

Original Research Article

Comparative Assessment of the Nutritive Potentials of Fresh and Dried *Terminalia mantaly* Leaves

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Abstract

This study was conducted to determine the effects of different drying methods of Terminalia mantaly leaves on their nutritive value. Three different samples of the leaves (fresh, air-dried and sun-dried) (corresponding with Treatments 1, 2 and 3 respectively) were used for proximate composition and phytochemical analysis to determine its nutritional and anti-nutritional profiles. Data collected were statistically analyzed with one-way analysis of variance (ANOVA) and means separated by Duncan multiple range test. There were significant differences in the crude protei, ether extract, moisture, and ash contents ($P < 0.05$) of the three treatments. Crude protein was highest in sun-dried (13.13%) compared to the fresh and air-dried leaves. Treatment 1 had a relatively higher amount of crude fibre than the other treatments. However the Nitrogen free extracts of the T1 was highest among the treatments means. The phytochemical analysis showed that alkanoids, tannins, flavoids, saponins and oxalates were detected, and their concentrations were significantly different ($P < 0.05$) among treatments. Fresh T. mantaly leaves had the highest value of alkanoids, tannins, flavoids, saponins and oxalates compare to the other treatments. In tannins, sun-dried leaves had the lowest value (0.001mg/g) while the fresh leaves had the highest (0.24 mg/g). Air-dried leaves had the highest oxalate content (18.10 mg/g) while sun-dried leaves had the lowest (2.70 mg/g). For saponins, fresh leaves had the highest (4.00 mg/g) while air-dried leaves had the lowest (1.70 mg/g). From the results, it was concluded that sun-dried Terminalia mantaly leaves could be partially or fully incorporated in the diets of livestock, since it generally had low anti-nutritional phytochemical contents, and the highest crude protein content.

Keywords: *Terminalia mantaly*, oxalates, tannins, alkaloids, proximate composition

Introduction

Agriculture is generally known as the cultivation of crops and rearing of animals for human consumption. In recent times, changes in agriculture by government intervention at all levels

have drifted the attention of the masses into various areas of agriculture. The contribution of the agricultural sector to Nigeria's gross domestic product (GDP) has increased from 23.86% in the fourth quarter of the 2014 to 24.18% in the first quarter of 2016 (National Bureau of Statistics, 2016).

In time past, cereals grains supplied much of the feed used in feeding livestock, especially the feeding of pigs and growing of poultry. The increasing use of cereals in livestock production has not only production cost of farmers, but it has led to scarcity of tills feed since human consumption of cereals increases (Adesehinwa *et al.*, 2011). In developing country, of which Nigeria is one, cereal grains are in high demand by humans for various uses, and the production capacity of cereal grain in Nigeria has been on the decline, making it inadequate or scarce for the production of livestock (Adesehinwa *et al.*, 2011; Dairo and Olagbegi, 2008) Even when there is little supply of these grains for use by livestock, it is usually very expensive. Based on this, there is need for livestock producers to look for means of providing alternative, cheaper and more readily available feeds for their livestock.

A number of browse plants worldwide serve as alternate feedstuffs for livestock (Aregawai, and Renhart, 2008)

Common leguminous and non-leguminous browse species that are constantly grazed upon by ruminants and pseudo-ruminant in different part of Nigeria include; *Leucaena leucocephala*, *Adansonia digitata*, *Moringa oleifera*, *Terminalia catappa*, and *Terminalia superba* (Ogunbosoye and Babayemi, 2010). They are of great potential, especially as sources of high quality nutrients for ruminants.

Terminalia mantaly is a large tropical tree in the family *Combretaceae* that is native to the tropical regions of Asia. *Terminalia mantaly* has not been used as an ingredient for livestock feed formulation. However some studies on the medicinal properties of the bark and wood have been reported in traditional medicine. The bark and wood are used in treating dysentery. It is also an excellent spreading shade tree (Orwa *et al.*, 2009). Kokora *et al.* (2013) reported that the extracts of *T. mantaly* on two strains of *Staphylococcus aureus* and *Escherichia coli* had the strongest inhibitory. Zirihi *et al.* (2012) reported that the *T. mantaly* extract was highly significant compared to the water extract of *T. catappa*, and that its hydro-alcoholic extract was slightly more active than the *T. catappa* on *Aspergillus fumigatus*. Thus, it has high antibiotic properties. In order to achieve maximum utilization of this feed resource by farm animals, it is important to ascertain the proximate composition, and the anti-nutritional properties of the leaves, and how drying (air-drying and sun-drying) impacts on the nutritional properties of the leaves. That way, an insight into its suitability for use in diets of livestock, especially of monogastric animals at low costs can be gained.

