>18.25</td>
<td>17.54</td>
</tr>
<tr>
<td>Crude fiber (%)</td>
<td>34.91</td>
<td>31.48</td>
<td>30.84</td>
</tr>
<tr>
<td>Crude fat (%)</td>
<td>1.88</td>
<td>3.57</td>
<td>1.79</td>
</tr>
<tr>
<td>Soluble carbohydrate (NFE) %</td>
<td>32.27</td>
<td>38.15</td>
<td>42.29</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>11.11</td>
<td>8.57</td>
<td>7.65</td>
</tr>
</tbody>
</table>

*Means within rows with different superscripts are significantly different (p<0.05).

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

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>DRDC</th>
<th>DRDS</th>
<th>DRDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOA</td>
<td>0.12</td>
<td>2.0</td>
<td>3.2</td>
</tr>
<tr>
<td>K</td>
<td>6.5</td>
<td>2.4</td>
<td>7.0</td>
</tr>
<tr>
<td>Mg</td>
<td>7.6</td>
<td>7.6</td>
<td>ND</td>
</tr>
<tr>
<td>Zn</td>
<td>3.5</td>
<td>3.5</td>
<td>ND</td>
</tr>
<tr>
<td>Mn</td>
<td>9.7</td>
<td>9.7</td>
<td>ND</td>
</tr>
<tr>
<td>Fe</td>
<td>6.8</td>
<td>6.8</td>
<td>ND</td>
</tr>
<tr>
<td>Cu</td>
<td>6.1</td>
<td>6.1</td>
<td>ND</td>
</tr>
<tr>
<td>Pb</td>
<td>0.1</td>
<td>0.1</td>
<td>ND</td>
</tr>
</tbody>
</table>

*Species of animals

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

<table>
<thead>
<tr>
<th>Species of animals</th>
<th>DRDC</th>
<th>DRDS</th>
<th>DRDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tannic acid (%)</td>
<td>1.60</td>
<td>1.12</td>
<td>1.52</td>
</tr>
<tr>
<td>Phytate (mg/g)</td>
<td>4.53</td>
<td>6.18</td>
<td>6.39</td>
</tr>
<tr>
<td>Phytin Phosphorus (mg/g)</td>
<td>1.29</td>
<td>1.74</td>
<td>1.80</td>
</tr>
<tr>
<td>Oxalate (mg/g)</td>
<td>0.41</td>
<td>0.81</td>
<td>0.77</td>
</tr>
<tr>
<td>Saponin (%)</td>
<td>0.22</td>
<td>0.21</td>
<td>0.19</td>
</tr>
<tr>
<td>Alkaloid (%)</td>
<td>0.11</td>
<td>0.14</td>
<td>0.13</td>
</tr>
</tbody>
</table>

*Means within rows with different superscripts are significantly different (p<0.05).

DRDC = Dried rumen digesta from cattle
DRDG = * * * goat
DRDS = * * * sheep

REFERENCES


