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Phytochemical and Nutrient Evaluation of the Leaves and Fruits of *Nauclea Latifolia* (Uvuru-ilu)

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Abstract. The Phytochemical and Nutrient evaluation of the leaves and fruits of *Naulcea latifolia* (Uvuru-ilu) was undertaken because of the wide application of the plant in ethnomedicine. Ethanolic extracts of the plant parts were analysed for their phytochemicals, proximate composition including minerals and some vitamins using standard methods. The phytochemical analysis revealed the presence of bioactive compounds in the leaves and fruit samples. The leaves of *Nauclea latifolia* contained tannins 0.374%, alkaloid 2.387%, 0.373% flavonoid, 1.25% saponins, 0.377% phytate and 16.897mg/kg of HCN. The fruit also revealed the presence of 0.214%, 1.407% 0.433%, 0.833%, 0.377% and 9.270mg/kg for tannins, alkaloids, flavonoids, saponins, phytates and cyanogenic glycosides respectively. The proximate analyses of the leaves and fruits revealed that *Nauclea latifolia* is rich in proteins 12.51%, fats 1.49%, fibre 34.82%, ash 5.46%, carbohydrates 46.69%, moisture 68.93% and dry matter 31.07% in the leaves while the fruit should 15.42%, 1.74%, 35.88%, 8.19%, 38.79%, 44.72% and 55.28% of proteins, fat, fibre, ash, carbohydrates, moisture and dry matter respectively. The analysis also show that the leaves and fruit contain essential minerals such as Ca 52.104, Mg 3.17, K 427.50, P 457.83 in mg/100g w/w basis for the leaves as well as 85.51 Ca, 4.50 Mg, 368.67 K, and 429.86 P. Vitamin A and C analysis for the leaves gave 17.65 mg/100g and 56.74 mg/100g respectively while we got 36.22 and 67.47 respectively from the fruits on a mg/100g basis. The phytochemical analysis supports the extensive use of the leaves and fruits of *nauclea latifolia* in ethnomedicine in many parts of Africa and the proximate analysis showed that its use in the feeding of ruminants and human consumption of the fruits is a good practice.

Key words: *Nauclea latifolia*, phytochemicals, nutrients, leaves, fruits, ethnomedicine.

INTRODUCTION

Phytochemicals sometimes referred to as phytonutients which are chemical compounds derived from plants are non-nutritive secondary metabolic compounds occurring in different parts of plants have continued to attract scientific interest. The identification and the study of the biosynthesis and metabolism of the chemical constituents of plants has continued.(Dean *et al.,* 1990, Chaterji,2006)).This is because of their importance as protective and disease fighting compounds which help the body prevent or fight against diseases and so are required by the human body to sustain life (Thomas, 2000, Van, 2000) and (Whik, 2000). Their therapeutic use in the prevention or fighting a number of diseases is the basis of their extensive use in traditional or ethnomedicine in many cultures. Some of the phytochemicals are water soluble while others are not (Adefagha and Oboh, 2011)

Some of these important groups of phytochemicals include phenolics of various types including flavonoids such as resversterol, catechins, anthocyanins and isoflavones as well as phenolic acids and lignin (Steinmet et al., 1996). These play a major role as antioxidants and especially the flavonoids and they play a role in phytopreventive therapies (Williams et al, 2012, Lotito and Free 2011, Okigbo, 1975, Herbert, 1994 and Young, 1995). **F**lavonoids are super antioxidants and free radical scavengers. They prevent oxidative cell damage caused by these free radicals. In this way they prevent chronic diseases such as cancer, and tumours. Flavonoids are antioxidants provide anti inflammatory actions (Okwu, 2001A and Okwu, 2001B) and are widely distributed in plants (Justesen and Knuthsen, 2011)

Saponins cause the haemolysis of cells. They prevent cancer by preventing DNA from damage. They are also antiviral and they can be cardio-protective via their ability to lower blood Cholesterol level (Coe and Anderson, 1996 and Giovarimucci, 1998).

Alkaloids seems to be the most significantly and efficiently phytochemical in terms of therapeutic use. They form precursors for the synthesis of drugs when isolated in pure form. They show high physiological effect on animals and humans.

