

Evaluation of the Nutritive Composition of Five Indigenous Tree Leaves Used as Vegetable in Ekiti State

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Abstract

This study was carried out to investigate the nutritional value of five indigenous tree leaves used as vegetable in Ekiti state (*Lecaniodiscus cupanioides*, *Albizia glaberrima*, *Virtex doniana*, *Bombax buonopozense*, and *Sterculia tragacantha*). Leaves used as vegetables are collected from open farm land within the University campus. Samples of the leaves were analyzed for proximate value (ash, moisture, fat, crude fibre, protein, carbohydrate and Energy value). Also anti-nutrient, minerals, vitamins and beta carotenes contents were analyzed. The result obtained from the study established that these components were present in a considerable amount in leaves investigated and that they varied significantly within and between the tree species. The result on proximate composition shows that *Lecaniodiscus cupanioides* has the highest value for fat (6.49 %), carbohydrate (42.83 %) and energy value content (1228.30 %). *Albizia glaberrima* has the highest value for protein content (25.31 %) while *Virtex doniana* has the highest value for ash content (13.52 %), moisture (28.29 %) and crude fibre (26.88 %). The result on anti-nutrient value revealed that *Virtex doniana* has the highest value in phytates (1.33 %), *Lecaniodiscus cupanioides* has the highest value in oxalates (19.41 %) while *Virtex doniana* and *Albizia glaberrima* has the highest value in Saponins (82.24 %) and tannis (0.67%) respectively. Result on mineral composition shows that the sampled leaves contained considerable amount of mineral deposition. With *Bombax buonopozense* having K and Ca value of 1159.93 % and 420.87 % while *Sterculia tragacantha* contained 20.73 % and 80.37 % of Mg and Fe. with value of in their result. Also the result on vitamins shows that sample B (*Albizia glaberrima*) has the highest value in Vitamins A, B1, B2, B3, D, E and beta carotenes with value of 1097.01%, 1.61%, 1.17%, 0.74%, 1.08%, 0.44% and 2744.66% with the result obtained from these vegetables, the result indicates that sample C (*Virtex doniana*) having the highest proportion of nutritive value while sample D (*Bombax buonopozense*) and sample E (*Sterculia tragacantha*) having the highest proportion of minerals while sample B (*Albizia glaberrima*) had the highest proportion of vitamins and beta carotenes content.

Keywords: Evaluation, nutritive composition, indigenous tree, vegetable and Ekiti State

1.0 Introduction

1.1 Background to the Study

Vegetables are the edible parts of plant that are consumed wholly or in parts, raw or cooked as part of main dish or salad. Vegetables may include leaf, stem, bark, root, flower, seed, fruit, bulb, tuber and fungi (Uzo, 1989; Uwaegbute, 1989). Vegetables are good sources of oil, carbohydrates, minerals and vitamins depending on the vegetable consumed (Ihekoronye and Ngoddy, 1985). Leafy vegetables are important items of diet in many Nigerian homes.

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Apart from the variety which they add to the menu (Mephba *et. al.*, 2007; Subukola *et. al.*, 2007), they are valuable sources of nutrients especially in rural areas where they contributes substantially to protein, minerals, vitamins, fibers and other nutrients which are usually in short supply in daily diets (Mohammed and Sharif, 2011). It is worthwhile to note that consumption of numerous types of edible plants as sources of food could be beneficial to nutritionally marginal population, especially in developing countries where poverty and harsh climatic condition is causing serious havoc to the rural populace in term of their health insurance. In many developing countries the supply of minerals is inadequate to meet the mineral requirements of rapidly growing human population. Since the time immemorial; man has used leaves as food. Different types of leaves, depending on the place and the season, were parts of the human diet since prehistoric times. Some edible plant leaves were historically documented in ancient Greece, Rome, Egypt and ancient Sri Lanka in the middle ages (Thurstan Shaw *et. al.*, 1994). With the passing of the centuries many of those traditional leaf vegetables have been replaced by tender leaves that have a more neutral taste or that are considered more refined (Thurstan Shaw *et. al.*, 1994). Forests and forest products play vital roles in human life from the cradle to the grave. The potential of the Nigerian indigenous tree leaves as a vegetable source, pharmaceuticals and other therapeutic materials have been emphasized. They, apart from healing, provide the necessary nutrients for health and development of the human body (Olujobi, 2007; Gbile and Adesina, 1986). Nigeria has rich genetic resources of cultivated, semi-wild and wild species of crops being used as traditional vegetables and different types are consumed by the various ethnic groups for different reasons (Denton *et.al.*, 1983; Mensah *et.al.*, 2008). Edible leaves from vegetable plants are eaten as supporting food or main dishes. They may be aromatic, bitter or tasteless (Edema, 1987). But are the cheapest and most accessible sources of proteins, vitamins, minerals, essential amino acids (Fasuyi, 2006; Mensah *et. al.*, 2008).

Leafy vegetables are highly beneficial for maintenance of health and prevention of diseases. They serve as valuable source of food ingredients that can be utilized to build up and improve the body successfully (Hanif *et. al.*, 2006). They also maintain alkaline reserve of the body. They contain high carbohydrate, vitamin and mineral contents. There are different types of vegetable and each group contributes in its own way to human diets (Robinson, 1990). In most local Nigeria diets, approximately half of the leafy vegetables consumed are from wild plants constituting significant micronutrient sources especially in times of drought and famine (Lockett *et. al.*, 2000; Grivetti and Ogle, 2000). In time past, an average Nigerian depends on the use of indigenous or wild plants leaf as vegetables, especially among low income rural dwellers to provide the necessary dietary requirement at least for their immediate family. The exploitation of forest resources is an important source of food and income, especially for the rural dwellers. Many of these resources particularly the leafy vegetables are mainly consumed for their nutritional values without much consideration for their medicinal importance. The age of civilization which influenced the drastic migration of people to urban centres has however had a great influence on the choice and use of these tree vegetables as food.

