Nutritional Appraisal of Processed *Gmelina arborea* Leaves as Feed of Livestock

Okpara, O., Akpodiete, O.J. And Okagbare, G.O.
Department of Animal Science, Delta State University, Asaba Campus,
Asaba, Delta State Nigeria
okparaoghenesuvwe@gmail.com

ABSTRACT
The effects of different processing techniques on *Gmelina arborea* leaves (GAL) for the maximum utilization as livestock feed were evaluated. The investigation was carried out in three phases. In phase one, the leaves of *Gmelina arborea* were collected and processed as fresh (T1), chopped (T2), sun-dried (T3), air-dried (T4) and boiled-dried (T5). In phase two, the processed samples were used for proximate, mineral, and phytochemical analyses to determine the Nutritional Profile (NP) and the anti-nutritional factors (ANFs) of GAL. In the third phase, data collected for the NP and ANFs of the various processing methods were statistically analyzed using the Analysis of Variance and significant means separation techniques. The values obtained for proximate, minerals and ANFs were significantly ($P<0.05$) different among the processing techniques. The crude protein (CP) values were significantly highest in the T1 and T2 followed by those in T4, T3 and T5 respectively. On the ANFs, tannin, alkaloid, saponin, oxalate, flavonoid and steroid were detected and their concentrations were significantly ($P<0.05$) different among the processing techniques. T5 had the lowest significant ($P<0.05$) concentrations in all ANF values determined, followed by T4 and T3 except for oxalate and steroid. The concentration of ANFs were high in all the ANFs present in the T1 and T2 techniques. The study reveals that the processing techniques adopted do not reduce the nutritional values but could significantly ($P<0.05$) reduce the anti-nutritional components, making GAL suitable for a sustainable livestock feed resource for livestock production.

Keywords: *Gmelina arborea* Leaves, Techniques Nutrition, Processed, Feed, Livestock

INTRODUCTION
Ruminants in the tropics are raised predominantly on grasses which are inherently poor in digestibility, nutritive value and availability in the off-season (Babayemi*;* 2009). At this period, the performance of ruminants depending on the native pasture is seriously impaired due to poor quality of the available pasture. This low quality is associated with the fibrous and lignified nature of the pasture which limits the intake, digestibility and utilization (Olafadehan, Olafadehan, Obun, Yusuf, Adeniji, Olayinka, and Abdullahi, 2009). Thus, there is the need for ruminant nutritionists to evolve feedstuff that are readily available and of little or no nutritional value to man. Browses have been reported to be fed to sheep and goats with improved animal performance and they form a good substitute for grass during prolonged period of drought to check the seasonal fluctuation in feed supply resulting in improved animal performance. One of such browse plants is *Gmelina arborea*, which has been reported to enhance weight gain of small ruminants (Okagbare *et al.*, 2005) and better performance. *Gmelina arborea* is a fast growing non-leguminous multipurpose tree that produces appreciable amount of forage even at the peak of dry season. However, the potential toxicity of these plants and their possible effects on animals and man need to be carefully investigated especially, those that they induce to herbivorous animals like cattle, goats and sheep (Akpabio, 2012). The economic consequences of plant toxicity have provided the impetus for concerted research efforts particularly in countries where extensive livestock faming is practiced. Tropical browses have been shown to contain varying quantities of condensed tannin and other anti-nutritional substances in their

biomass which affect their optional utilization by animals. (Osakwe, 2003). The utilization of *Gmelina arborea* leaves also have the attended problem of high Anti-Nutritional Factors (ANFs) (Bruneton,1999) and information on the various processing techniques to detoxify these anti-nutritional factors before it can be fully utilized as feedstuff for ruminants is still limited.

As a result of these, there is the need to search for an effective technique of processing *Gmelina arborea* leaves into a more nutritious feed to enhance its utilization as feed for ruminant animals. Against this backdrop some processing techniques such as fresh, chopping, sun-drying, air-drying, as well as boiled-drying techniques of processing were investigated.