Tannins are useful in healing wounds, various ulcers, haemorrhoids, frost bites and burns in herbal medicine (Igboko, 1983, Maduiyi, 1983, Agoha, 1981, and Ross, 2005).

The proximate composition of plant materials is also important as they show their respective percentage protein, fat, carbohydrate, fibre, ash, moisture and dry matter content of the plant and hence their food value as well as minerals and vitamins. The leaves of nauclea latifolia are used extensively in the feeding of ruminants as well as for treating different ailments in herbal medicine. The fruit is eaten by humans when ripe and is also fed to animals and used for ethnomedical treatment of diseases.

Nauclea latifolia have been extensively used in ethnomedicine. The plant is commonly known as pincushion tree. It is a struggling shrub or small tree native to tropical Africa and Asia. It is a tropical plant that can be found in many parts of Nigeria especially in Akwa Ibom, Cross River State and the South Eastern States and some areas of Northern Nigeria. In the South Eastern part of Nigeria it is called "Uvuru-ilu" in Igbo and called "Mbom-mbong" in Efik and "Uche" by the Igede people of Northern Nigeria.

The plants medicinal value has been acknowledged by the different use in ethnomedicine by different people. Preliminary report shows that the roots have been used for the treatments of hypertension. Also extracts of different part of the plant *Nauclea latifolia* (eg fruits, leaves, stembark) in hot water or alcohol have been used in form of infusion, decotions or concoctions (Irvine, 1961 and Agoha, 1971).

In many parts of Africa ethnomedical practitioners have used the plant extracts for the treatment of various diseases including the use as antibacterial agents, especially most effective against corbnebacterium diphtherias, *streptobacillus spp., treptococuss spp., Neisseria spp*., *pseudomonas aceruginosa, salmonella spp* (Deen and Hassan, 1991). It has also been used as anti hypertensive agent as well as anti malaria drug in Ghana (Boye, 1990). East Africans also use it for treatment of malaria as used also in Nigeria, Ivory Coast, Burkina Faso; the

plant is used for the treatment of several diseases such as jaundice, malaria, infant gastroentritism, dysentery etc. The plant is also used as a tonic and fever medicine, chewing stick against toothaches, dental caries septic mouth diarrhoea and dysentery (Lamidi *et al*., 1985).

It has been reported to be effective against *Bacillus subtilis, Eschericia coli, Salmonella enteritisdis, Pseudomonas, Aeruginosa and Klebsiella pneumonia* (Tona *et al*., 1999). The bark is also used for the treatment of wounds, coughs and gonorrhoea in Nigeria (Abbiw, 1998).

The roots was also reported to be used to induce abortion and as a purgative.

- *Nauclea latifolia* has broad leaves with deep greenish colour which the fruits flesh is grey in colour with the inside reddish and white when ripened. The fruit is 6.5 cm long with multiple seeds and flesh still remain the same colour even after been ripened. The only colour change is on the inside which becomes more reddish that it can be seen from the outer flesh.

The ripe fruit has a very good flavour and is eaten by some people of Eastern Nigeria. It is believed that the fruit have potency to fight against HIV/AIDS disease infection as the fruit extracts have been shown to boost human immune system. The fruits contain lots of vitamins and can be used as food supplements (Hussien *et al*., 1998).

The fresh leaves aqueous extracts have been used as a hypoglycaemic agent on blood glucose levels of Normal and Alloxan-induced diabetic rats (Morah, 1995). Parts of the plant are commonly prescribed traditionally as a remedy for diabetes mellitus, gastrointestinal track disorders, sleeping sickness, prolonged menstrual flow, hypertension and as a chewing stick (Asbiofo et al., 1982, Abrew and Pereira, 2001, Dalziel, 1937, Akubue and Mittal, 1982). There is growing interest in the plant because of its importance. The anticonvulsant, anxiolytic and sedative properties of the roots of the plant in mice have been investigated by (Bum et al,2009).Their findings was in favour of the use of the plant in the treatment of fever, malaria, insomnia, and epilepsy in traditional medicine as the plant seem to possess these properties. Okoli et al,2004) evaluated the effect of the ethanolic , cold

