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Comparative Proximate Analysis of Leaves and Bark of *Alchornea Cordifolia* (Euphorbiaceae)

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Abstract

This study was conducted to determine and compare the nutritional value of the leaves and bark of *Alchornea Cordifolia* using standard analytical method (Proximate analysis). Three samples of leaves and bark of *Alchornea Cordifolia* were taken and analyzed for its nutritional content. The result of leaves revealed the presence of 13.19% of Crude Protein, 1.12% of Ether Extract, 33.58% of Crude Fiber, 58.51% of Neutral Detergent Fiber, 39.71 % of Acid Detergent Fiber, 15.65% of Acid Detergent Lignin, 8.72% of moisture, 91.27% of dry matter and 96.36% of Organic matter. The proximate analysis on the bark also revealed the presence of 5.61% of crude protein, 0.72% of Ether Extract, 31.37% of Crude Fiber, and 60.57% of Neutral Detergent Fiber, 49.64% of Acid Detergent Fiber, 29.23% of Acid Detergent Lignin, 10.06% of moisture, 89.93% of dry matter, and 89.65 % of organic matter for bark. The results confirmed that there is variation in nutritional value of *Alchornea Cordifolia* leaves and bark. However, the results indicated that *Alchornea Cordifolia* is a good source of nutritional elements which supports their use as food and medicinal plant.

Keywords: *Alchornea Cordifolia*, proximate analysis, nutritional value, standard analytical method, Leaves and bark.

1. Introduction

African forests are blessed with precious and rich plants species. One of the opportune country among is Cameroon, West African country, whom is blessed with different plants species. Most of these plants species are either use as traditional medicine or as food. *Alchornea Cordifolia* (Euphorbiaceae) is one of the precious and rich plants that were used for medicinal purposes. All parts of the plant are known to contain variety of phytochemicals exhibiting medicinal values(Philipet al., 2014).*Alchornea Cordifolia* (referred to as Christmas bush), also called *Libo'owhile* by the "Bakoko" people in Cameroon **(**Mamadou, 2005), is native to Senegal, East Kenya, South Tanzania,and throughout Central Africa to Angola. This plant usually grows very close to water bank, moist or marshy places to a significant height while remaining in a shrubby or scrambling habit (Kwabena, 2012).

Alchornea Cordifolia is a perennial evergreen shrub or small tree up to 4 -8 m high, with erected young shoots, which become horizontal, hollow and glabrous later (Timibitei et al., 2013).The plant has a woody stem with many branches carrying leaves and bushy when young. The leaves are simple, alternate broadly - ovate and 10 - 28cm long and 6.5 - 16.5cm wide, with smooth blade to touch, and generally coated with few glands at the base (Timibiteiet al., 2013). The plant possesses unisexual and sessile flowers. The male flower have 2 cup -shaped sepals and 8 stamens, while the female are identified with 2-4 lobed calyx. The fruit is made up of 3 -lobes capsule, usually green or red with ovoides seeds (Noundou, 2012).

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Different research findings related to these plants was indicating that, the plant was richer in many biological components of pharmaceutics interest (Adeshina et al., 2012). The most common among them are; terpenoids, steroid glycosides, flavonoids, tannins, saponins, carbohydrate and imidazopyrimidine alkaloids, alchorneine, alchornidine, guanidine alkaloids, hydroxybenzoic acid, namelygallic acid and its ester, anthralinic acid,ellagic acidand Alchornoic acid (Agyare et al., 2014; Noundou, 2012). It was believed to known that, most plants that were used in traditional medicine are also known to be used as food. The leaves and bark of *Alchornea Cordifolia* are commonly used in zero-grazing for the feed of small ruminants by rural livestock farmers; also, local inhabitants used these plants to cure many ailments/diseases in humans (Nodu et al., 2014).

In traditional medicine, mostly *Alchornea Cordifolia* leaves are used compared to bark, stem, fruits, and their roots (Mohammed et al., 2012). The grounded leaves were locally apply for the management of rheumatism, pain, toothache, pile and arthritis(Osadebe and Okoye, 2003).Different research findings were conducted on pharmacological activity of various part of *Alchornea Cordifolia*. It was revealed that, *Alchornea Cordifolia* was precious and rich in pharmacological activities. In the findings of Thomford et al. (2015), *Alchornea Cordifolia* leaves extract found to have anti-diabetic activity. *Alchornea cordifolia* plant part has also assigned to possessed analgesic, anxiolytic and anti-inflammatory potential (Ismaila et al., 2012; Kamenan, 2013; Marva-Manga, 2004). The plant part also exhibits pasmolytic, bacterial, antimicrobial, anti-diarrhea, anti-malarial and antioxidant activity (Ezeokeke et al., 2015).