1.2 Statement of Problem

Nigeria is a country blessed with different ecological zones that support production of different kinds of food crops and forest resources. However, hunger and malnutrition are still found in many rural and urban areas. The quality and quantity of nutrients present in the food consumed by the people in the rural area is very low compare to the actual requirement from a balance diet for normal growth. Intake of protein, vitamin and minerals enriched food among the rural dwellers is grossly insufficient and this is because they are simply unavailable or too expensive for them to procure. Consequently, sickness and even death in young children are very common due to malnutrition. The use of tree leaf vegetables to supply these nutrients has declined over the years and the material and knowledge of its uses are disappearing at an alarming rate. Inadequate documented scientific information on indigenous African vegetable species is a major factor that influences people to choose exotic vegetables over indigenous types, thus promoting consumption of indigenous green leafy vegetables among people is a key to improving the health of many. Man, more than ever before needs a re-orientation on the sustainable use of his natural resources particularly tree leaf vegetables for the provision of balance nutrition. So knowledge of indigenous plant use needs urgent scientific investigation and documentation before it is irretrievably lost to future generations (Guarino, 1997)

1.2 Objective of the Study

The broad objective of this study is to investigate the nutritional potentials of five indigenous tree leaves used as vegetables in Ekiti State.

The specific objectives include to;

1. Determine the proximate values, mineral composition and vitamin content of five indigenous tree leaves used as vegetables among Ekitis.
2. Examine the anti-nutritional factors of the leaves of these tree species.

1.3 Justification

Indigenous tree leaf vegetables have the potential to provide a valuable source of nutrition to the body of rural dwellers. It also generate money/income for some of the people living in various rural areas and serve as herb in curing some ailments among the people. Ononugbu (2002), reported that vegetable fats and oil lower blood lipids thereby reducing the occurrence of disease associated with damage of coronary artery. Vegetables also contain fibre, which adds bulk to the food, thereby minimizing the feelings of hunger in addition to enhancing movement of food through the digestive system (Okigbo, 1990). All these benefits calls for the need to establish the chemical, nutritional and toxicological properties of indigenous tree leaves used as vegetables before advocating for their increase utilization. However, many of these inexpensive wild plants are yet to be adequately studies and their nutritional contribution to human diets has not been widely exploited (Ilelaboye *et. al.*, 2013). Information on these species of vegetables will be useful for the education of the public as a means to improve their nutritional status. Consequently, this study was designed to determine the proximate values, mineral composition, vitamin content and anti-nutritional factors of five indigenous tree leaves used as vegetables among Ekitis.

2.0 Literature Review

2.1 The Role of Wild Vegetables in the Livelihood of Rural Dwellers

Wild tree species vegetable integrated as part of the main diet have a role in the management of hunger and specifically micronutrient deficiencies. Their main role is as relish, that is they are consumed to complement staple diets, made from cereal, crops (maize and sorghum) and tuber crops (yam, cocoyam and cassava)(Oniang'o *et. al.*, 2003). They are usually prepared as the preferred relish on their own or as substitute for expensive cultivated vegetables in stews and soups in cases where they cannot be afforded. However, where an alternative relish is available, they can be referred to as supplements (Kepe, 2008). Relish is an indispensable part of the African diet (Smith and Ezyaguirre, 2007; Oniang'o *et. al.*, 2003) as the main staple cereal is not normally eaten in the absence of relish. Thus, the presence of relish directly impacts on the consumption of the bulk of the main staple even though the relish is required and consumed in smaller proportions relative to the staple. It is evident from the foregoing that wild vegetables play a significant role in food system stability at the household level.

Food system instability is determined by the temporary or permanent loss of access to the resources needed or inability to consume adequate food (FAO, 2008). The temporal variability in the occurrence of wild vegetables, due to their seasonal availability in response to the changes in seasons of the year, certainly causes instability in rural people's food systems, especially among those vulnerable groups who depend totally on them for relish (Modi *et. al.*, 2006; Vorster *et. al.*, 2007; Shackleton, 2003; Lewu and Mavengahama, 2010). One attribute of wild vegetables, about which there is general agreement among researchers, is their potential to combat "hidden hunger (Tisdale *et. al.*, 1990; Harvest, 2011). This is especially important among rural people or low income earners and the rural population (Lewu and Mavengahama, 2010) as the vegetable are not purchased. Most of the important indigenous tree leaf vegetables have been identified as having potential for commercial exploitation and production for human consumption. Studies have shown that indigenous leaf vegetable offer a significant opportunity for poor people in the rural areas, because indigenous tree leaf vegetables production can be done with little capital investment. A direct effect of this is that these vegetables provide employment opportunities for those that are outside the formal sector. Indigenous leaf vegetables and fruits play a key role in income generation and subsistence. Besides nutritional benefits, it has been suggested that the utilization of these vegetables represents significant savings of cash in the rural area (Shackleton 2003). Traditional vegetables represent inexpensive but high quality nutrition sources for the poor segment of the population, especially where malnutrition is widespread. Apart from promoting good health when indigenous green leafy vegetables are consumed, increased consumption of African indigenous vegetable also help to enhance crop diversity, alleviate poverty and promote food security.

