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Proximate composition, phytochemical and mineral contents of young and mature *Polyalthia longifolia* Sonn.leaves

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Abstract

Proximate composition, phytochemical and mineral composition of young and mature *Polyalthia longifolia* Sonn. leaves were investigated using standard analytical procedures. Young leaves of *Polyalthia longifolia* contained 9% protein, 4% ash, 0.21% lipid, 25% fibre, 8% moisture and 54% carbohydrate while the mature leaves contained 10% protein, 5% ash, 0.26% lipid, 19% fibre, 9% moisture and 57% carbohydrates. The results for the quantitative phytochemicals revealed that the young leaves contained 3.91 (ppm) tannins, 0.34 (ppm) phenols and 62% flavonoids with the mature samples showing a relative result of 3.69 (ppm) tannins, 0.33 (ppm) phenols and 63% flavonoids. The mineral analysis of both samples showed that they contained appreciable quantities of minerals with the mature sample having higher concentrations of Na (30.03 mg/100 g), K (23.55 mg/100 g), Ca (89.18 mg/100 g) and Mg (27.55 mg/100 g) relative to Na (20.30 mg/100 g), K (16.93 mg/100 g), Ca (57.03 mg/100 g) and Mg (14.48 mg/100 g) found in the young leaves. The study showed that the leaves examined contained high levels of carbohydrates and fibre, low fat and phenols but very rich in minerals. These findings suggest that the leaves of *Polyalthia longifolia* might be a potential source of carbohydrates, fibre, phytochemicals and mineral elements for human and animal use.

Key words: *Proximate composition, minerals, phytochemicals, Polyalthia longifolia*

Introduction

A medicinal plant is one which one or more of its organs contain substances with recognized medicinal value/therapeutics, or which are precursors for chemo-pharmaceutical semi-synthesis. The medicinal value of these plants lies in some chemical substances (phytochemicals) that produce a definite physiological action on the human body (Edeoga *et al.*, 2005). Medicinal plants play a significant role in providing primary health care services to rural dwellers and are used by about 80% of the marginal communities around the world (Latif *et al.*, 2003; Shinwari *et al.*, 2006).

The nutritional composition of medicinal plants is of immense importance. Each medicinal plant species has its own nutrient composition besides having pharmacologically important

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phytochemicals. These nutrients are essential for the physiological functions of human body. Such nutrients and biomolecules like carbohydrates, fats and proteins play an important role in satisfying human needs for energy and life processes (Novak and Haslberger, 2000). They also form the major portion of the diet, while minerals and vitamins constitute a comparatively smaller but highly important part (Indrayan *et al.*, 2005).

Mineral elements present in living organisms are of biological importance; since many of these elements take part in some metabolic processes and are known to be indispensable to all living things (Shul'man, 1974). The body usually contains small amount of these minerals, being components of many enzyme systems and metabolic mechanisms, and as such contribute to the growth of living organisms. The most important mineral salts are calcium, sodium, potassium, phosphorous, iron and chlorine while many others are also needed in trace amounts. The deficiency in these principal nutritional mineral elements induces a lot of malfunctioning; as it reduces productivity and causes diseases, such as inability of blood to clot, osteoporosis, anemia etc. (Shul'man, 1974).

Moreover, the measurement of some proximate profiles such as proteins, carbohydrates, lipids, moisture and ash contents in plants is often necessary to ensure that they meet the requirements of food regulations and commercial specifications (Watermann, 2000).

Polyalthia longifolia Sonn. (Family-Annonaceae) is an evergreen tree native to the drier regions of India. Its common names are Mast Tree, Ashoka, False Ashoka, The Buddha Tree, and Indian Fir Tree. It has been introduced in gardens of many tropical countries across the world even in Nigeria, due to its beautiful appearance (Bose *et al.*, 1998) effectiveness in alleviating noise pollution. It is a tropical, lofty, narrow, odd looking, evergreen tree that grows straight up vertically to a height of 15-20 meters tall. Young plants have straight trunks and weeping pendulous branch. The longest branch is seen at the base and shorter at the end of the trunk, giving an appearance of conical crown. Leaves are long, narrow dark green and glossy. Leaf blades are ovate-oblong to ovate-lanceolate with wavy margins (Jothy et al., 2013).