Unfortunately, despite the fact that *Alchornea Cordifolia* was very rich with broad spectrum use,but to our knowledge there are limited or no available data regarding the nutritional content of *Alchornea Cordifolia* leaves and bark. In this direction, the research was carried out with the objectives of evaluating the nutritional values of this plant (leaves and bark), via proximate analysis, in order to estimate and compare the nutritional composition of *Alchornea Cordifolia* leaves and bark.

2.0 Methodology

The collection of materials and processing, method/procedure used in conducting the research as well as analyzing the data was described below.

2.1 Collections of plant materials

Fresh mature leaves and bark of *Alchornea Cordifolia* were harvested and collected at Eloudem village, about 31 km from Yaoundé, a capital of Cameroon, West African country. A voucher specimen was deposited at the National Herbarium of Cameroon national under reference number No. 33548/CST. The harvested parts of *Alchornea Cordifolia* leaves and bark were cut into smaller pieces and allowed to dry on a free air-dried for about a week. After drying, both sample of dried leaves and barks were crushed into powder using an electric grinding machine. Different proportion of the samples was taken for the proximate analysis for the determination of their nutritional contents (AOAC, 1999). The study was conducted at the Nutritional laboratory of Department of Animal Science, Faculty of Agriculture, Universiti Putra Malaysia.

2.2 Procedures in conducting the proximate analysis

All the plant samples in powder form were subjected to analysis of crude protein, Ether Extract content, Crude Fiber, Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Acid Detergent Lignin (ADL), moisture and dry matter using different analytical methods. The analyses were carried out in accordance with the Association of analytical chemist (AOAC, 1999). All methods used in conducting the proximate analysis is as follows;

2.2.1 Determination of crude protein

Crude protein content was determined by Kjeldahl (digestion) method. Accurately weighed 1g of sample was transferred to kjeldahl flask. One tablet of catalysts and 12 ml of concentrated H_2SO_4 (98%) acid. Then 3ml of H_2O_2 were added slowly. After the reaction was complete the tubes were placed in a preheated block digester at 410 °C .The digestion was continued until mixture was clear. Tubes were then removed and cooled for 10 minutes at room temperature. The percentage of crude protein was obtaining using kjeldahl apparatus.

2.2.2 Determination of Ether Extract (crude fat)

3 g of sample was transfer in extraction thimble and the thimble was placed in soxhlet apparatus. 150 ml of petroleum ether was add in a pre weight aluminum cup and place in the soxhlet apparatus.

The total lipids from the feed samples were extracted by soxhlet apparatus at 60 °C and the extract was dry for 30 minutes at 100 °C and cool and weigh. Total lipid contents were determined as follow.

$$\text{Crude fat (\%)} = \frac{(\text{weigh of cup+extracted lipid}) - (\text{weigh of empty cup})}{\text{weigh of the sample}} \text{ X } 100$$

2.2.3 Crude fiber

Crude fiber content of both leaves and bark samples were determined. 2 g feed samples were digested with 150 ml of 0.1275 M H_2SO_4 for 30 minutes. The content was Filtering over Buchner funnel using filter paper N 51 and rinse with hot water to remove acid. Further residue was boiled with 150 ml of 0.313 M KOH for 30 minutes, then rinsed with boiling water and acetone. The residue was dried in an oven at 105 °C for 12 hours and weigh then transfer in muffle furnace at 520 °C for 3 hours. The loss of weight represented the crude fiber. The crude fiber was calculated as follow.

$$\text{Crude Fiber (\%)} = \frac{(\text{weigh of crucicble+filtred dry residy}) - (\text{weigh of crucuble+ash})}{\text{weigh of the sample}} \text{ X } 100$$

2.2.4 Determination of Neutral Detergent Fiber (NDF)

1g sample of leaves and barks was put into a beaker and 100 ml of Neutral detergent solution was added. The mixture was heated and allowed to boil for 60 minutes. After boiling, the content was filtered using a crucible and rinsed with boiled distilled water and finally with acetone. The crucible was dried in the oven for 24 hours and weighed.

$$\text{NDF (\%)} = \frac{(\text{weigh of the crucible + residue}) - \text{weith ofcrucible}}{\text{weigh of the sample}} \text{ X } 100$$

2.2.5 Determination of Acid Detergent Fiber (ADF)

1g of the sample was weighed and put into beaker. 100 ml of acid detergent solution was added and the beaker was heated and allowed to boil for 60 minutes. After boiling, the content is filtered using a crucible and rinse with boiled distilled water and finally with acetone. The crucible was dried in the oven for 24 hours and weighed.