Leafy vegetables have continued to provide populations with limited access to meat and fish, a rich source proteins and micronutrients essential for pregnant and lactating mothers, as well as young and growing children (Eroarome, 2012). The utilization of tree leaf vegetable is part of Africa's cultural heritage and they play important roles in the customs, traditions and food culture of the African household. (Mensah, *et. al.*, 2008).

2.2 The Nutritional Composition of Wild Vegetables

The nutritional composition of wild vegetables has been, and continue to be, characterized and they generally have been reported to be rich in micronutrients especially beta carotene, zinc, and iron, the principal nutrients whose absence from a diet results in 'hidden hunger'. Several studies conducted on indigenous wild vegetables have suggested that they generally have higher levels of various nutrients than the conventionally cultivated species (Flyman and Afolayan, 2006; Ndloru and Afolayan, 2008; Odhav *et. al.*, 2007; Steyn *et. al.*, 2011; Nesamvui *et. al.*, 2011). Micronutrient malnutrition affects more than half of the world population, particularly in developing countries (WHO, 2000). In 2000, the world health report identified iron, vitamin A, zinc and iodine deficiencies as the most serious health constraints worldwide (WHO, 2000; Faber and Wenhold, 2007). Studies on chemical composition of indigenous tree leaf vegetables and fruits have shown that they contain appreciable amounts of crude protein, fat and oil, energy, vitamins and minerals (Adebooye, *et. al.* 2003). They have also been known to make food more palatable and digestible. This food of plant origin contains many bioactive compounds and thus serves as an important source of minerals, vitamins and certain hormone precursors in addition to protein and energy sources. However, the presence of inherent toxic components or anti-nutritional factors in plants materials has been a major obstacle in harnessing the full nutritional potential of tree vegetable (Akindahunsi *et. al.*, 2005). However cooking and bleaching have been highlighted as possible means of reducing the anti-nutrient levels in plant food sources to innocuous level that can be tolerated by monogastric animal including man. (Fasuyi, 2006)

The human population in tropical Africa depends largely upon a large number of edible leaves to meet up with shortage in minerals and vitamins. Medicinal plants and their phytochemical constituents are used for different therapeutic purposes and as precursor for the synthesis of drugs (Patel *et. al.*, 2011). Dark green leafy vegetables provide high amounts of micro-minerals which play vital roles in nutrient metabolism and retard degenerative diseases reported on high vitamin, dietary fiber and mineral contents of vegetables and the role they play in maintaining alkalinity in the body. Most green vegetables, legume seeds, peas, beans and nuts are rich in magnesium as are some shellfish, spices and soya flour, all of which usually contain more than 500mg/kg fresh weight (WHO, 2000). The nutrient content of different types of vegetables varies considerably and they are not major source of carbohydrates compared to the starchy foods which form the bulk of food eaten, as well as mineral and antioxidants (Fasuyi, 2006). Knowledge of the nutritional composition of these tree leaf vegetables has enable one to know the better type of fruits, seeds and leaves to eat or feed to animals at any given time. Some spices due to their aroma and delicacy are eaten irrespective of their composition. There is the possibility that some fruits, seeds or leave could contain very small quantity of either anti-nutritional or poisonous chemicals. For example, *Anacardium occidentale* nutshells contain vesicant poisons, 90 percent anacardic acid and 10 percent cardol. Also *Lupinus albus* seeds contain erucic acid which is hazardous to health at high amount (Ihekoronye and Ngoddy, 1985).

2.3 Benefits of vegetable to human health

Eating vegetables is highly beneficial in that it help in maintaining good health and preventing diseases. People who eat more vegetables and fruits as part of an overall healthy diet are likely to have a reduced risk of some chronic diseases. Vegetables provide nutrients vital for health and maintenance of the body. Eating green vegetable rich in fiber may help regulate the digestive system thereby aiding bowel health and lower the risk of colon cancer (Asaolu *et. al.*, 2012). Folate intake can also reduces the risk of heart related disease such as heart attack and stroke. Vegetables are truly the best sources of vitamins, minerals and disease fighting phytochemicals which makes them excellent food cures. The great thing about eating daily, servings of vegetables is that they provide man with an array of nutrients. There are several important indigenous tree leaf vegetables whose leave are harvested to make food, which can be cooked, dried and stored. These leaves are highly popular and nutritious. Leafy vegetables intake contributes to the production of serotonin, which help ward off depression as well as improving mood. Riboflavin and niacin are B vitamins that help prevent cataracts, while vitamin C help slow bone loss and decrease the risk of fractures. It also allows the body to make collagen which is a major component of cartilage, which aids in joint support and flexibility. (Madisa *et. al.*, 2010). Copious consumption of vegetables treats hemorrhoids, gallstones, obesity and constipation.

The antioxidants in vegetables decrease the risk of heart disease and vitamin K contents of dark green leafy vegetables provide a number of health benefits including protecting bones from osteoporosis and helping to fight against inflammatory diseases (Whitney *et. al.*, 2003). Also, the consumption of dark green leafy vegetables which have the highest nutritional value will enhance the nutritional status of both poor rural and urban households who may not be in a position to consume enough vegetables because of affordability (Subukola *et. al.*, 2007). The nutrients in vegetables can be absorbed and used as regulatory and protective materials, as well as for body building ((Mepha *et. al.*, 2007). Leafy vegetables are important items of diet in many Nigerians homes. Apart from the variety which they add to the meal they are valuable sources of nutrients especially in rural areas where they contributes substantially to protein, vitamins, fibres and other nutrients which are usually in short supply in daily diets (Mohammed and Sharif, 2011). The vegetable if consume in sufficient amount would contribute greatly towards meeting human nutritional requirement for normal growth and adequate protection against diseases arising from malnutrition (Asaolu *et. al.*, 2012). Some plants are also sources of traditional medicine in southwest Nigeria (Adebooye *et. al.*, 2003).

