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## Quantification of *Sclerocarya birrea* (Marula) fruits as feed supplement for ruminants in dry sub-humid zone of Nigeria

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### ABSTRACT

A study was conducted in four selected local government areas of Sokoto state in the extreme North-western part of Nigeria to quantify *Sclerocarya birrea* fruits as feed supplement for ruminant animals. The areas were Kware, Wamakko, Bodinga and Rabah. A check list was used to obtain information from ten respondents from five districts in each local government area making a total of 200 respondents. Information collected includes tree availability, yield and uses. Data generated from the study were subjected to simple descriptive statistics and analysis of variance. Results obtained indicated that 48 % of the respondents reported the availability of *S. birrea* while 20 % indicated its scarcity. 43 % of the respondents reported the use of *S. birrea* as food and medicine for animal and man and 10 % reported its use as fuel and wood work. Kware local government had a significantly higher number of *S. birrea* trees compared to other locations ( $P < 0.05$ ). However, the yield obtainable was significantly higher in Bodinga and Rabah local government areas ( $P < 0.05$ ) compared to Kware and Wamakko. Results indicated that a total of 13,953; 10,377; 11,069 and 9,641 kg of *S. birrea* could be obtained from Kware, Bodinga, Rabah and Wammako Local Government areas annually. It was concluded that *S. birrea* is a potential feed supplement in the dry sub-humid zone of Nigeria.

**Keywords:** *Quantification*, Marula fruits, supplement, ruminant dry sub-humid, Nigeria

## 1. INTRODUCTION

Small ruminant production in dry sub-humid zone of Nigeria is mainly dependent on native range land and crop residues for a greater part of the year. The nutritive value of native pasture decreases rapidly and becomes highly lignified as the dry season approaches (Ogunbosoye and Babayemi, 2010). Most feeds becomes depleted of essential nutrients including protein, energy, minerals, and vitamins which are required to improve rumen microbial fermentation and increased performance of the host animals (Simbaya, 2000). Increasing demand and subsequent high cost of conventional feed ingredients complicated the situation and created the need for sustainable alternatives from natural feed resources indigenous to the region (Okoli *et al.*, 2003 Abubakar and Mohammed, 1992; Osagie, 1998; Tian *et al.*, 1998). Farmers incur heavy economic losses as a result of change in animal weight and condition, reduction in reproductive capacity and increased mortality (Simbaya, 2000). The potentials of these alternative feed resources lies in their nutrient content and anti-nutritional factors, low content of nitrogen, poor digestion and acceptability (Leng, 1997). Composition, availability within locations, affordability in terms of cost, palatability and utilization are also important factors (Kaleijaiye and Balogun, 2008). *Sclerocarya birrea* has high Protein content (20-35%), phosphorous (0.7-1.9g/100g) and have an energy value of 25 MJ/kg (Vermaak *et al.*, 2011 Weinert *et al.*, 1990). Aganga and Mosase (2001) reported that the fruits contained an average of 30.96% crude protein. It is rich in oleic acid (64-74.5g/100g) with good oxidative stability, palmitic acid (11-17.5g/100g), stearic acid (5-11g/100g) and linoleic acid (4-9g/100g) (Vermaak *et al.* 2011). The main amino acids present in *Sclerocarya birrea* are glutamic acid (18-27g/100g protein), arginine (11-16g/100g protein) and aspartic acid (5.5-8g/100g protein) (Weinert *et al.*, 1990; Vermaak *et al.*, 2011). This study therefore focused on availability and quantification of *Sclerocarya birrea* (Marula) fruits as feed supplement for ruminants in selected local government areas of Sokoto in the extreme North-western part of Nigeria.



**Fig. 1.** *Sclerocarya birrea* (Marula) tree



**Fig. 2.** *Sclerocarya birrea* (Marula) fruits

## **2. MATERIALS AND METHODS**

### **2. 1. Experimental Location**

The study was conducted in four selected local government areas of Sokoto state. Sokoto is located in the Sudano-Sahelian zone in extreme North-Western part of Nigeria. It lies between longitude 4°8'E and 6°54'E and latitudes 12°0'N and 13°58'N and at altitude of 350 m above sea level (Mamman *et al.*, 2000).