Material and Methods

Experimental Location

The study was carried out in the Teaching and Research laboratory of the Department of Animal Science, Delta State University, Asaba Campus, Asaba, Nigeria. Asaba is located at

latitude 16°14N and longitude 6°49E, and has an average annual temperature of 28±6°C. It has a mean annual rainfall of 1505-1849.3mm, relative humidity of 69.80% and sunshine of 4-8bars. It lies within the rainforest agro-ecological zone (Asaba Metrological Station, 2016).

Collection and Processing of Experiment Samples

The *Terminalia mantaly* leaves used in this experiment were harvested from its trees within the University vicinity.

Two hundred and fifty grammes (250g) portions of fresh *Terminalia mantaly* leaves were weighed and processed by air-drying and sun-drying.

The *Terminalia mantaly* leaves used were processed as follow;

Fresh Green: The fresh green samples were crushed in a mortar.

Air-dying: The samples were spread in a well-ventilated room at the Animal Science Department Laboratory, Asaba Campus, at room temperature (approximately 28.5°C) for forty-eight (48) hours.

Sun-drying: The *Terminalia mantaly* leaves samples were sun-dried on a special drying platform at the University premises at a mean temperature of 33.2°C for two days.

Determination of Proximate/Phytochemical Composition

Samples of fresh, air-dried and sun-dried *Terminalia mantaly* leaves were subjected to laboratory analysis to determine their proximate composition (moisture, crude protein, crude fibre, ash, ether extract and nitrogen free extracts) and phytochemical properties (alkanoids, cyanogenic glycosides, flavonoids, phenol, saponin, tannin and oxylate).

(i) Moisture

Procedure: about 2g of a feed sample was weighed into a previously dried and weighed crucible. The sample is was dried in an oven for 70°C for 36 hours, cooled in a desiccator, and weighed. The drying and weighing continued until a constant weight is was achieved.

$$\% \text{ Moisture} = \frac{100 (\text{Weight of sample before drying} - \text{Weight of sample after drying})}{\text{Weight of sample before drying}}$$

(ii) Ash Content

Procedure: About 2g of the sample was weighed into a pre-heated crucible. The crucible was placed into muffle furnace at 400-600°C for 4hrs until whitish-grey ash was obtained. The crucible was then placed in the desiccator and weighed.

$$\% \text{ Ash} = \frac{100 (\text{Weight of crucible} + \text{Ash}) - \text{Weight of crucible}}{\text{Initial weight of sample}}$$

(iii) Crude protein (CP)

Digestion: About 2g of the sample was weighed into a Kjeldahl flask with 25ml of concentrated sulphuric acid, 0.5g of copper sulphate and a speck of selenium tablet. Heat was

applied and the sample was digested for 45 minutes until the digesta became clear pale green. It was allowed to cool and 100mls of distilled water was added to it.

Distillation: Markham was used for distillation. The distillation apparatus was steamed up and about 10ml of the digesta was added into the apparatus via a funnel and was allowed to boil. Add 10mls of sodium hydroxide from the measuring cylinder so that ammonia is not lost. Distill into 50mls of 2% boric acid containing methyl red indicator.

Titration: the alkaline ammonium borate formed was titrated directly with 0.1NHCl. The titre value which is the volume of the acid was recorded.

VA= volume of acid used

W= weight of sample

%CP = %N X 6.25

Crude Fibre (CF)

Procedure: Petroleum ether is added to the fresh sample used, stir and allow it to decant. This is done three times. The free fat material is transferred into a flask and 100mls of pre-heated 1.25% H₂SO₄ is added and the solution was boiled for 30mins to maintain a constant volume of acid by the addition of hot water. The buckner flask and funnel fitted with Whitman filter is pre-heated by pouring hot water into the funnel. The boiled acid sample is then filtered hot through the funnel under sufficient suction. The residue is washed several times with boiling water and transferred back into the beaker. 100ml of pre-heated 1.25% Na₂SO₄ is added and boiled for 30mins. Filter under suction and wash thoroughly with hot water six times and lastly with methylated spirit. The residue is dried at 650°C for about 24hrs and is weighed. The residue is transferred into a crucible and placed in muffle furnace (400-600°C) and ash for 4hrs, then cool in a dessicator and weigh.

$$\% \text{ Crude fibre} = \frac{100 (\text{weight of residue before ashing} - \text{weight of residue after ashing})}{\text{Initial weight of sample}}$$

5. EtherExtract: It consists of three major components namely:

- An extractor, comprising the thimble, which holds the sample.
- Condenser: for cooling and condensing the ether vapors.
- 250ml flask.

