

# Proximate and Phytochemical Composition of Leaves of *Ceiba pentandra*, *Manihot esculentus* and *Abelmoschus esculentus* in Southwestern Nigeria

\***Raimi, Monsurat M.**

Department of Applied Sciences  
Osun State Polytechnic, Iree  
Nigeria

\*Corresponding author: [raimimonsurat@gmail.com](mailto:raimimonsurat@gmail.com)

**Oyekanmi, Adeyinka M.**

Department of Applied Sciences  
Osun State Polytechnic, Iree  
Nigeria

**Farombi, Abolaji G.**

Department of Science Laboratory Technology,  
Osun State Polytechnic, Iree  
Nigeria

**Abstract-** The leaves of *Ceiba pentandra* (Java), *Manihot esculentus* (Cassava) and *Abelmoschus esculentus* (Okra) are consumed as vegetables in Southwestern Nigeria. The proximate and phytochemical composition of these leaves were investigated using standard procedures. Powdered dried leaves of Java, Cassava and Okra were analysed for ash, moisture, fat, fibre, protein, carbohydrate, tannins, flavonoids, phenols and ascorbic acid composition. The percentage composition result values for ash, moisture, fat, fibre, protein and carbohydrate in the leaves ranged from 15.00% - 6.30%, 0.15% - 4.85%, 9.60% - 8.40%, 25.44% - 17.55%, 21.16% - 8.65% and 41.25% - 32.65% respectively. Tannins, flavonoids and phenols composition values ranges were 8.98% - 0.81%, 4.71% - 0.12% and 0.07% - 0.03% respectively while ascorbic acid content ranged from 3.16mg/100g to 2.84mg/100g. The result values obtained have shown that these leaves have good nutritive and therapeutic values and there is need for increased inclusion of these leaves as vegetables in everyday meal.

**Index Terms**— Cassava, Java, leaves, Okra, phytochemical, proximate

## I. INTRODUCTION

*Ceiba pentandra* is a tropical tree of the order *Malvales* and the family *Malvaceae* (previously separated in the family *Bombacaceae*), native to Mexico, Central America and the Caribbean, Northern South America and (as the variety *C. pentandra* var *guineensis*) to tropical West Africa. Kapok is the most used common name of the tree and may also refer to the fibre obtained from its seed pods. The tree is also known as the Java cotton, Hara kapok, Silk cotton or *Ceiba* [1]. It is the largest African forest tree and severally known among some Nigerian ethnic groups as Rimi (Hausa), Bamtami (Fulani), Arabaogungun (Yoruba) and Akpi (Igbo) [2]. In Nigeria, the leaves are cooked in form of slurry sauce comparable to Okra. The young leaves or the shoots are normally used for soup (sauce). A powder prepared from dried leaves is used to prepared sauce during the dry season [3].

*Manihot esculentus*, Crantz (Cassava) is the important source of energy as staple food for more than 500 millions people in Africa, Latin America and Asia. Tuber of Cassava is used as raw materials in the garment, bakery, food and pharmaceutical industries. Cassava root can be consumed raw as a snack or just after boiling like sweet potato. Though, tuber is the main product of Cassava plant, its young branch and leaf is also edible both for human and animals [4]. Nigeria alone, currently produces over 14million tones annually representing about 25% of sub-saharan Africa's output [5]. This implies that millions of tonnes of Cassava leaves are available annually as green vegetable.

*Abelmoschus esculentus* (L) Moench (Okra) belongs to the family *Malvaceae*. It is a plant of African origin and is known under various local names; *Abelmoschus esculentus* which was earlier designated as *Hibiscus esculentus* established by Carlos Lineaus in 1737. In Nigeria, it is known as "Ila" in Yoruba, Kubewe in Hausa and "Okwale in Igbo" land [6]. The plant is native to Africa and is now grown in many areas such as Asia, Middle East and Southern states of the USA. Okra is processed to be clear soup or just consumed as fresh vegetable [7]. It is a vegetable valued for many of its properties. The fruits are used as boiled or fried vegetable and added to soups and stews. Mature pods of Okra contain a mucilaginous substance; young shoots and leaves are edible [8].

Vegetables are the fresh and edible portions of herbaceous plant which can be eaten raw or cooked. Vegetable may be edible roots, stems, leaves, fruits or seed [9]. A closer look at the vegetable content of the diet in this geographical (Southwestern) area of Nigeria however revealed that very few vegetables are routinely included in the diet compared to the abundance of vegetables in the area. This can be attributed to the inadequate knowledge of dietary and medicinal use of some of these plants [11].

Many of the local vegetable materials are underexploited because of inadequate scientific knowledge of their nutritional potentials [10]. Increased vegetable utilization

and consumption are critical to alleviate worldwide incidence of nutritional deficiencies [12].