**Fig. 3.** Map of Nigeria showing Sokoto State



Fig. 4. Map of Sokoto State

### 2. 1. 1. Climate and Livestock Resources

Sokoto has a semi-arid climate, which is characterized by low rainfall with mean annual rainfall of between 500-1300 mm varying in amount from year to year and it is seasonal in incidence. Heat is more severe in the state in March and April, but the weather in the state is always cold in morning and hot in afternoons save in peak harmattan. Diurnal and seasonal temperature fluctuations are very wide, where minimum temperature has been recorded to be 13 °C in January and maximum temperature of 44 °C in April (SSGD, 2002). Sokoto has two main seasons; the dry season, which lasts from October to May/June, and the rainy season that lasts from June to September/October. Sokoto state is part of the North Western Nigeria with abundant livestock resources. This is because the climate is more suitable for livestock production, due to absence of Tse-tse fly and an open grass land (SSGD, 2002). Sokoto ranks second in livestock production in the country with livestock population of over 8 million (SSGD, 2002).

### 2. 1. 2 Soil Condition

The soils are imperfectly drained and generally loamy sand in texture with deep rooting zone, loamy sand on the surface to sandy clay loam in the subsoil and generally gravelly in texture (Famiran and Areola, 1979).



## 2. 2. Quantification of *Sclerocarya birrea* fruits in Selected Local Government areas of Sokoto State

### 2. 2. 1. Sampling

Purposive sampling was used in the selection of the four Local Government areas according to their proximity to Sokoto metropolis in the capital of the state while random sampling was used in selecting five districts each from the local government areas. The local governments were Kware with Kware, Ummaruma, Durbawa, Hamma-Ali and Tsaki as districts.

Wamakko Local Government with Wamakko, Gumbi, Gandu, Dundaye and Gumbarawa as districts. Bodinga Local Government with Bodinga, Kauran miyo, Sifawa, Dalhera, and Dingyadi as districts and Rabah local government with Rabah, Rara, Gandi, Yartsakuwa and Tsamiya as districts.

### 2. 2. 2. Methodology of Quantification

This involves the use of check list to obtained data from ten respondents from each district, making a total of 200 respondents. Information collected includes number of trees, Height, yield and uses.

Haga altimeter and tape method were employed for the measurement of the *Sclerocarya birrea* tree heights in the locations. The estimate of yield of fruits/plant is determined by multiplying the number of fruits/branches by number of branches per tree (kg) using an average of 17g per fresh fruit weight. The estimate of yield per tree and per area is finally determined (kg).



Fig. 5. Harvested fruits of *Sclerocarya birrea* (Marula)

### 2. 3. Statistical Analysis

The data generated from the experiment were subjected to simple descriptive statistics and analysis of variance (ANOVA) using Statview Statistical Package (SAS, 2002). Where significant difference exists, Least Significant Difference (LSD) was used to separate the means as described by Steel and Torrie (1980).

## 3. RESULTS AND DISCUSSION

### 3. 1. Result

#### 3. 1. 1. Availability of *S.birrea* in the study area

Availability of *S. birrea* in the study area is presented in Table 1.

**Table 1.** Availability of *S.birrea* in the study Area

Availability	Frequency	Percentage (%)
Readily available	95	48
Scantly available	65	32
Non available	40	20
<b>Total</b>	<b>200</b>	<b>100</b>

Results indicated that 47.5% of the respondents reported that *S. birrea* is readily available and 20% reported its non-availability.

**Table 2.** Uses of *S. birrea* in the study Area

Uses	Frequency	Percentage (%)
Food for man and animals	53	27
Medicine	41	20
Food and medicine	86	43
Others (fuel, woodworks)	20	10
<b>Total</b>	<b>200</b>	<b>100</b>

Results indicated that 43 % of the respondents reported that *S.birrea* is used as food and medicine and 10 % reported its use for fuel and other woodworks.

### 3. 1. 2. Quantification of *S. birrea* fruit in selected Local Government Area of Sokoto State

Quantification of *Sclerocarya birrea* fruit in selected Local Government areas of Sokoto State is presented in Table 3.