and hot water root extracts of *nauclea latifolia* against bacterial isolates from non-gonococcal urethritis while Benoit-Vical *et al*,1998) had studied the in vitro antispasmodial activity of the stem and root. Agyare et al, 2006) had also worked on the antimicrobial properties of the plant. Giddado *et al*,2005) examined the effect of the leaves extracts on blood glucose levels of normal and alloxan induced diabetic rats. The blood pressure lowering effects of the roots of the plant was reported in a preliminary report by Nworgu *et al,* 2008).The ethnomedical use of the plant in the treatment of malaria have been recently investigated by Abbah *et al*, 2010) and their report showed pharmacological evidence favouring the use of *nauclea latifolia* in malaria ethnopharmacy as the plant was effective against mociception, inflammation and pyrexia in rats and mice. There is less interest shown on the analysis of the fruits and leaves compared to the roots and stem. There is therefore the need to compare the phytochemical and proximate composition of the leaves and fruits of this important plant in other to assess their nutritive value.

MATERIALS AND METHODS

Sample collection:

The leaves and fruits of the plant were collected from Akpukpa Uturu in Isuikwato LGA, Abia State, Nigeria. The name of the plant was authenticated by the Plant Science and Biotechnology Department, Abia State University, Uturu and confirmed by Dr. Mmeregini of the Department of Forestry and Environmental Resources Management, Michael Okpara University of Agriculture Umudike, Abia State, Nigeria.

Sample Preparation:

The leaves and fruits were examined to be free from diseases. Only healthy plant parts were used. Extraneous materials were also removed from the plant materials. They were cut into pieces using a kitchen knife and the leaves were sun dried for 7 days while the fruits were sun dried for 10 days.

The dried plant parts were separately ground in an Arthur Thomas Laboratory mill in which the ground samples were passed through a 1 mini test sieve to obtain pure processed sample used for the analysis.

Phytochemical Screening

The plant materials were screened for phytochemicals using standard methods as described variously by (Harbone, 1973, Sofowora, 1993, AOAC, 1980 and Trease and Evans, 1989 ,Dietland,2009).

Quantitative Analysis

The phytochemicals were quantified using standard methods. Tannins were determined using the Follins-Dennis spectrophotometric method described by Pearson, 1976 and adopted by Okeke and Elekwa 2003. Alkaloids were determined by the alkaline precipitation method described by Harbone, 1973 and adopted by Kelvin, 2003. Flavonoids were determined according to Harbone, 1973 as described by Okeke and Elekwa 2003. The determination of saponins was done by the double solvent extraction gravimetric method described by Harbone, 1973 as well as Obadoni and Ochuko 2001. To assess cyanogenic glyeosides – HCN, we used the modified Alkaline Picrate coloumetric method as described by AOAC, 1998 and Dietland, 2009. Phlobatanins, phytates and sterols and triterpenoids were also estimated using standard methods as described by Harbone, 1973 and AOAC, 1998.

Proximate Analysis

The protein content of the leaves and fruit samples was determined by the Kjeldahl method reported by (James, 1995). The total N_2 was determined and multiplied by a factor 6.25 to obtain the protein content. The total ash was determined by the furnace incineration gravi metric method described by James 1995 and Pearson, 2003c. The fat determination was achieved by the continuous solvent extraction method in Soxhlet apparatus as described by James, 1995 and Pearson, 1975. The crude fibres was determined by the Weende method described by both (Pearson, 1976 and James 1995). Moisture content of each of the sample was determined by the method put together by Pearson (1976) and James (1995).

Carbohydrate content of the analyte was determined by estimation, using the Arithmetic method put together by Pearson, 1976 and James 1995.

The mineral content of the sample was estimated by the dry ash extraction method put together by James, 1995. Calcium and Magnesium was determined by EDTA versanate complexometric titration method while potassium was determined by flame photometric method, Phosphorus was determined spectrophotometrically by the vanadomolybdate yellow method.

Ascorbic acid content was determined by the method of AOAC, 1980 while the vitamin A was determined by the spectrophotometric method described by Pearon and James, 1995.