$$\text{ADF (\%)} = \frac{(\text{weighofthecrucible + residue}) - \text{weithofcrucible}}{\text{weighofthesample}} \text{x} 100$$

2.2.6 Determination of Acid Detergent Lignin (ADL)

Crucibles with residues from ADF were placed on a glass try with sides and 72% of H_2SO_4 was added to the crucible to totally wet the residue. After 3 hours, the remaining acid was drained from the crucible by using vacuum pump. The content was rinsed with hot distilled water and dried in the oven for 24 hours for ashing and weighed.

$$\text{ADL (\%)} = \frac{(\text{weigh of crucible + residu aftert drying}) - (\text{weight of crucible+ash})}{\text{weight of sampl}} \text{ X } 100$$

2.2.7 Determination of moisture content

The moisture content of the sample was calculated by using procedure via the sample drying method in an oven at 105°C temperatures for 12- 24 hours to its constant weight. The moisture content was calculated as follows:

$$\text{Moisture (wt/wt) (\%)} = \frac{\text{Wt: of wet sample} - \text{Wt: of drysample}}{\text{Wt: of wet sample}} \text{ x } 100$$

2.2.8 Determination of organic matter content

Organic matter content in both leaves and bark powder samples was determined using Association of the Official Analytical Chemists (AOAC, 1995) methods. First crucibles were dried at 100°C for 2 hours in an oven and placed in desiccators, cooled and recorded their weights. 2 g of sample was placed into the crucible, recording weight of crucible with cover and sample.

The samples were then placed in a furnace for8 hours at 550 °C until all carbon was removed (ashing). Percentage of organic matter content was measured by the resulting inorganic residuein percentage as follows:

$$\text{Organic matter (\%)} = \frac{\text{Wt:of ash}}{\text{Wt:of sample}} \times 100$$

2.3 Data Analysis

All the data obtained was subjected to one-way ANOVA using (SAS Institute software, 2010) 9.4 version. Statistical test was performed on level of nutritional content of both leaves and barks (*Alchornea Cordifolia*), comparison between the level of nutritional content of both leaves and barkswere done using Duncan multiple range test at P< 0.05.

3.0 Results

Table 1: Nutritional contain of leaves and bark of *Alchornea Cordifolia*

	PLANT PARTS		
PARAMETER (%)	Leaves (Means ± STD.DEV)	Bark (Means ± STD.DEV)	CV
Crude protein (CP)	13.19^{a}± 0.31	5.61^{b}±0.15	2.62
Ether extract (EE)	1.12^{a}±0.47	0.72^{a}±0.34	12.65
Crude fiber (CF)	33.58^{a}±3.14	31.37^{b}±0.38	6.90
NDF (%)	58.51^{a}±1.13	60.57^{a}±0.71	1.58
ADF (%)	39.71^{a}±6.44	49.63^{a}±1.78	10.58
ADL (%)	15.65^{b}±3.90	29.23^{a}±2.14	14.02
Moisture (%)	8.73^{b}±0.08	10.07^{a}±0.05	0.68
Dry matter (%)	91.27^{a}±0.07	89.93^{b}±0.05	0.07
Organic matter (%)	96.36^{a}±0.03	89.65^{b}±0.07	0.06
Ash (%)	3.65^{b}±0.03	10.35^{a}±0.08	0.84

Note: - $^{a, b}$ Values with different superscript are significantly different (p<0.05), (P<0.05): Alpha is less than 0.05, STD-DEV: Standard deviation, CV: Coefficient of variation, NDF: - Neutral Detergent fiber, ADF**:** -Acid Detergent fiber, ADL: - Acid Detergent lignin

The result of the nutritional contents of the leaves and bark of *Alchornea Cordifolia* was presented (Table 1). The result was indicating that, there was a significant difference (P<0.05) on level of crude protein between leaves and bark. The highest mean crude protein (CP) (13.19%) was obtained in the leaves, while the bark is with the lowest mean crude protein (5.61%). In case of Ether extract result, there was no significant (P<0.05) different between leaves and bark. However, higher and lower level of ether extract (1.12% and 0.72%) was obtained in leaves and bark respectively. On Crude fiber result, there was a significant (P<0.05) between leaves and bark on level of CF. The highest mean of CF was obtained with the leaves (33.58%), while the bark is with the lowest (31.37%) level of CP. The result of NDF was indicating that, no significant (P<0.05) difference was observed between leaves and bark. However, higher mean NDF (60.57%) was obtained with the bark, while the leaves are with the lowest mean NDF (58.51%).