MATERIALS AND METHODS

The study was conducted at the Animal Science laboratory of the Department of Animal Science, Faculty of Agriculture, Delta State University, Asaba Campus. Delta State falls within the humid tropics of Nigeria, and Asaba, the State capital, and location of this study, lies between longitudes 6º E and 8^0 E and Latitude 06º 49`N of the Equator. Asaba has its raining season from March to September with a mean annual rainfall of 1500 – 1849.3mm. It has a moderate climate with very high temperature during the dry season (October – February) with its mean annual temperature and precipitation of 28^0 C$\pm$ 6^0 C and 117mm, respectively (Asaba Metrological Station, 2011). Leaves of *Gmelina arborea* in Asaba and its environs were collected and processed as fresh, chopped, sun-dried, air-dried and boiled-dried for 48 hours. Samples were used for proximate, minerals and phytochemical analyses to determine nutrient profile (NP) and anti-nutritional factors (ANFs). Data collected for NP and ANFs were statistically analyzed using Analysis of Variance and significant means were separated by New Duncan Multiple Range Test using the procedure of SAS (2000).

RESULTS AND DISCUSSION

Nutritional Compositions

The CP values obtained as shown in Table 1 within the various processing methods in this study are comparable with previously reported values by earlier workers (Adamu *et al.*., 2013; Okagbare *et al.*., 2014). The crude protein of GAL obtained in this study are similar to crude protein content values reported for other browse plants such as *Albizialebbeck* 22.3, *Gliricidiasipium* 24.7, *Leucaenaleucocephala* 23.8, (Babayemi *et al.*, 2005).

Table 1: Proximate Analysis of GAL under Different Processing Techniques

Nutrient	Processing Techniques				
	Fresh T1	Chopped T2	Sun-dried T3	Air-dried T4	**Boiled-dried T5**
Dry matter (%)	88.54^{c}	87.54^{c}	93.67^{a}	93.6^{a}	91.5^{b}
Ash (%)	6.00^{a}	5.90^{a}	2.73^{c}	3.03^{b}	3.78^{b}
Crude Fibre (%)	14.18^{a}	14.17^{a}	8.35^{c}	7.31^{c}	10.86^{b}
Crude Protein (%)	20.95^{a}	20.75^{a}	19.08^{b}	19.79^{b}	18.05^{c}
Ether Extract (%)	13.77^{a}	13.77^{a}	4.73^{c}	5.55^{c}	8.41^{b}
NFE (%)	42.62^{c}	42.52^{c}	58.74^{b}	61.18^{a}	55.25^{b}
ADF (%)	31.48^{a}	31.45^{a}	17.82^{c}	24.38^{b}	15.38^{c}
NDF (%)	61.45^{a}	60.45^{a}	43.91^{c}	50.74^{b}	34.28^{c}

Note: abcd Means on same row with different superscripts are significantly different. ($P<0.05$)

The crude protein values in this study also compared favourably with the crude protein values of some foliage crops that have been evaluated and integrated into ruminant feeding. They include *Bamibosa vulgaris* 22.38% *Mangefera indica* 15.13% and *Newbouldia leavis* 15.57% respectively by (Ikhimioya, 2005 and Osuntokun *et al.*, 2014).

The value of GAL crude protein (18.05 – 20.95%) obtained in this present study is far above 7% recommended value for tropical livestock by Minson (1990) below which there will be a deficiency in performance.

The high crude protein of GAL obtained in this study has been considered as an important factor in ruminants' diet because, free choice intake of feed by animals is increased by increase in crude protein content of the diet (Olham and Alderman, 1980). It is quite obvious that the browse plant under study (*Gmelinaarborea*) has a high potential compared to other available browse plants. This suggests that it can be a potential sustainable feed resource that could be used in ruminant feeding for optimum performance. Furthermore, the high crude protein levels of ether extract, crude fibre, ash, NDF, ADF and NFE values recorded in this present study are closely related to the reports of Adamu *et al* (2013) and Okagbare *et al* (2014). These findings provide an impetus for adoption of these processing methods for nutritional quality improvement of GAL for ruminant feeding.

