IN-VITRO DIGESTIBILITY EVALUATION OF SOME UNEXPLOITED FOLIAGE AS RUMINANT DIETS FO MILK PRODUCTION

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ABSTRACT
Digestibility of feed is a means by which the nutritive value of feed can be determined. The nutritional potential of some foliage (*Gardenia aqualla, Vittellaria paradoxa*, *Ficus syncomorus* and *Anogessius leiocarpus*) as ruminant feed was assessed using *in-vitro* digestibility trial technique. Gas production was continuously measured by incubating samples in buffered rumen fluid from goat for 24hr. Cumulative gas production was recorded at 3hr interval incubation period of 24hr and *in-vitro* characteristics was observed. Results showed significant ($p<0.05$) differences in gas production and *in vitro* characteristics. At 24 hours of incubation, *Gardenia aqualla* had the highest gas production (4.67v/hr), while *Anogessius leiocarpus* produced the least volume of gas (3.00v/hr). *Gardenia aqualla* had the highest (31.04%) organic matter digestibility, followed by *Vittellaria paradoxa* (31.01%), *Ficus syncomorus* (27.79%) and *Anogessius leiocarpus* (25.44%). *Gardenia aqualla* and *Ficus syncomorus* had short chain fatty acid values of 0.05 and 0.04 µmol respectively. The metabolizable energy was significantly ($p<0.05$) highest (4.39Kcal/g) in *Gardenia aqualla* and least (3.64 Kcal/g) in *Anogessius leiocarpus.* *Gardenia aqualla* and *Ficus syncomorus* had the highest value (3.00ml) of carbon IV oxide. *Ficus syncomorus* had the highest value (92.51%) of *in-vitro* dry matter digestibility while *Gardenia aqualla* had the least value (72.75%). It can be concluded hat the foliage examined can make up ruminant diets, however, *Gardenia aqualla* had better potential as feed resource in ruminant feeding.

Keywords: Foliage, *In-vitro* digestibility, Milk production, ruminants

INTRODUCTION
High quality feeds are only available during the rainy season and the attainment of sustainable livestock production largely depends on the availability, quality and quantity of feed (Ibhaze *et al*., 2015). Tree foliage is being increasingly recognized as a potentially high quality feed resource for ruminants, particularly to supply crude protein, this is especially true in harsh and arid conditions where trees often provide more edible biomass than pasture and this biomass remains green and high in protein, even when pastures dry off and senesce (Leng, 2011). There are some untapped foliage in the South Western Nigeria that could be fed as alternative feed during total absence of lush vegetation or as supplemental feed when low quality pasture is available for ruminants. Among such are; *Anogessius leiocarpus, Gardenia aqualla, Ficus syncomorus, Vittelaria paradoxa.* These foliage have medicinal and other desirable properties such as rich source of protein, minerals, antioxidants and low antinutrients. The determination of the digestibility of feed materials *in vivo* is time consuming, laborious, expensive, requires large quantities of feed and is unsuitable for large scale feed evaluation (Carro *et al*., 1994). Therefore, *in-vitro* gas production technique has been extensively used for evaluation of nutritive value of feed stuffs. Hence, the rust of this study is to ascertain the suitability and utilization of these foliage as ruminant feed resource especially during the dry periods of the year using *in vitro* digestibility technique.

MATERIALS AND METHODS
The study was carried out at the Small Ruminants Unit of the Teaching and Research Farm, Federal University of Technology Akure, Ondo State, Nigeria. Akure is located on longitude 4.944055^{o}E and 5.82864^{o}E, and latitude 7.491780 ^{o}N with annual rainfall ranging between 1300 mm and 1650 mm average maximum and minimum daily temperature of 38^{o}C and 27^{o}C respectively (Daniel, 2015). The foliage (*Anogeissus leiocarpus, Gardenia aqualla, Ficus syncomorus, Vittelaria paradoxa*) were obtained from the villages around Akure metropolis, Ondo State, Nigeria and cured by air drying. The *In-vitro* nutrient digestibility study of the different foliage was carried out using *in vitro* gas

production techniques according to the modified methods of Babayemi and Bamikole (2006). Incubation procedures were carried out according to the procedure of Menke and Steingass (1988). At the end of 24th hour termination, the methane production was determined according to he method of Fievez *et al*. (2005). The OMD, ME, SCFA were estimated according to the methods of Menke and Steingass (1988). The *in vitro* dry matter digestibility (IVDMD) was determined according to the method of McDonald (1979).

Experimental design and Statistical analysis

The experimental design was the completely randomized design and all data obtained were subjected to ANOVA, and the treatment means were compared by the methods of Duncan's Multiple Range Test at $p < 0.05$ using SAS (2010) version 9.3.

RESULTS AND DISCUSSION

Shown in Table 1 is the *in vitro* gas production characteristics of the foliages. There were significant ($p<0.05$) differences in the gas production. At 24 hours of incubation time, *Gardenia aqualla* recorded the highest gas production (4.67v/hr), while *Anogessius leiocarpus* produced the least volume of gas (3.00v/hr). Gas volume has been observed to be a good parameter for measuring the degree of digestibility, fermentation end product and microbial protein synthesis of the substrates by rumen microbes in *in vitro* studies (Sommart *et al*., 2000). The *in vitro* gas production indicated that the gas production was least in *Anogessius leiocarpus* at 24 hours. However, there was a consistent increase in gas production from 3hours to 12 hours in all foliage examined. The level of gas production indicates the extent of degradation of dietary organic matter, the higher the gas production, the higher the degradation of Organic matter. This suggests that most of the dry matter in the diets would be available to ruminal microbes within this period. Gas production is closely related to SCFA production which is based on carbohydrate fermentation (Sallam *et al*., 2007). The relatively low gas produced indicates that the foliage when consumed by ruminants would not result in ruminal tympany.