**Table 3.** Quantification of *S. birrea* fruit in selected Local Government Area of Sokoto State

Parameter (mean)	Local Government Area				SEM	Prob.
	Bodinga	Kware	Rabah	Wamakko		
No of trees	4.31 <sup>b</sup>	6.76 <sup>a</sup>	4.38 <sup>b</sup>	5.21 <sup>b</sup>	0.71	0.03
Height (m)	6.63	6.56	6.50	6.48	0.11	0.02
No of branches/tree	4.74 <sup>a</sup>	4.68 <sup>ab</sup>	4.41 <sup>b</sup>	4.46 <sup>b</sup>	0.09	0.01
Branch yield (kg)	105 <sup>b</sup>	8.04 <sup>c</sup>	122 <sup>a</sup>	86.0 <sup>c</sup>	10.8	0.04
Trees fruit yield (kg)/tree	511 <sup>a</sup>	416 <sup>b</sup>	538 <sup>a</sup>	384 <sup>c</sup>	49.7	0.03

abc, Means the same row with different superscript are significantly different (P<0.05)

Results showed no difference (P>0.05) in the number of trees between Bodinga, Rabah and Wamakko. Number of trees was higher (P<0.05) for Kware compared to other locations (P<0.05). There was no difference (P>0.05) in height of trees across the local government areas. Number of branches are lower (P<0.05) for Rabah and Wamakko. Branch fruit yields showed no difference (P>0.05) between Kware and Wamakko. There is no difference (P>0.05) between Bodinga and Rabah in terms of tree fruit yield.

### 3. 1. 3. Quantification of *Sclerocarya birrea* fruits yield in selected districts of Bodinga Local Government Area

Quantification of *Sclerocarya birrea* fruits yield in selected districts of Bodinga Local Government area is presented in Table 4.

**Table 4.** Quantification of *Sclerocarya birrea* fruits yield in selected districts of Bodinga Local Government Area

Parameter (mean)	Districts					SEM	Prob.
	Bodinga	Kauran miyo	Sifawa	Dalhera	Dingyadi		
No of trees	5.56 <sup>b</sup>	5.00 <sup>a</sup>	3.00 <sup>b</sup>	3.50 <sup>b</sup>	3.00	0.81	0.03
Height (m)	6.82 <sup>a</sup>	6.72 <sup>a</sup>	6.45 <sup>b</sup>	6.49 <sup>a</sup>	6.39 <sup>b</sup>	0.15	0.02

No of branches/tree	6.60 <sup>a</sup>	4.78 <sup>b</sup>	4.80 <sup>b</sup>	4.83 <sup>b</sup>	4.80 <sup>b</sup>	0.23	0.02
Branch yield (kg)	21.3 <sup>a</sup>	98.7 <sup>b</sup>	107 <sup>a</sup>	92.9 <sup>c</sup>	95.7 <sup>c</sup>	8.28	0.04
Trees fruit yield (kg)/tree	58.1 <sup>a</sup>	477 <sup>b</sup>	515 <sup>a</sup>	466 <sup>b</sup>	529 <sup>a</sup>	36.7	0.03

abc, Means in the same row with different superscript are significantly different (P<0.05)

Results showed that the number of trees between Bodinga Dalhera and Sifawa are not different (P>0.05). The height are longer (P<0.05) in Bodinga, Kauran miyo, and Dalhare compared to Sifawa and Dingyadi. There is no difference in Branch fruits yield (p>0.05) between Bodinga and Sifawa districts. Kauran miyo, Dingyadi and Dalhera are the same (P>0.05) in terms of branch fruit yield. The total fruits yield showed no difference (P>0.05) between Bodinga, Dingyadi and Sifawa and between Kauran miyo and Dalhera.

### 3. 1. 4. Quantification of *Sclerocarya birrea* in selected districts of Kware Local Government Area

Quantification of *Sclerocarya birrea* in selected districts of Kware local government area is presented in Table 5.