The Ash and crude fibre values were relatively highest in the fresh and chopped and the Boiled-dried treatment. The mineral contents of GAL of fresh and chopped treatment in this study as shown in Table 2 was higher than those reported by Adamu *et al.* 2013 (5.39) but similar to other browse plants reported by Osuntokun *et al.* 2014, which makes the plants richer in minerals and vitamins and could serve as a complete fodder for livestock.

Anti-Nutritional Components

The phytochemical analysis of processed GAL as shown in Table 3, revealed the presence of tannin, alkaloid, saponin, oxalate, flavonoid and steroid depicting potential toxicity of the feed resources. The processing methods adopted in the study showed that they do not reduce the nutritional values but reduced the anti-nutritional components.

Table 2: Mineral Contents of *Gmelina arborea* Leaves Using Different Processing Techniques

Minerals (mg/l)	Processing Techniques				
	Fresh T1	**Chopped T2**	**Sun-dried T3**	**Air-dried T4**	**Boiled-dried T5**
Phosphorous	0.390^{b}	0.390^{b}	0.360^{b}	0.500^{a}	0.360^{b}
Zinc	0.0250^{a}	0.0250^{a}	0.0220^{b}	0.100^{c}	0.230^{b}
Potassium	2.819^{a}	2.819^{a}	1.224^{b}	2.856^{a}	0.817^{c}
Sodium	162.034^{a}	162.034^{a}	98.004^{c}	158.600^{b}	84.602^{d}
Magnesium	0.028^{c}	0.028^{c}	0.140^{b}	0.260^{a}	0.078^{d}
Copper	4.409^{a}	4.409^{a}	3.562^{b}	4.022^{a}	2.032^{c}
Iron	52.830^{a}	52.830^{a}	32.081^{c}	44.620^{b}	19.798^{d}
Calcium	0.018^{a}	0.018^{a}	0.014^{c}	0.017^{b}	0.014^{c}

Note: abcd Means on same row with different superscript differ significantly, ($P<0.05$).

Table 3: Anti-nutritional Components of GAL under Different Processing Techniques

Anti-Nutrient	Processing Techniques				
	Fresh T1	**Chopped T2**	**Sun-dried T3**	**Air-dried T4**	**Boiled-dried T5**
Tannin (g/l)	4.40[a]	4.30[a]	2.44[b]	2.37[b]	1.64[c]
Alkaloid (g/l)	6.74[a]	6.64[a]	1.32[b]	1.05[b]	0.01[c]
Saponin (g/l)	1.51[a]	1.41[a]	1.32[b]	1.05[c]	0.01[d]
Oxalate (g/l)	17.08[a]	17.07[a]	14.44[b]	15.52[b]	10.61[c]
Flavonoid (g/l)	9.64[a]	9.64[a]	4.50[b]	3.89[b]	3.11[c]
Steroid (g/l)	43.47[a]	43.45[a]	40.27[b]	41.47[b]	0.00[c]

Note: abcd Means on same row with different superscript differ significantly ($P<0.05$).

The boiled-dried method had a better reduction effect of ANFs, followed by air-dried and sun-dried, compared to the fresh and chopped methods. The saponin value of (0.01) in the boiled - dried method apparently seems to be the best and closely followed by air-dried (1.05), sun-dried (1.32) and fresh (1.51) due to their concomitants imparts on the increase and decrease in the anti-nutritional component of the GAL. More importantly processing methods tremendously improved its nutritive values suggesting its potential sustainability in ruminant nutrition.

CONCLUSION

Proximate analysis of the processed *Gmelina arborea* leaves showed that GAL contains major nutrients like protein, fat, energy, minerals and vitamins for ruminant optimum physiological performance and can serve as a potential feed resource that could sustain ruminant production. The processing of *Gmelina arborea* leaves (GAL) improved the nutritive value of GAL as it reduced the ANFs especially the boiled–dried method which will enhance its utilization by ruminants. The study recommends that boiled-dried system of processing is the best method recommended for GAL processing followed by air-dried and sun-dried. Again, processing tremendously improved the nutritive value of *Gmelina arborea* leaves as feed for ruminants.

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