Procedures: About 150ml of anhydrous diethyl ether (petroleum ether) of boiling point of 40-600°C is placed in the flask. 2g of the sample is weighed into the thimble. The thimble with content is placed into the extractor; the ether in the flask is then heated. As the ether vapor reaches the condenser through the side arm of the extractor, it condenses to liquid form and drop back into the sample in the thimble, the ether soluble substance are dissolved and are carried into solution through the siphon tube back into the flask. The extraction continued for

at least 7 hours. The thimble is removed and most of the solvent is distilled from the flask into the extractor. The flask is then disconnected and placed in an oven at 650°C for 4 hours, it is cooled in the dessicator and weighed.

$$\% \text{ Ether extract} = \frac{100 (\text{Weight of flask + extract}) - \text{weight of flask}}{\text{Weight of sample}}$$

Qualitative Analysis of Phytochemical Constituents

Test for tannins

The extract prepared (2 ml) was stirred with 2ml of distilled water and few drops of Iron (III) chloride (FeCl₃) solution (5% w/v) was added. The formation of a green precipitate indicated the presence of tannins (Sofowora, 1993).

Test for saponins

The extract prepared (5 ml) was shaken vigorously with 5ml of distilled water in a test tube. The formation of stable foam, honey comb in shapes, indicated the presence of saponins (Sofowora, 1993).

Test for steroids

A red colour produced in the lower chloroform layer when 2ml of the extract was mixed with 2ml of chloroform and 2ml of concentrate sulphuric acid added in a test tube indicated the presence of steroids (Ogbuewu, 2008).

Test for alkaloids

The extract prepared (3 ml) was stirred with 3ml of 1% hydrochloric acid (HCl) on a steam bath. Mayer's and Wagner's reagents were then added to the mixture. Turbidity of the resulting precipitate was an evidence for the presence of alkaloids (Harborne, 1973).

Test for cyanogenic glycosides

Salkowski's test was employed. The extract (2 ml) was dissolved in 2ml of chloroform; then 2ml of sulphuric acid was added carefully and shaken gently. A reddish brown ring colour at the interface signified the presence of a steroidal ring (i.e., a glycone portion of glycoside) (Trease and Evan, 1983).

Test for flavonoids

To 1ml of the extract, was added 1ml of 10% lead acetate solution. The formation of a yellow precipitates was taken as a positive test for flavonoids (Sofowora, 1993).

Preparation of fat free sample

The sample (2g) was weighed and defatted with 100ml of diethyl ether using a Soxhlet apparatus for 2 hours (Padamanabhan *et al.*, 2014).

Statistical Analysis

The experiment was subjected to one way analysis of variance (ANOVA) in a Completely Randomized Design (CRD) using GenStat (Release 4.24) statistical package (Genstat, 2010). Duncan's Multiple Range Test (DMRT) was used to differentiate the means.

Results

Proximate Composition of fresh and dried Terminalia mantaly leaves

The result of the proximate analysis, presented in Table 1, shows that drying significantly ($P < 0.05$) increased the crude protein contents of *Terminalia mantaly* leaves, with sun-drying producing the highest crude protein content of 13.13%, while the fresh samples had the lowest protein content of 5.60%.

Table 1: Proximate Composition of *Terminalia mantaly*.leaves

Parameters	T1 (Fresh)	T2 (Air-dried)	T3 (Sun-dried)	SEM
Crude Protein	5.60 ^b	12.00 ^{ab}	13.13 ^a	0.13
Ether Extract	7.69 ^a	5.10 ^b	2.90 ^c	0.06
Dry Matter	91.48 ^a	84.55 ^b	80.62 ^{bc}	0.03
Crude Fibre	23.45 ^a	16.47 ^b	14.57 ^{bc}	17.48
Ash	7.64 ^a	6.75 ^{ab}	4.45 ^c	0.68
Nitrogen free extracts	47.10 ^a	44.23 ^{ab}	45.57 ^a	0.03

* Means with different superscripts within a row differ significantly ($P < 0.05$).

There were also significant differences ($P < 0.05$) between the groups for the ether extract (fat) content in the three samples. Fresh *Terminalia mantaly* leaves had the highest fat content (7.69%) while sun-dried leaves had the lowest fat content of 2.90%. The highest moisture content was recorded in fresh *Terminalia* leaves (91.48%) while sun-dried leaves had the lowest moisture content of 80.62%.

The crude fibre observed showed that fresh samples of *Terminalia mantaly* had the highest value of 23.45% followed by the air-dried sample with 16.47%, with the sun-dried sample having the lowest value of 14.57%.

Sun-dried samples were observed to have the least ash content of 4.45%, followed by air-dried with 6.75% and fresh samples with the highest ash content of 7.64%.

Mean Nitrogen-free extracts of the T1 (fresh samples) were highest among the treatments means (47.10%).

The phytochemicals composition of fresh, air-dried and sun-dried Terminlia mantaly

Fresh *T. mantaly* had the highest contents of cyanogenic Glycosides, flavonoids, phenol, tannins and saponins. For oxalic composition, air-dried sample had the highest (18.10mg/g), while fresh sample had 15.76mg/g, and sundried had 2.70mg/g. Fresh *T. mantaly* samples were observed to have the highest saponin content (4.00mg/g) followed by sundried (2.0mg/g), while air-dried had the lowest saponin (1.79mg/g). Air-dried *Terminalia mantaly* contained the highest mean value of 9.87 and 18.10 for alkanoids and oxylates respectively.