This study investigated the proximate and phytochemical composition of the leaves of *Ceiba pentandra* (Java), *Manihot esculentus* (Cassava) and *Abelmoschus esculentus* (Okra).

## II. MATERIALS AND METHODS

The leaves of *Ceiba pentandra* (Java), *Manihot esculentus* (Cassava) and *Abelmoschus esculentus* (Okra) plants were collected from farmlands in Ikirun, Nigeria. These leaves were carefully washed and air dried for two weeks. The dried leaves were ground into powder (mesh size 40) and kept in properly labeled air tight containers prior to analysis. Proximate analysis for ash, moisture, fat, fibre, protein and carbohydrate composition was according to the procedures of A.O.A.C., [13]. Tannins, flavonoids and phenol analysis were carried out according to methods described by Edeoga *et al.*, [14]. Ascorbic acid determinations were according to methods described by Okwu and Josiah, [15]. All analyses were done in triplicate and results are presented as mean  $\pm$  standard deviation of triplicate determinations.

## III. RESULTS AND DISCUSSION

The results obtained for the proximate and phytochemical composition of the leaves of *Ceiba pentandra* (Java), *Manihot esculentus* (Cassava) and *Abelmoschus esculentus* (Okra) are presented in Tables 1 and 2 respectively.

The moisture contents of the leaves ranged from 9.15% - 4.85% (Table 1). The low moisture contents of these leaves suggest that these leaves can keep for a long time without spoilage and can thus be useful as soups in the dry season when common vegetables are scarce. Percentage moisture content values of 79.98, 87.84, 89.47 and 83.46, and 9.6, 10.2 and 10.8 have been reported for *Corchorus olitorius*, *Ocimum gratissimum*, *Talinum triangulare* and *Telfaria occidentalis* [9], and *Zanthoxylum zanthoxyloides*, *Vitex doinana* and *Adenia cissampeloides* [16] respectively.

Percentage ash content values, an index of mineral contents, obtained in this study (15.00% - 6.30%) compare favourably with leafy vegetables such as *Ochthocharis dicellandroides* (4.19%) [17], *Urera trinervis* (5.54%) and *Hippocratea myriantha* (6.14%) [18], and *C. olitorius* (0.64%), *O. gratissimum* (0.83%), *T. triangulare* (0.55%) and *T. occidentalis* (0.49%) [9]. Values reported for *Amaranthus asper*, and *Amaranthus hybridus* and *Cucurbita pepo* were 18.5% [11], and 17.70% and 15.20% [17] respectively.

This study reveals that the leaves of *C. pentandra* (Java), *M. esculentus* (Cassava) and *A. esculentus* (Okra) contain moderate quantities of fat ranging from 9.60 - 8.40%, thus the consumption of 100g of Java, Cassava and Okra leaves will provide 84.6, 96.4 and 75.6 Kcal of energy respectively. The values obtained in this study are high compared to those of the leaves of *Brassica oleracea* (0.26%) [19], *Rumex crispus* (0.30%), *Taraxicum officinale* (0.21%)

and *Medicago denticulata* (0.14%) [20], *C. olitorius* (5.07%), *O. gratissimum* (3.89%), *T. triangulare* (2.57%) and *T. occidentalis* (4.22%) [9] while the fat content values obtained in the studied leaves are lower than those of *Annona senegalensis* (24.0%) [21] and *Pachira gabra* (15.29%) [22].

The studied leaves have high percentage fibre composition (25.44 - 17.55%) which surpasses the value for certain commonly consumed vegetables such as *Celosia argentea* (1.8%) [23], *C. olitorius* (0.33%) *O. gratissimum* (3.89%), *T. triangulare* (2.57%) and *T. occidentalis* (4.22%) [9]. The recommended dietary allowance (RDA) of fibre for children, adults, pregnant and lactating mothers are 19-25, 21-38, 28 and 29 respectively [24]. Fibre in human diet helps to prevent overabsorption of water and the formation of hard stools which can result in constipation. Besides, fibre lower the body cholesterol level thus reducing the risk of cardiovascular disease [26]. Fibre aids and speeds up the excretion of waste and toxins from the body, preventing them from sitting in the intestine or bowel for too long which could cause a build up and lead to several diseases [9].