**Table 5.** Quantification of *Sclerocarya birrea* in selected districts of Kware Local Government Area

Parameter (mean)	Districts					SEM	Prob.
	Hamma Ali	Ummaruma	Kware	Tsaki	Durbawa		
No of trees	7.00	6.00	7.00	7.50	6.00	1.06	0.12
Height (m)	6.01 <sup>c</sup>	6.69 <sup>b</sup>	6.45 <sup>b</sup>	6.85 <sup>a</sup>	6.82 <sup>a</sup>	0.08	0.01
No of branches/tree	4.69 <sup>b</sup>	5.64 <sup>a</sup>	4.15 <sup>c</sup>	4.57 <sup>b</sup>	4.46 <sup>c</sup>	0.15	0.03
Branch yield (kg)	84.8 <sup>ab</sup>	85.9 <sup>b</sup>	97.4 <sup>a</sup>	82.2 <sup>b</sup>	90.5 <sup>a</sup>	4.92	0.03
Trees fruit yield (kg)/tree	398 <sup>b</sup>	476 <sup>a</sup>	421 <sup>a</sup>	376 <sup>b</sup>	424 <sup>a</sup>	31.4	0.02

abc, Means in the same row with different superscript are significantly different (P<0.05)

Results showed no difference (P>0.05) in number of trees in all the districts. There is no difference (P>0.05) in the height of trees between Tsaki and Durbawa and between Ummaruma and Kware. The branching showed no difference (P>0.05) between Hamma Ali and Tsaki and between Durbawa and Kware. Branch fruits yield showed no difference (P>0.05) between Kware and Durbawa and between Ummmaruma, Hammali, and Tsaki. The



tree fruits yield showed no difference ( $P>0.05$ ) between Ummaruma, Durbawa, and Kware and between Hammali and Tsaki.

### 3. 1. 5. Quantification of *Sclerocarya birrea* in selected districts of Rabah Local Government Area

Quantification of *Sclerocarya birrea* in selected districts of Rabah local government area is presented in Table 6.

**Table 6.** Quantification of *Sclerocarya birrea* in selected districts of Rabah local government area

Parameter (mean)	Districts					SEM	Prob.
	Yartsakuwa	Gandi	Rabah	Rara	Tsamiya		
No of trees	5.50	4.27	4.00	4.50	3.00	0.79	0.10
Height (m)	6.36 <sup>b</sup>	6.65 <sup>a</sup>	6.51 <sup>a</sup>	6.58 <sup>a</sup>	6.55 <sup>a</sup>	0.26	0.04
No of branches/tree	4.20 <sup>b</sup>	4.73 <sup>a</sup>	4.71 <sup>a</sup>	4.13 <sup>b</sup>	4.20 <sup>b</sup>	0.15	0.01
Branch yield (kg)	131 <sup>a</sup>	94.1 <sup>c</sup>	127 <sup>b</sup>	112 <sup>bc</sup>	131 <sup>a</sup>	11.1	0.02
Trees fruit yield (kg)/tree	552 <sup>b</sup>	448 <sup>c</sup>	598 <sup>a</sup>	462 <sup>b</sup>	550 <sup>b</sup>	44.8	0.02

abc, Means in the same row with different superscript are significantly different ( $P<0.05$ )

Results showed no difference ( $P>0.05$ ) in the number of trees in all the selected districts. Height of trees are the same ( $P>0.05$ ) for Gandi, Rabah, Rara and Tsamiya. Branch fruits yield showed no difference ( $P>0.05$ ) between Yartsakuwa and Tsamiya and between Rabah and Rara. The total fruits yield showed no difference ( $P>0.05$ ) between Yartsakuwa, Rara and Tsamiya.

### 3. 1. 6. Quantification of *Sclerocarya birrea* in selected districts of Wamakko Local Government Area

Quantification of *Sclerocarya birrea* in selected districts of Wamakko Local Government Area is presented in Table 7.