2.4 Description of Sampled Tree Species

2.4.1 *Lecaniodiscus Cupanioides*

Lecaniodiscus cupanioides is a tropical plant widely distributed in Africa and Asia. It belongs to the sapindaceae family and it is identified by various names in Nigeria, such as Ukpo (Igbo), Utantan (Edo), Kafi-nama-zaki (Hausa) and Akika (Yoruba). This small tree has leaves resembling that of a Blighiasapida but very different fruits. The tree is about 6-12m high, occasionally more, branching low down and with a widely spreading crown. Evergreen and understory of high forest, semi-deciduous, periodically found in flooded forest, on rocky riversides and forest outliers in savanna areas. Extends from Senegal to Sudan and southern Angola. (Keay, *et. al.* 1989). The plant is ethno medically reputed to be useful in the treatment of wounds and sores, abdominal swelling caused by liver abscess, fevers, measles, hepatomegaly and burns. (Yemitan, *et. al.* 2005)

2.4 .2 *Albizia Glaberrima*

Albizia glaberrima is a deciduous tree with a flattened, umbrella-shaped crown; it can grow up to 30 metres tall. The bole can be straight and cylindrical, or can be irregular; it is up to 100cm in diameter. The species is widespread in tropical Africa. This var. *A. glaberrima* occur in Nigeria, and it extends from Ghana to Sudan, Uganda, southern Cameroun and Angola. *A. glaberrima* occurs most commonly in semi-deciduous forest, but sometimes also in logged – over evergreen forest. In Cameroon it is the characteristic of secondary forest. In East-Africa it can be found in lowland rain forest, riverine forest and evergreen bush land, in Madagascar in deciduous woodland (keay *et. al.*, 1989). In Uganda, *Albizia glaberrima* is a good shade tree for coffee, tea, banana and cocoa plantations. The foliage is used as forage for livestock, while the wood is used for furniture. In Tanzania it is used for construction, stools, beehives, tool, handle and grain mortars. In Malawi, the wood is used for doors, beds and implements (e.g mortars). It is also suitable for light and heavy flooring, interior trim, joinery, mine props, shipbuilding, vehicle bodies, railing sleepers and plywood making. The wood serves as firewood and charcoal production. In southern Nigeria the bark is applied externally to treat fever and in Benin a root decoction in a mixture with other plant ingredients is used as a bath to treat anemia. In Cameroon the decoction of the twig bark is drunk against chest pain, and ash of burned roots is applied to scarifications to treat liver complaint (Katende *et. al.*, 1995).

2.4.3 *Bombax Buonopozense*

This species is also known as the Gold Coast Bombax or red flowered silk cotton tree and is in bombacaceae family. It is native primarily in West Africa. *Bombax buonopozense* is a characteristic tree at the savannas and dry woodland of the Sudanian zone of West Africa, extending to the north into the Sahelian zone and to the south in the Guinean zone. It can be found in low land rain forest zone especially in secondary forest and also in forest outliers. It is a deciduous tree. Bole cylindrical, with small rounded buttresses, typically at elevations of 900 to 1200 meters. A large tree, that often reaches heights of 40m and 4m in diameter. The bark of younger tree is covered with spines and large deep-pink to red flowers while the tree is leafless. (keay, *et. al.*, 1989). In Burkina Faso, it grows on stony and gravelly lateritic soils and often in cropland close to settlements. Its ticks, corky bark protect it against fire (Achigan-Dako, *et. al.*, 2010). Various parts of the plant are used for medicinal purposes, building material and dye. The fruits are eaten by animals such as the water chevrotain (Debost, 1984). Many parts of the plant are utilized for traditional purposes. In Ghana, the leaves are common as fodder for domestic livestock.

The bark is burnt to produce a smoke that is believed to drive away evil spirits. The abundant thorns present on the bark are burnt and the resulting charcoal is mixed with butter to treat swelling. Dried gum produced from the tree is used as incense. The wood is quite light which limits its uses to canoes and other implements. The cotton-like fibre that covers the seeds is gathered and used as a cotton substitute. It cannot be spun however, so its use is limited to a stuffing for pillows and clothing. Both the flowers and the young fruits are used in food. (Beentje *et. al.*, 2011).

2.4.4 Sterculia Tragacantha

The tree belongs to the family *Sterculiaceae*. It is about 3 to 24m tall; bole cylindrical, sometimes with fluted buttresses; bark rough, grey or greyish brown, often deeply fissured; slash pale pink or pale orange, quickly becoming deep orange. Exudates clear, branchlets densely covered with brown stellate hairs 5 – 10 mm thick, the apex is rusty and is sometimes a deciduous shrub. The crown tends to be fairly small and sparsely branched. The tree is valued especially for the gum obtained from its trunk, which has a range of applications. Widespread in tropical Africa from Guinea to Cameroon, eastward to Sudan and Rwanda and south to the Democratic Republic of Congo, Angola and Zambia. It occurs in lowland rain forest, also forest outliers and transition woodland. Tree to 26m high and up to 5m in diameter, sometimes with buttresses. (keay *et. al.*, 1989). Young shoot and leaves are cooked as vegetable, the leaves are used for wrapping while the seed can be cooked or roasted and eaten whole like peanuts. The wood is white and somewhat soft, planes easily and works up to a neat finish. It is used for posts, boards and construction work (Ken – Fern, 2012).