RESULTS AND DISCUSSION

The result of the phytochemical screening is shown in Table 1 below;

Table 1: Result of the Phytochemical Screening of the Leaves and Fruit of *Nauclea Latifolia*

Samples	Titerpenes	Phlobutanins	Tannins%	Flavonoids	Alkanoids	Steroids	Saponins
Leaves	+ve	+ve	+ve	+ve	+ve	+ve	+ve
Fruits	+ve	+ve	+ve	+ve	+ve	+ve	+ve

Note: +ve = present

The phytochemical screening results of the leaves and fruit of *Nauclea latifolia* show that they contain alkaloids, flavonoids, tannins, saponins, phlobatanins, sterols and cyanogenic glycosides.

The quantitative estimates of the phytochemicals in percentage is shown in Table 2 below;

Table 2: Quantitative Estimates of the Phytochemicals in *Nauclea Latifolia* Leaves and Fruits

Sample	Tannins (%)	Saponins (%)	Flavonoids (%)	Alkaloids (%)	Phytates (%)	HCN (mg/kg)
Leaves	0.374	1.250	0.373	2.387	0.423	16.897
Fruits	0.214	0.833	0.433	1.407	0.377	9.270

Results are mean of triplicate determinations on dry weight basis.

The result indicate that the leaves of *Nauclea latifolia* contains 0.374% tannins, 2.387% alkaloids, 0.373% flavonoids, 1.250% saponins, 0.423% phytates and contain a little cyanogenic glycoside of 16.897 mg/Kg as shown in table 2. The same table also show that the fruits contain 0.214% tannins, 1.407 alkaloids, 0.433% flavonoids, 0.833% saponins, 0.377% phytate and 9.270 mg/Kg cyanogenic glycoside. The proximate composition of the leaves and fruits of *Nauclea latifolia* is shown in table 3 below

Table 3: Proximate Composition of *Nauclea latifolia*

Sample	% Protein	% Fat	% Fibre	% Ash	% Carbohydrate	% Moisture	% Dry matter
Leaves	12.51	1.49	34.82	5.46	46.69	68.93	31.07
Fruits	15.42	1.74	35.88	8.19	38.79	44.72	55.28

The percentage composition of the plant parts in table 3 above shows that the plant leaves and fruits contain appreciable amount of the basic food nutrients such as protein, fats, carbohydrates and fibre.

The mineral composition and vitamin A and C content of the plant parts are shown in table 4 below

Table 4: Mineral and Vitamin A and C composition

Sample	Ca Mg/100g	Mg Mg/100g	K Mg/100g	P Mg/100g	Vit. A Mg/100g	Vit. C Mg/100g
Leaves	52.10	3.17	427.50	457.83	17.65	56.74
Fruits	85.51	4.50	368.67	429.86	36.22	67.47

The results are mean of triplicate determinations on dry weight basis.

The results of the mineral composition of the plant parts show that *Nauclea latifolia* leaves contain appreciable amount of the minerals which are micronutrients required by the body in small amounts. Calcium and Magnesium were more in the fruits than in the leaves while Potassium and Phosphorus were more in the leave than in the fruits. There were also more vitamin A and C in the fruits compared to the leaves.

Alkaloids are the most efficient therapeutically significant plant substance. Pure alkaloids and their synthetic derivatives are used as the basic medicinal agents because of their analgesic, antispasmodic and antibacterial properties (Stray, 1998). The pure substances and their derivatives form precursors for the synthesis of other more potent drugs. Alkaloids show marked physiological effects when administered to animals. Alkaloids are very important as medicine and constitute most of the valuable drugs used in medicine and ethnomedicine.

The level of alkaloids 2.387% and 1.407% for the leaves and fruit of *Nauclea latifolia* confers the plant parts to be good medicine. This explains why the leaves of the plant is used in the treatment of diabetes mellitus and malaria (Kokwaro, 1976, Akubue and Mittal, 1982, Boye, 1990) as well as chewing stick to reduce toothache Asubojo et al., 1982.