The protein composition of leaves of *C. pentandra* (Java), *M. esculentus* (Cassava) and *A. esculentus* (Okra) were 18.80%, 21.16% and 8.65 % respectively. The health implications of protein consumption include the involvement of its essential and nonessential amino acids as building blocks for protein biosynthesis not only for the growth of infants and children but also for the constant replacement and turnover of body protein in adult [24]. These leaves are thus good, rich and cheap sources of protein as compared to expensive animal protein sources. Leafy vegetables such as *Piper umbellatum* and *Peperomia pellucida*, *M. denticulata* and *R. crispus*, *O. dicellandroides*, *Azelia africana*, *B. oleracea*, *A. senegalensis* and *A. hybridus*, *C. pepo* and *Gnetum africana* reportedly have protein values of 3.9% and 7.7% [25], 5.99% and 1.82% [20], 15.50% [17], 16.52% [22], 11.67% [19], 8.80% [21], and, 32.95%, 20.80% and 19.657% [26] respectively.

The percentage carbohydrate content of the leaves in this study (41.25% - 32.65%) is higher than 2.43%, 6.25% and 8.07%, 11.73% and 3.17%, 4.45%, 5.65% and 6.25% reported for *R. crispus*, *M. denticulata* and *T. officinale* [20], *O. dicellandroides* [17], and *T. triangulare*, *O. gratissimum*, *T. occidentalis* and *C. olitorius* [9] respectively. However, 42%, 48.8%, 52.18%, 59.7% and 75.74% carbohydrate content values were reported for *P. pellucida* [25], *A. asper* [11], *A. hybridus* [27], *Elais guineensis* [28], and *Indigofera astragalina* [29] respectively. Carbohydrate provides energy to the cells in the body, particularly the brain, the organ whose only energy source is carbohydrate.

Tannins, flavonoids, phenols and ascorbic acid composition of the leaves of *C. pentandra* (Java), *M. esculentus* (Cassava) and *A. esculentus* (Okra) are presented in Table 2. Flavonoids are known to possess antibacterial, anti-inflammatory, anti allergic, antiviral and antineoplastic activity [17]. Tannins are well known for their antioxidant and antimicrobial properties as well as for soothing relief, skin regeneration, as anti-inflammatory and diuresis [25].

Table 1. Proximate composition of the leaves of *Ceiba pentandra*, *Manihot esculentus* and *Abelmoschus esculentus*

Parameter	Percentage composition (%)		
	<i>Ceiba pentandra</i>	<i>Manihot esculentus</i>	<i>Abelmoschus esculentus</i>
Moisture	5.30±0.17	4.85±0.02	9.15±0.00
Carbohydrate	34.41±0.30	32.65±0.05	41.25±0.12
Protein	18.80±0.01	21.16±0.09	8.65±0.02
Fat	9.40±0.10	9.60±0.14	8.40±0.01
Fibre	21.69±0.20	25.44±0.40	17.55±0.07
Ash	10.40±0.03	6.30±0.00	15.00±0.11

Values are expressed as mean ± standard deviation of triplicate determinations

Table 2. Phytochemical composition of the leaves of *Ceiba pentandra*, *Manihot esculentus* and *Abelmoschus esculentus*

Parameter	Composition (%)		
	<i>Ceiba pentandra</i>	<i>Manihot esculentus</i>	<i>Abelmoschus esculentus</i>
Tannins	0.81±0.13	9.83±0.06	8.98±0.04
Flavonoids	0.12±0.01	4.51±0.03	4.71±0.02
Phenols	0.03±0.00	0.07±0.00	0.03±0.01
Ascorbic acid (mg /100g)	2.84±0.02	3.00±0.01	3.16±0.01

Values are expressed as mean ± standard deviation of triplicate determinations

Phenols are strong antioxidants which prevent oxidative damage to biomolecules such as DNA, lipids and proteins which play a role in chronic diseases such as cancer and cardiovascular diseases [12]. Ascorbic acid, vitamin C strengthen the body immunity against infection, helps in collagen and thyroxin synthesis and enhance iron absorption [30]. In living organisms, ascorbate (anion of ascorbic acid) is an antioxidant since it protects the body against oxidative stress and is a cofactor in several vital enzymatic reactions [31]. These phytoconstituents confer their protective, preventive and therapeutic properties on these leaves and these improve the benefits that can be derived from the consumption of these leaves.

#### IV. CONCLUSION

This study has revealed that the leaves of *Ceiba pentandra*, *Manihot esculentus* and *Abelmoschus esculentus* contain significant quantities of essential nutrient molecules needed for the maintenance of good nutritional status and these leaves compare favourably with commonly consumed vegetables. The presence of phytochemicals with diverse beneficial properties confer health promotion and medicinal values on the leaves. The inclusion of these underutilized leaves in everybody's diet will serve nutritional and health management requirements of man as well as address food crises and life expectancy issues. Thus, increased inclusion of these leaves as vegetables in everyday meal is recommended. Furthermore, governments and agencies should create more awareness on nutritional benefits of underutilized food sources.

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