2.4.5 Vitex Doniana

It belong to family *Verbenaceae*, a deciduous small to medium - sized tree up to 25m tall, bole branches up to 11 m in diameter, often slightly fluted at base. Bark surface greyish white to pale greyish brown, fissured and scaly, inner bark yellowish white, darkening to brown. Crown rounded; young branches shortly hairy glabrescent. Leaves with a stout common stalk 7–15cm long with 5 obovate to very broadly elliptic leaflets 7–15cm long by 5–9cm broad. (keay *et al.*, 1989). *Vitex doniana* is extremely widespread in tropical Africa, occurring from Senegal in the west to Somalia in the east and South Africa in the south. It is occasionally cultivated elsewhere, e.g in Mauritius. *Vitex doniana* occurs in a variety of habitats from forest to savanna, often in wet localities and along river and on termite mounds up to 2000m altitude. It occurs in regions with mean annual rainfall of 750 – 2000mm. It is most commonly found on alluvial soils. In central Africa, it is often the first species to establish when gallery forests evolve in low-lying areas in the savanna (Bolza, *et. al.*, 1972). The wood is popular for roofing house, vats, furniture, stools, caring, tool handles, gunstocks, bowls, spoons, drums, guitars and beehives. It is also suitable for light construction, light flooring, joinery, interior trim, shipbuilding, vehicle bodies, and agricultural implements. The wood is also used as firewood and for charcoal production. Cooked young leaves are eaten as vegetable or in sauces. The blackish pulp of the fruits is sweet, edible and eaten raw. The seeds inside the fruit stone are also edible. *Vitex doniana* has numerous applications in traditional medicine

3.0 Materials and Method

3.1 The Study Area

Ekiti state came to existence in 1996. It was carved out of North Western part of the old Ondo State. The state is made up of sixteen local government areas (LGAs). According to the population census of 2006, Ekiti State had about two million, three hundred and eighty four thousand, two hundred and twelve (2,384,212) people. The State is a mono-ethnic group type, all speaking Ekiti dialect. The state covers about 7,500km² of land mass. The State comprises of agrarian communities, industries are not well pronounced in the state which invariably leads to its low commercial status.

Ekiti state is located between Longitude 4° 51' and 5° 45' East of the Greenwich meridian and 7° 15' and 8° 51' North of the Equator. It lies south of Kwara and Kogi State. It is bounded in the west by Osun State and in the east and south by Ondo State.

3.2 Climate and Vegetation

The climate of the study area is of the West Africa monsoon type with dry and wet seasons. The wet or raining season normally start from late march to October with occasional strong wind and thunder storm usually at the onset and at the end of the season. The dry season normally start from November to March and characterized by cold wind of harmattan. The annual rainfall ranges between 1,500mm and 2,000mm (Adebayo, 1993).

Diurnal temperature ranges between 21° and 25° with little variation throughout the year. Annual average humidity is about 90 % at 7.00 am and 65 % at 4.00 pm. The topography is hilly with large number of hills of various sizes surrounding most of the towns and villages. The state's vegetation consists of Savannah woodland to the northern peripheries, while the southern part is predominantly high forest ecosystem. Also noticeable are small patches of riparian forest along the river banks.

3.3 Identification of Sampled Tree Species

The sampled tree species were identified on the field with the aid of standard key using the method of keay (1989), and assistance of a staff from the Department of Plant Science in the University.

3.4 Sample Collection and Preparation

Fresh leaves of five indigenous tree species used as vegetables (*Lecaniodiscus cupanioides*, *Albizia glaberrima*, *Bombax buonopozense*, *Sterculia tragacantha* and *Vitex doniana*) were collected from open farm land within the University campus. Leaves of three (3) stands of each plant species were collected using separately numbered polythene bag (the 3 stands represent replicates). The samples were transported to the laboratory where they were rinsed in water to remove the dust. The samples were dried, sorted and put inside polythene bags and tagged accordingly using the first letter of their generic name. The samples were kept in a cool dry place to prevent decay by fungi attack.

3.5 Laboratory and Statistical Analysis

Standard laboratory analytical methods of Association of the Official Analytical Chemist (AOAC, 2000) procedure was used to determine the proximate values (moisture content, crude protein, crude fat, total ash and crude fiber contents) of each sample. Moisture content was determined by heating 5.0 g of each fresh sample to a constant weight in a crucible placed in a Gallenkamp oven at 105° C for one hour. Each dried sample was milled with Thomas Wiley milling machine and sieved with 1.00 mm sieve. Each sample was stored in a labeled bottle. The dry matter was used to determine other parameters. Crude protein (% total nitrogen x 6.25) was determined by Kjeldhal method; crude fat by Soxhlet apparatus; ash by incinerating the sample in muffle furnace at 550° for 5 hours; crude fiber by digesting the sample with H₂SO₄. The Minerals and Vitamins were determined after digestion using Atomic Absorption Spectrophotometer (AAS). Anti-nutrients (Oxalic acid and Saponin) were determined according to methods described by AOAC (2000). All the data will be replicated three times. The data obtained was subjected to Analysis of Variance (ANOVA) using SPSS statistical package (2000 edition).