Tannins posses astringent properties and hasten the healing of wounds and inflamed mucous membrane (Bohn and Kolipai Abyazan, 1994). The tannin content of 0.374% and 0.214% in the leaves and fruits of *nauclea latifolia* respectively support the use of the plant for treating wounds, various Ulcers, haemorrhoids, frost bite and burn in herbal medicine because of antbacterial effects of tannins(Akiyana *et al*, 2011) as well as treating inflamed throats, mouth and as a veterinary intestinal astringents (Agoha, 1981).

Saponins are responsible for the haemolytic properties of plant parts. This confers to the plant the traditional medicinal function as a cholesterol binding agent. Saponins also prevent cancer by preventing DNA from damage. They are antiviral and they inhibit colon cancer. They may also be cardio protective via their ability to lower cholesterol levels when they bind on them. (Coe and Anderson, 1996, and Giovanmucci,1998). The significant high levels of saponins in leaves and fruits of *Nauclea latifolia*- 1.250% and 0.833% respectively support their use in traditional medicine. Saponins have a relationship with sex hormones involved in controlling the onset of labour in women and subsequent release of milk called oxytocin (Okwu and Okwu, 2004). The leaves can be fed to animals during parturition and after for easy explanation of retained placenta. They are often used in conjunction with the

leaves of *spondias mombin*. They may also function as natural antibiotics. Saponins assist in combating bacterial infections and counter fungus and viruses and have been shown to compliment the effectiveness of some vaccines (Agoha, 1981, Osunwole, 1999). Therefore the leaves and fruits of *Nauclea latifolia* may prove to be useful in treating those difficult to control fungal and yeast infections. This supports the use of the plant in treating sexually transmitted diseases such as gonorrhoea, syphilis and herpes in herbal medicine (Okwu and Okwu 2004, Farquar 1996).

Flavonoids are biologically active phytochemicals whose functions include anti inflammatory, antiallergic and anti- tumour agents. They also prevent platelate aggregation, ulcers and also function as anticancer agents. Some flavonoids eg isoflavones relieve hay fever, eczema, sinusitis and asthma, as well as reduce blood cholesterol and can prevent osteoporosis as well as ease menopause symptoms (Bohm and Kolipai-Abyazan, 1994).

Flavonoids are free radical scavengers and are super antioxidant as phenolics which are water soluble and prevent oxidative cell damage and have strong anti cancer properties (Salah et al., 1995). The 0.373% and 0.433% flavonoid in the leaves and fruits of *nauclea latifolia* supports its ethnomedical use. Flavonoids also show antimicrobial properties (Cushnie and Lamb, 2009) and anti-cancer properties (Paul *et al*, 2012).

Phytates and cyanogenic glycosides are usually considered as antinutritive factors in foods. Phytates reduce the bioavailability of minerals such as Zn, Iron, Copper and Manganese. However in lower concentration they can suppress colon cancer and control dental carries and lower blood glucose. This is in accord with the ethnomedical use in treating diadetes mellitus and the use as chewing stick to reduce toothache (Cosgrove, 1981, Abulude, 2007). The low concentration of 0.423% and 0.377% for the leaves and fruits of the plant does not pose any serious problem. Also the 16.897 mg/kg and 9.270 mg/kg for the leaves and fruit of the plant in the cyanic glycoside content is quite low and does not pose a great threat on the consumption of the leaves and fruits of *Nauclea latifolia*.

The result of the proximate analysis of *Nauclea latifolia* leaves of fruit shows that the plant is a rich source of proteins, fats, fibre, ash, carbohydrate and dry matter.

The protein content of 12.51% and 15.42% for the leaves and fruits respectively shows the plant is a rich source of protein supplement for animals fed with the plant leaves and fruits as practiced in many parts of Africa. However, the protein content is not as high as 27.74% reported for *vitex doniana* leaves, (Umar, K. J et al., 2008), 20.72% for *Moringa oleifera* and 19.1% for *leptadenia haetate* leaves.

Fruits also are not good sources of fat. Never the less some fruits such as avocado pear have been reported to contain 17 – 20% oil Ihekeronye and Ngoddy, 1985. The low fat content of 1.49% and 1.74% for the leaves and fruits respectively are below the range (8.3 – 27.0%) reported for some leafy vegetables consumed in Nigeria and Niger republics (Sena, et al., 1998, Ifon and Bassir, 1980). Generally, leafy vegetables are known for their low lipid content.