**Table 7.** Quantification of *Sclerocarya birrea* in selected districts of Wamakko Local Government Area

Parameter (mean)	Districts					SEM	Prob.
	Dundaye	Gumbarawa	Gumbi	Gandu	Wamakko		
No of trees	5.00 <sup>a</sup>	3.50 <sup>c</sup>	7.00 <sup>a</sup>	4.26 <sup>b</sup>	4.50 <sup>a</sup>	0.84	0.02
Height (m)	5.94 <sup>c</sup>	6.32 <sup>b</sup>	6.59 <sup>a</sup>	6.65 <sup>a</sup>	6.76 <sup>a</sup>	0.08	0.01

No of branches/tree	4.22 <sup>b</sup>	4.17 <sup>b</sup>	4.69 <sup>a</sup>	4.73 <sup>a</sup>	4.38 <sup>b</sup>	0.15	0.01
Branch yield (kg)	91.4 <sup>a</sup>	81.9 <sup>b</sup>	80.8 <sup>b</sup>	94.1 <sup>a</sup>	97.7 <sup>a</sup>	4.86	0.03
Trees fruit yield (kg)/tree	386 <sup>b</sup>	342 <sup>c</sup>	380 <sup>b</sup>	448 <sup>a</sup>	432 <sup>a</sup>	33.1	0.02

abc, Means in the same row with different superscript are significantly different (P<0.05)

Results showed no difference (P>0.05) in the number of trees between Gumbi, Dundaye, and Wamakko. Height of the trees were observed as the same (P>0.05) between Wamakko, Gandu and Gumbi. Branching showed no difference (P>0.05) between Gandu and Gumbi and between Wamakko, Dundaye and Gumbarawa. Branch fruit yield was not different (P>0.05) between Wamakko, Gandu and Dundaye. Tree fruits yield indicated no difference (P>0.05) between Gandu and Wamakko and between Dundaye and Gumbi. However, Gumburawa was lower in terms of fruit yield compared to other locations (P<0.05).

### 3. 2. Discussion

The study indicated an estimated mean yield of 11,260.10 kg/year of *S birrea* could be obtained from the study area. *S birrea*, therefore, has the potential of being a feed supplement in the diet of ruminant animals. The significantly higher number of trees in Kware Local Government and Tsaki district could be attributed to activities of man (afforestation) and other climate related factors (temperature, rainfall, relative humidity and radiation or sun light) as well as edaphic factors as reported by Van Wyk and Gericke (2000).

The values for the tree height obtained in this study (between 4-6.2m) are similar to the report of Nerd and Mizrachi (1993). It is however lower than the value of 6.9m and 8.2m reported by Van Wyk and Gericke (2000), and Weinert *et al.* (1990). This variation could be due to differences in the human activities in respect of uses of the trees, climatic and soil factors. The estimated values for the seasonal tree fruit yield obtained from the present study ranged from 383.58kg to 538.34kg/tree.

These values can be compared with values of 315kg to 1643kg reported by Leakey (1999), Van Wyk and Gericke (2000) when they estimated seasonal fruit crops from individual trees in semi-arid areas of South Africa. However, variation observed in the present study for weight of fruits which ranged from 16 to 18g contradicted the report of Leakey (1999) and Van Wyk and Gericke (2000). This variation could be due to geographical location, soil types and characteristics, organic matter deposition, climatic factors (rainfall, temperature and relative humidity) and human activities (such as bush burning, deforestation and other activities).

The study indicated that a total of 13,952.6; 10,377.41; 11,069.07 and 9,641.33 kg of *S. birrea* could be obtained from Kware, Bodinga, Rabah and Wammako Local Government areas annually. As feed supplement, *S. birrea* therefore has potential of reducing a lot of pressure exerted by high cost of protein, minerals and vitamin ingredients especially in the dry season. *S. birrea* starts fruiting in the late dry season when most feed materials are short in supply and could therefore serve as an alternative source of protein, minerals and vitamins. Potential of *S. birrea* as feed for livestock has already been documented (Leaky, 1999; Agaga and Mosase 2001; Babayemi *et al.*, 2004).

#### 4. CONCLUSION

The total yield of *S. birrea* obtainable from the study areas indicated that it is a potential protein, minerals and vitamins supplement in the dry sub-humid zone of Nigeria.

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( Received 26 March 2016; accepted 10 April 2016 )