Similarly, on ADF result, no significant (P<0.05) difference was observed. The higher level (49.63%) of ADF was obtained with the bark, while lower ADF level (39.71%) was recorded with the leaves. However, the result of ADL is showing a significant (P<0.05) difference between leaves and bark. The highest and lowest mean ADL (15.65% and 29.23%) was obtained with the leaves and bark respectively. Regarding the moisture content result, there was a significant (P<0.05) difference between leaves and bark. The bark recorded higher level (10.07%) of moisture than the leaves (8.73%). Similarly, significant (P<0.05) difference occur between leaves and bark on dry matter (DM) content. The highest and lowest level of DM (91.27% and 89.93%) was obtained with the leaves and bark respectively. Also, on organic matter (OM) result, there was a significant (P<0.05) difference between leaves and on level of OM.

Higher level (96.36%) of OM was obtained with the leaves, while lowest mean OM (86.65%) was observed in the bark of *Alchornea Cordifolia* plant. The result present significant ($P<0.05$) difference on ash content between leaves and bark of *Alchornea Cordifolia*. The highest mean value of ash was obtained in bark (10.35%) while the leaves is with the least value (3.65%).

4.0 Discussion

The present result on CP of *Alchornea Cordifolia* plant coincides with other research finding outcome. On observation in related to this result, the crude protein was present in high proportional amount in the leaves (13.19%) and lower proportion in the bark (5.61%). Similarly, differences in crude protein value among plant part have been reported by Dastagir et al.(2013) which observed that crude protein may vary among plant parts. The protein content of leaves is within the standard range of 8 % to 30 % of dry weight basis like other leafy vegetables (Huskie et al., 2010). This value is also almost nearer to the one reported by Priya and Chavan (2015) from the leaves of *Carallia Brachiate* (13.59%).According to Priya and Chavan (2015), a plants with more than 12% of calorific value from protein can be considered as a good source of protein. This statement, supported the use of leaves as a food to humans and also to ruminant animals.

Availability of energy in food and its ability to regulate blood pressure can be estimated by its fat contents. However, fat consumption must be less than 30 calories. *Alchornea Cordifolia* leaves is rich in crude fat compared to bark. A food stuffs having crude fat value of 1-2% is sufficient to maintain good health by reducing risk of diseases such as obesity, atherosclerosis, cancer, and aging caused by its excess consumption (Sodamade, 2013). Thomfordet al. (2015) found that leaves *Alchornea Cordifolia* can be used to maintain a glucose and lipid level which is in relation with the value of fat present in the leaves and bark.

Plant with high amount of fiber are advised for the treatment of obesity, diabetes, cancer and gastrointestinal disorders prevent coronary heart disease, hypertension, constipation, diabetes (Ibironke, 2013; Iniaghe, 2009). The leave and bark of *Alchornea Cordifolia* are rich in crude fiber and this is a dietary advantage knowing that crude fiber assist digestion and limited cholesterol absorption. This result agreed with the findings of Mohammed et al. (2012) who noticed that the leaves have anti-diabetic effect. Crude fiber is also associated to high bowel movement which can cause abortion (Abolaji et al., 2007). This plant part can thus be advised as digestive helper while it is not advisable for pregnant women. The high significant level of ADL in the bark is in consistent with Chaves et al. (2012) who reported that, lignite is more present in high proportion in stem than leaves.

The amount of moisture in plant material determines its absorption and assimilation rate within an organism. Thus, the plant moisture content determines storability and plant quality since high moisture content is associated with lower storage stability .The reasonable amount of moisture in most vegetable is 6 % to 15% (Rishi et al., 2012). This contributes in slowing the growth and development of microorganism and inhibiting hydrolysis of component present in plant material, so that the material can be stockpiled for a long period time with no risk of microbial attack (Egga et al., 2014; Rishi et al., 2012). This study revealed moisture content to be 8.72% and 10.06% for leaves and bark respectively. These values was consistent with (Egga et al., 2014; Rishi et al., 2012) which means that these plant parts can be stored easily. These values of moisture content are negatively related to the value obtained in dry matter which is consistent with Gbekele-Oluwa (2013) and Adeyemi et al. (2014).

The value of organic matter of each plant part indicated that they also contained minerals elements (ash).This two parameter are commonly used to assess functional properties of vegetable and also indicate food mineral intake (Ajetunmobi, 2014). The significant high proportion of organic matter in leaves compared to bark is associated with significant high value of ash in bark compared to leaves. These parameter indicated that barks are rich in mineral constituents than leaves.

Conclusion

This present study on nutritional content of *Alchornea Cordifolia* was indicated that, with some differences among the proportion of tested elements in leaves and bark, both parts have recommendable nutritive values for both animal and human nutrition. Their uses can be viewed as a good source of nutritional and therapeutic elements that can be explored in the field of nutritional and pharmaceutical industry.

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