The estimated carbohydrate content for the leaves of ***nauclea latifolia*** of 46.69% was higher compared to some leafy vegetables such as Sena obtusfolia leaves 20% (Lockett et al, 2000), *amarantus incurvatus* leaves 23.7%, Dena et al, 1998 *mormordica balsamina* 39.05% (Hassan, 2008) and *Solanum americanum* 31.82% (Faruq, 2002). The carbohydrate content 38.79% for the fruit of *nauclea latifolia* is also high compared to that reported for some common fruits such as guava and ripe pawpaw with values of 13% and 10% respectively. Carbohydrates are useful as they supply energy to cells such as brain, muscles and blood. They contribute to fat metabolism and spare proteins as energy source and act as mild laxative for human beings. They generally add to the bulk of the diet (Gordon, 2000, Ogbuagu, 2008).

Dietary fibres are also constituents of many fruits and vegetables. The percentage fibre of 34.82 and 35.88 for the leaves and fruits of *Nauclea latifolia* is quite higher than a range of values 0.1% and 6.8% reported for selected fruits (Osee,

1970) on wet basis but corresponds to those reported on dry weight basis 10 – 41% for some fruits (Fotso, 1994).

High fibre content for the leaves of the plant is usually a major drawback in human nutrition as they cause intestinal irritation and they are low in nutrient availability as humans cannot digest them easily (Hassan *et al,* 2008, Faruq, 2002. Aletor *et al,* 1995, Plessi *et a*l, 1999 and Parvathin and Umar, 2002).

High moisture content of the leaves and fruits of *Nauclea latifolia* of 68.93% and 44.72% respectively was within the range 58% to 93% reported for some leaves vegetables consumed in Nigeria (Ifon and Bassir, 1980, Tomori and Obijole, 2000, Ladan *et al,* 2000).

The mineral composition of the fruits and leaves of the plant is shown in table 4. To find the nutritional significance of the minerals, the values were compared with the standard Mineral Recommended Dietary Allowance (Alais and Linden, 1999) and the result was shown in table 5 below.

Table 5: **Mineral Composition of Nauclea Latifolia Compared with Recommended Dietary Allowwnace**

	Available Quantity Dry Weight mg/100g		**Recommended Dietary Allowance (mg/day)**			
			Children 7-10 years	Adult		Pregnant and breast feeding mothers
				male	Female	
	Leaves	Fruits				
Potassium	427.50	368.67	1600	2000	2000	2000
Sodium	Nd	Nd	400	500	400	500
Calcium	52.10	85.51	800	800	800	1200
Magnesium	3.17	4.50	170	350	280	335
Phosphorus	457.83	429.86	800	800	800	1200

nd= *Not determined*

From the table it can be seen that the leaves and fruits of *Nauclea latifolia* can supply substantial amount of the required daily intake of K, Ca and Phosphorus. The average daily requirement for Vitamin A (retinol oraxerophotol) is 0.75 – 1.2 mg while that of Vitamin C (Ascorbic acid) is 10 – 75mg. The leaves and fruits of *Nauclea latifolia* gave 17.65 mg/100g and 36.22mg/100g Vitamin A and 56.74 mg/100g and 67.47 mg/199g of Vitamin C respectively. Many vitamins are useful to the body are very useful to the body (Mobh, 2012)

It is therefore as expected that the leaves and particularly the fruit of *Nauclea latifolia* are very good and rich sources of vitamin A and C with their beneficial biological role in the maintenance of healthy body especially the eye and teeth respectively (Alais and Linden, 1999).

Conclusion

From the results of the phytochemical analysis, we can conclude that the leaves and fruits of *Nauclea latifolia* are important sources of important phytochemicals and phytonutrients which are in accord with their use in ethnomedicine. We can also conclude that the leaves and fruits of the plant are of significant nutritive value and can play a great role as good sources of Vitamins, fats and proteins needed for the maintenance of good health. The fruit is healthy for human consumption and the leaves which are fed to ruminants in many parts of Africa are acceptable.

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