Table 1: *In vitro* gas production (volume/hour) characteristics of foliage

	Hours							
Foliages	3	6	9	12	15	18	21	24
Anogessius leiocarpus	3.67	4.00	4.33	4.33	3.67	4.00	3.00^{b}	3.00^{b}
Gardenia aqualla	4.33	4.33	4.33	4.33	4.33	4.67	4.67^{a}	4.67^{a}
Ficus syncomorus	4.00	4.33	4.33	4.33	4.33	4.33	4.33^{a}	4.33^{ab}
Vittellaria paradoxa	3.00	3.33	3.67	3.67	3.67	3.67	3.00^{b}	3.33^{ab}
±SEM	0.250	0.213	0.241	0.241	0.246	0.241	0.279	0.271
P –value	0.297	0.330	0.757	0.757	0.672	0.557	0.024	0.059

^{a,b,c} = Means in the same column with different superscripts are significantly different ($P<0.05$).

Table 2: *In vitro* characteristics of foliage

Foliage	OMD (%)	SCFA(µmol)	ME(Kcal/g)	CH_4(ml)	CO_2(ml)	IVDMD (%)
Anogessius leiocarpus	25.44^{c}	0.01^{c}	3.64^{c}	2.00	1.00^{c}	73.35^{b}
Gardenia aqualla	31.04^{a}	0.05^{a}	4.39^{a}	2.00	3.00^{a}	72.75^{b}
Ficus syncomorus	27.79^{b}	0.04^{a}	3.96^{b}	2.00	3.00^{a}	92.51^{a}
Vittelaria paradoxa	31.01^{a}	0.02^{b}	4.36^{a}	2.00	1.50^{b}	74.40^{b}
±SEM	0.3	0.01	0.12	0.00	0.08	2.29
P-value	0.001	0.059	0.001	0.001	0.001	0.002

^{a,b,c} = Means in the same column with different superscripts are significantly different ($P<0.05$), OMD= Organic matter digestibility, SCFA= Short-chain fatty acids, ME = Metabolizable energy; $CH_{4,}$ = Methane; IVDMD= *In vitro* dry matter digestibility.

The *in vitro* characteristics of foliage presented in Table 2 showed significant ($p<0.05$) differences. The OMD ranged from 25.44 to 31.04% with *Gardenia aqualla* having the highest value (31.04%), followed by *Vittellaria paradoxa* (31.01%), *Ficus syncomorus* (27.79%) and *Anogessius leiocarpus* (25.44%). *Gardenia aqualla* and *Ficus syncomorus* had SCFA values of 0.05 and 0.04 µmol respectively which were not significantly ($p>0.05$) different while *Anogessius leiocarpus* had the least (0.01 µmol) value. The ME of the foliages ranged from 3.64 to 4.39 Kcal/g with *Anogessius leiocarpus* having the least (3.64 Kcal/g) while the highest value (4.39Kcal/g) was recorded for *Gardenia aqualla*. *Gardenia aqualla* and *Ficus syncomorus* had the highest value (3.00ml) of CO_2 while the least (1.00ml) value was obtained in *Anogessius leiocarpus*. *Ficus syncomorus* had the highest value (92.51%) of IVDMD while *Gardenia aqualla* had the least value (72.75%). The *in vitro* characteristics of foliage indicated that *Gardenia aqualla* had the highest OMD, SCFA, ME and CO_2. This result corroborates the findings of Sallam *et al.* (2007) who reported that the higher the OMD, the higher the ME. The OMD obtained suggests that many of the soluble nutrients were degraded and would be available and adequate to support growth and production in the animal. The rate of digestion and the amount which is potentially degradable together, determine how much of the material will be digested during the time the food is exposed to rumen fermentation (Orskov, 1991). The level of SCFA indicates that the foliage have potential to make energy available to ruminants when consumed**.** Wanapat *et al*. (2013) reported that CO_2 provides most green house gases (55-60%) followed by methane (15-20%). Methane emission has been a global issue due to its contribution to global warming and climate change. Wanapat *et al*. (2015) opined that methane production in the rumen represents 2–12% loss of feed energy thereby decreasing the ME content of feeds. Since methane production is a form of energy loss, relatively low methane gas observed suggests that the foliage examined would reduce the activities of methanogenic archaeas in the rumen that would lead to biomethanation, hence more dietary energy would be available to the animals for productive use such as milk production. This result further shows that these foliage can be used as environmental friendly fodders for alleviating ruminant impact to greenhouse emission.

CONCLUSION

From the results obtained, it can be concluded that *Gardenia aqualla* showed better nutritional potentials for milk production and can be used as supplementary or basal feed especially when pastures dry off. However, *in-vivo* study should be piloted to ascertain these findings.

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