Table 2: Phytochemical Properties of *Terminalia mantaly*.

Parameters	T1 (Fresh <i>T. mantaly</i>)	T2 (Air-dried <i>T. mantaly</i>)	T3 (Sun-dried <i>T. mantaly</i>)	SEM
Alkanoids	7.45 ^a	9.87 ^b	5.43 ^c	0.26
Cyanogenic Glycosides	14.53 ^c	10.72 ^b	6.93 ^a	0.55
Flavonoid	16.67 ^{bc}	14.55 ^b	10.76 ^a	0.32
Phenol	9.45 ^c	5.47 ^b	3.57 ³	0.74
Tannin	0.24 ^c	0.23 ^b	0.03 ^a	0.03
Oxylated	15.76 ^{ab}	18.10 ^a	2.70 ^c	0.03
Saponin	4.00 ^c	1.70 ^a	2.03 ^b	0.06

* means with different superscript within a row differ significantly (P<0.05).

Discussion

Nutritional Profile

The proximate composition of fresh and sun-dried *Terminalia mantaly* leaves which was presented in table 1, shows that the crude protein percent in sundried diets (13.13%) was comparable and differs slightly with air-dried leaves (12.00%), but this differs greatly from the fresh diet (5.60%). The lower values of the fresh leaves may have been due to the anti-nutritional factors present in the leaves. These crude protein values for the different samples fall slightly outside the range of what is reported for some browse plants used in feeding animals; 15.57%-22.38% (Osuntokun and Ajayi, 2014). This implies that the *Terminalia mantaly* leaves have a lower protein content compared to some other browse plants reported for the production of livestock.

The proximate composition of the *Terminalia mantaly* leaf with different processing method, which was presented in table 1, shows that the crude protein percent in sundried diets (13.13%) was comparable and differs slightly with air-dried (12.00%), but this differs greatly from the fresh diet (5.60%). The lower value of the fresh diet is due to the anti-nutritional factors acting on the leaf. These crude protein values for the different diet fall slightly outside the range of what is reported for some browse plant used in feeding animals, 15.57%-22.38% (such as those reported by Osuntokun *et al* (2014). This implies that the *Terminalia mantaly* leaf have a lower protein content compared to other browse plant reported for the production of livestock.

The percentage values obtained for Ether Extract from the proximate composition of the differently processed *T. mantaly* leaves show a higher percentage in fresh leaves, which were

comparably different from the air-dried (5.10%) and the sundried leaves (2.90%). The lower value of the sun-dried leaves can be attributed to the processing technique adopted that induced more heat which reduced the fat content in the leaf. The ether extract values obtained for the *Terminalia mantaly* with the different processing technique (i.e. 2.90 - 7.69%) fell outside the range reported in previous work by Okpara (2016) for *Gmelina* leaves, but air-dried leaf corresponded slightly to his report.

In terms of dry matter percentage of *Terminalia mantaly* leaves, the fresh leaf sample had the highest percentage (91.48%) which was far higher comparatively to that of the air-dried (84.55%) and the sun-dried (80.62%), reason being that it has not been subjected to any processing method. The ash and crude fibre values were relatively higher than the one reported for *Gmelina* by Okpara (2016), which implies that *Terminalia mantaly* has higher ash and crude fiber contents.

The phytochemical analysis for the difference processing techniques used to process the leaves was reported in table 2. Alknoids, flavonoids, phenols, cyanogenic glycosides, tannins, oxylate and saponins were observed to be present in the leaf. The tannin concentrations were higher in the fresh leaf (0.24) which slightly differed from the air-dried (0.23), but differed greatly from the sundried (0.01). The saponin concentration reported shows that there was a higher saponin presence in the fresh (4.00) than in the air-dried (1.70) and the sundried (2.00) samples. The saponin concentrations were within the range as reported by Zirihi *et al.*, (2012). There was higher oxylate in the air-dried (18.10) than the fresh (15.76) and the sun-dried (2.70) leaves

Conclusion

Proximate analysis of the processed *Terminalia mantaly* leaves showed that they contained major nutrients required for the production of livestock, such as (protein, fat and energy), Phytochemical analysis of *Terminalia mantaly* indicated the presence of anti-nutritional factors, which reduce the availability of one or more nutrient whose effect was recorded in the fresh leaves as having low protein content.

Drying (air-drying and sun-drying) improved the nutritional value in relation to the protein content, except for fresh *Terminalia mantaly*. Sun-drying also reduced the anti-nutritional values of the sun-dried *Terminalia mantaly*.

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