Table 1: Scientific and Different Local Names of the Sampled Trees Species

Family	Scientific name	Yoruba	Hausa	Igbo
Sapindaceae	<i>Lecaniodiscuscupanioides</i>	Akika	Kafi-nama-zaki	Okpu
Mimosoideae	<i>Albiziaglaberrima</i>	Ayere/ayinta	Madobiya	Nyie
Bombaceae	<i>Bombaxbuonopozense</i>	Ponpola/egiigun	Gurjiya	Akpu
Sterculiaceae	<i>Sterculiatragacantha</i>	Abalo/alawefun	Kukukinrafi	Oloko
Verbenaceae	<i>Vitexdoniana</i>	Oriri/oori-nla	Dinya	Uchakoro

4.0 Results

4.1 Proximate Composition of Sampled Leaves

Proximate composition of the leaves of five indigenous tree species (*Lecaniodiscus cupanioides*, *Albizia glaberrima*, *Bombax buonopozense*, *Sterculia tragacantha* and *Vitex doniana*) is presented in Table 2. The result shows that there is variation in the proximate constituents within each species. The result also shows that the value for each proximate constituent differ significantly between the species. Result on ash content varies across all the samples, with *Vitex doniana* having the highest value (13.52 %) and *Lecaniodiscus cupanioides* the least value (5.62 %). *Albizia glaberrima* and *Bombax buonopozense* are not significant different. The result on moisture content show the highest value (28.29%) for *Vitex doniana* while *Sterculia tragacantha* has the least value of 11.98 %. *Albizia glaberrima* and *Bombax buonopozense* are not significant different ($p < 0.05$). The result shows that fat content is significantly ($p < 0.05$) higher in *Lecaniodiscus cupanioides* (6.49%). Fat content are not significantly different in *Albizia glaberrima*, *Bombax buonopozense* and *Sterculia tragacantha* (table 2). The result also shows that crude fibre value is significantly higher in *Vitex doniana* (26.88 %), while *Lecaniodiscus cupanioides* has the least value (13.19 %).

Albizia glaberrima and *Sterculia tragacantha* are not significantly different ($p < 0.05$). Table 2 shows that *Albizia glaberrima* has the highest protein value (25.31 %) while protein value is significantly lower in *Vitex doniana* (7.44 %). Carbohydrate and energy values follow the same pattern with *Lecaniodiscus cupanioides* having significantly higher values of 42.83 % and 1228.30 % respectively. *Vitex doniana* has the least values of carbohydrate and energy (22.57 % and 693.96 %) respectively.

Table 2. Proximate Composition of Sampled Leaves (%)

Sp	Ash	Moisture content	Fat	Crude fibre	Protein	CHO	Energy value
A	5.62±0.40 ^d	16.60±0.85 ^c	6.49±0.16 ^a	13.19±0.47 ^d	15.00±0.19 ^c	42.83±0.60 ^a	1228.30±0.97 ^a
B	7.58±0.50 ^c	19.01±0.88 ^b	2.28±0.16 ^{bc}	21.46±0.30 ^b	25.31±0.30 ^a	24.55±0.21 ^d	929.62±0.63 ^d
C	13.52±0.06 ^a	28.29±1.10 ^a	1.40±0.17 ^c	26.88±0.73 ^a	7.44±0.68 ^d	22.57±0.97 ^e	693.96±1.97 ^e
D	7.74±0.62 ^c	20.36±0.17 ^b	2.70±0.74 ^b	15.57±0.89 ^c	14.17±0.80 ^c	39.86±1.86 ^b	1010.04±0.70 ^b
E	11.80±0.42 ^b	11.98±0.86 ^d	2.62±0.73 ^b	22.16±0.38 ^b	18.04±0.69 ^b	33.72±0.76 ^c	975.16±0.74 ^c

Values in the same column followed by the same letter are not significantly different.

A = *Lecaniodiscus cupanioides*, B = *Albizia glaberrima*, C = *Vitex doniana*, D = *Bombax buonopozense*, E = *Sterculia tragacantha*

4.2 Minerals Content of Sampled Leaves

Table 3 revealed that significant different occur in the mineral content across the sampled species. The result shows that *Vitex doniana* has the highest Na content of 84.87mg followed by *Bombax buonopozense* (74.81 mg) and *Lecaniodiscus cupanioides* (74.60 mg) respectively. Potassium (K) and Calcium (Ca) content follow the same pattern and they are significantly higher in *Bombax buonopozense* with 1159.93 mg and 420 mg respectively, while *Lecaniodiscus cupanioides* has the least value of 445.85 mg and 70.23 mg respectively. *Sterculia tragacantha* has the highest Magnesium (Mg) and Iron (Fe) content with 20.73 mg and 80.37 mg respectively, this is followed by *Albizia glaberrima* with 20.11 mg of magnesium and 60.86 mg of Iron respectively.

Table 3: Mineral Contents of Sampled Leaves (mg/kg)

Sp	Sodium (Na)	Pottasium (k)	Calcium (Ca)	Magnesium(mg)	Iron (Fe)
A	74.60±0.18 ^b	445.89±0.20 ^e	70.23±0.15 ^e	17.38±0.23 ^c	2.78±0.12 ^d
B	65.37±0.05 ^c	512.35±1.15 ^d	81.70±0.36 ^d	20.11±0.04 ^b	60.86±0.02 ^b
C	84.87±0.24 ^a	804.90±0.20 ^c	109.87±0.22 ^c	17.07±0.16 ^d	60.39±0.22 ^c
D	74.81±0.02 ^b	1159.93±0.16 ^a	420.87±0.23 ^a	15.69±0.17 ^e	60.83±0.04 ^b
E	1.04±0.02 ^d	982.90±0.18 ^b	272.87±0.25 ^b	20.73±0.02 ^a	80.37±0.03 ^a

Values in the same column followed by the same letter are not significantly different.

A = *Lecaniodiscus cupanioides*, B = *Albizia glaberrima*, C = *Vitex doniana*, D = *Bombax buonopozense*, E = *Sterculia tragacantha*.

4.3 Vitamins Content and Beta-Carotene of the Sampled Leaves

Table 4 shows that vitamin content across the sampled species varied significantly. The result revealed that *Albizia glaberrima* has significantly higher value in all the vitamins except vitamin C with vitamin A having the highest value (1097.01 mg) and vitamin E the least value of 0.44 mg. The result also shows that all the vitamins except vitamin C are significantly lower in *Lecaniodiscus cupanioides* with the least range of 545.77 mg in vitamin A to 0.21 mg in vitamin E. The result also shows that Beta Carotene content varied significantly ($p < 0.05$) in all the sampled species. The result shows that *Albizia glaberrima* has the highest value (2744.66 μg) followed by *Bombax buonopozense* and *Sterculia tragacantha* with 1708.35 μg and 1400.16 μg respectively. *Vitex doniana* has the least value of 648.47 μg .

Table 4. Vitamin Content of the Sampled Leaves (mg/100g)

Sp	Vit A	Vit B1	Vit B2	Vit B3	Vit C	Vit D	Vit E
A	545.77±0.61 ^e	0.75±0.11 ^e	0.64±0.07 ^c	0.55±0.03 ^c	223.86±0.11 ^b	0.63±0.03 ^c	0.21±0.02 ^e
B	1097.01±0.28 ^a	1.61±0.10 ^a	1.17±0.12 ^a	0.74±0.02 ^a	193.21±0.60 ^c	1.08±0.01 ^a	0.44±0.01 ^a
C	648.54±0.24 ^d	1.23±0.37 ^c	0.73±0.03 ^c	0.60±0.04 ^{ab}	261.64±0.10 ^a	0.71±0.04 ^c	0.25±0.01 ^d
D	985.78±0.33 ^b	1.43±0.03 ^b	0.87±0.03 ^b	0.66±0.03 ^b	108.38±0.76 ^e	0.94±0.17 ^b	0.35±0.03 ^b
E	783.20±0.96 ^c	0.83±0.06 ^d	0.94±0.02 ^b	0.58±0.06 ^c	175.63±0.81 ^d	0.85±0.04 ^b	0.27±0.03 ^c

Values in the same column followed by the same letter are not significantly different.

A = *Lecaniodiscus cupanioides*, B= *Albizia glaberrima*, C= *Vitex doniana*, D= *Bombax buonopozense*, E= *Sterculia tragacantha*

4.4 Anti- Nutrients Content

Table 6 present the anti-nutrient content of sampled tree leafy vegetables. The result shows that all the anti-nutrient varies significantly across all the sampled tree leaf vegetables. The result shows that *Vitex doniana* has the highest phytates and saponins values (1.33 mg/g and 82.24 mg/g), while oxalate and tannins are significantly higher ($p < 0.05$) in *Lecaniodiscus cupanioides* and *Albizia glaberrima* with 19.41 mg/g and 0.67 mg/g respectively.

Table 5: Anti - Nutrients Content (mg/100g)

Species	Phytates	Oxalates	Saponins	Tannins
C	1.27±0.16 ^a	19.41±0.12 ^a	60.04±0.64 ^d	0.14±0.03 ^d
B	0.62±0.01 ^d	15.48±0.71 ^b	70.06±0.18 ^b	0.67±0.11 ^a
C	1.33±0.07 ^a	15.68±0.19 ^b	82.24±0.43 ^a	0.35±0.04 ^b
D	0.93±0.07 ^c	11.95±0.5 ^c	61.70±0.11 ^c	0.21±0.03 ^c
E	1.05±0.03 ^b	7.91±0.35 ^d	2.29±0.18 ^e	0.65±0.11 ^a

Values in the same column followed by the same letter are not significantly different.

A= *Lecaniodiscus cupanioides*, B= *Albizia glaberrima*, C= *Vitex doniana*, D= *Bombax buonopozense*, E= *Sterculia tragacantha*.

5.0 Discussion

5.1 Proximate composition of Sampled Leaves

The moderate moisture contents value of the sampled five indigenous tree leaves investigated in this study suggest that they can be store for a period of time without spoilage. Since higher moisture content enhance microbial activities thereby bringing about rotting and decay of vegetable (Sobowale *et.al*, 2011). The hardy nature of these leafy vegetables allowed them to be transported over a long distance from village to the city without rotting or decay. This attribute of the sampled leaves gives them an advantage over some common garden vegetables that get rotten soon after they are harvested. The result also revealed that among the sampled leaves *Sterculia tragacantha* followed by *Lecaniodiscus cupanioides* would have the longest shelf life due to their relatively low moisture content. However, the low moisture content of these leaves would reduce the activity of water soluble enzymes and co-enzymes needed for metabolism of these vegetables (Udousoro and Ekanem, 2013). Result obtained for ash content in this study is similar to the values reported by Odousoro and Ekanem, (2013) for twelve edible vegetables in Nigeria. The relatively high value of the ash content obtained in the leaves investigated is an indication that these leafy vegetables could be a good source of mineral for human nutrition. This assertion is in consonance with the report by Fagbohun *et. al*, (2012) that high ash content in any food substance implies high mineral content. The low value of fat obtained in this study suggest that these leaves are poor sources of lipids, hence they could be a good diet for people suffering from obesity (Ejoh *et. al*, 1996) However, the significant higher fat content in *Lecaniodiscus cupanioides* could make it a good supplement in the diet of a person suffering from disease associated with coronary artery since vegetable fat and oil are lower in cholesterol thereby help in reducing blood lipids.

Similar assertion has been reported by Fagbohun *et. al*, (2012). High value of fibre obtained for the leaves in this study is similar to those obtained by Sobowale *et. al*, (2011) who reported that leafy vegetables are rich in dietary fibre. Fibre plays an active role in cleaning of digestive tract and increase faeces consistency. It also helps in reducing blood sugar and also acts as general body purifier (Emebu and Anyika, 2011). The protein value in all the leaves investigated except for *Vitex doniana* are moderately high and higher than 12 % which is the acceptable value for any food to be considered as a good source of protein (Onwordi *et. al*, 2009, Asaolu *et. al*, 2012). Protein is important in body building and repair of tissue; hence these vegetables could be a good diet for individuals with deficiency disease. The moderately high value of carbohydrate obtained in all the leaf investigated in this study suggests that they could be a good source of energy and body fuel for daily activities. Inclusion of these vegetables in the diet could reduce fatigue, poor mental function and lack of stamina. Similar assertion has been made by Udousoro and Ekanem, (2013). The result in this study also revealed a moderate high energy value. This is an indication that these indigenous tree leaf vegetables could offer a good source for the supply of the daily dietary energy requirement for man. FAO (1986) have reported about 2500 kcal as daily energy requirement for adult. Hence, only about 200 g of *Lecaniodiscus cupanioides* would be needed by adult per day to meet its energy requirement.

5.2 Mineral Contents of Sampled Leaves

The relatively high mineral content obtained in the tree leafy vegetables investigated in this study has proved that indigenous tree leaf vegetables could be a cheap source of dietary mineral requirement for man and hence a good substitute for expensive cultivated varieties of vegetable with lower mineral content value. Minerals are very important in normal body functions. Mineral such as sodium (Na) has been reported to be very important in the maintenance of acid-base balance in the body (Adeyeye, 2002). The ratio of Na to Potassium (K) is important to hypertensive patient while Calcium (Ca) is essential for bone and teeth formation (Vunchi *et al*, 2011). Magnesium is an important element in the correction of diseases associated with circulatory system (Vunchi *et. al*, 2011, Ishida *et. al*, 2000) while Iron (Fe) is essential for blood formation and normal functioning of central nervous system (Adeyeye and Otoketi, 1999).

5.3 Vitamin and Beta-Carotene Content of the Sampled Leaves

The value obtained for vitamins in all the vegetables investigated revealed that the vegetables are rich in vitamins and the values shows a close agreement with those obtained by Adeniyi *et. al*, (2011). In some selected leafy vegetables, vitamins B1, B2 and B3, have been reported to highly essential for micronutrient metabolism while vitamin C is used for protein metabolism and collagen synthesis (Vunchi *et. al*, 2011). Vitamin A and beta-carotene are essential for good vision while vitamin E is essential for the production of enzymes and hormones needed for proper growth and development (Adeyeye 2014).

5.4 Phyto-Chemical Components of the sampled Leaves

Results in table 6 revealed that phyto-chemical components varied significantly in all leafy vegetable investigated. The presence of these phyto-chemicals is an indication that the leaves could be used for medicinal purposes. The medicinal relevancy of these leafy vegetables is manifested in their usage by local people in the preparation of pot herb for curing of various ailments.

This assertion is in consonance with the opinion of Musa *et. al*, (2000), who noted that extract from *Acalypha* species could be used as anti-biotics. Saponin has been reported to suppress cholesterol build up in the body, while tannin has been used in the treatment of common pathogenic strains in the body (Kubmarawa *et. al*, 2007). Though, phytate have been implicated with some nutritional diseases such as bio-availability of mineral elements, and inhibitions of some metabolic activities, the values obtained in this study were below the established toxic level of 6% (Sobowale *et. al*, 2011).

6.1 Conclusion

It has been observed that five indigenous tree leaves investigated in this study contained considerable amount of proximate constituents (ash, moisture, fat, crude fibre, protrein, carbohydrate and energy value content), anti-nutrient (phytates, oxalates saponins, tannins), minerals (Na, K, Ca, Mg and Fe), vitamins (A, B1, B2, B3, C, D, E and beta carotenes) in varying proportion. Result from the study indicated that proportions of these compositions/components are significantly different both within and between the various plants. Also the result has shown that among five indigenous tree leaves used as vegetable in Ekiti State, *Lecaniodiscus cupanioides* contained higher fat, carbohydrate and Energy value than others, while *Albizia glaberrima* is rich in protein and *Vitex doniana* contained higher nutritive value in ash, moisture and crude fibre content.

Although some of these plants such as samples A, B,C contained some harmful anti-nutrients like oxalates and phytates, processing like boiling and squeezing can be used to reduce their effect. Also the percentage content of these anti-nutrients is within the recommended level needed by our body.

6.2 Recommendation

Since the leaves of the indigenous tree species investigated in this study contained considerable amount of important nutrients it is suggested that they should be taken as food or added to food as condiments to supplement minerals, vitamins protein and energy in human diet especially among the rural dwellers with low income. It is also recommended that Government and corporate bodies should embark on plantation establishment of these species for sustainable production. Also modern propagation techniques should be taught to all communities that produce these plants by the extension staff of the relevant government agencies.

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