The plant has been used in traditional system of medicine for the treatment of fever, skin diseases, diabetes, hypertension and helminthiasis (Kirtikar and Basu, 1995). *P. longifolia* is one of the most important indigenous medicinal plants and found throughout Malaysia and widely used in traditional medicine as febrifuge and tonic (Jothy *et al.*, 2013). Pharmacological studies by various groups of investigators have shown that *Polyalthia longifolia* possesses significant biological and pharmacological activities, such as antibacterial, antifungal, antitumor, anti-ulcer and antioxidant properties (Jothy *et al.*, 2013). Pharmacologic studies on the bark and leaves of this plant display effective antimicrobial activity (Faizi *et al.*, 2003a, b; Faizi *et al.*, 2008), cytotoxic function (Chen *et al.*, 2000; Chang *et al.*, 2006) and hypotensive effects (Saleem *et al.*, 2005). Besides this, toxicity studies of this plant have revealed no toxic effect on mice. Nair *et al* (2009) reported oral acute toxicity of *P. longifolia* leaf in mice. The mice were administered orally five different dose levels (400 mg, 800 mg, 1200 mg, 1600 mg and 3200 mg/kg) of *P. longifolia* leaf extract. From safety assessment in acute condition and gross behavioral studies it is concluded that all extracts produced mild to moderate hypo activity and also exhibited analgesic activity to some extent. Also, Chanda *et al* (2012) recently reported the acute oral toxicity of *P. longifolia* leaf extract in Wistar albino rats. The parameters evaluated daily after oral drug administration of the extract (540, 1080, 2160 and 3240 mg/kg body weight) were mortality, signs of toxicity, feed and water consumption, body weight changes, biochemical and hematological parameters. They found that the methanol extract of *P. longifolia* leaf at all the doses tested did not produce any toxic effect or death; the extract was well tolerated by the rats. Information in the biomedical literature has indicated the presence of a variety of medicinally-

Plate 1: Young *Polyalthia longifolia* leaves

Plate 2: Mature *Polyalthia longifolia* leaves

longifolia (Ghosh *et al.*, 2008).

In this study therefore, young and matured leaves of *P. longifolia* were analyzed for proximate, phytochemical and mineral constituents with the objective of comparing the composition of the young and mature leaves.

Materials and Methods

Sample preparation

P. longifolia (young and mature) leaves were obtained from the premises of Al-Hikmah University, Ilorin, Nigeria. Young *P. longifolia* leaves were coppery or lighter green, small, soft and delicate to the touch while the mature leaves were dark green and glossy with a lighter midveins and undersides.

The plant was authenticated at the Herbarium of Department of Plant Biology, University of Ilorin, Ilorin, Nigeria, with a voucher number ULH 810. The leaves were air dried separately until constant weights were obtained and made into powder using a blender. A known weight (10 g) of the powdered samples were separately extracted in 100ml of distilled water for 48 hours after which the extracts were filtered using Whatmann filter paper No. 1 and the The powdered samples and prepared extracts were subjected to the following tests:

Proximate analysis

Moisture, ash, crude protein, crude fat and crude fibre were determined in accordance with the Official Methods of the Association of Official Analytical Chemists (AOAC, 1999). Carbohydrate was determined by difference (i.e. all other parameters deducted from 100).

Phytochemical analysis

A portion of each of the extracts was subjected to standard chemical tests for the detection of saponins, flavonoids, phenolics, alkaloids, steroids, anthraquinones and cardiac glycosides using the methods described by Harborne (1973), Odebiyi and Sofowora (1978). Tannin (Van-Burden and Robinson, 1973), total phenol and flavonoid (Boham and Kocipai-Abyazan, 1974) contents were also determined in the extracts.

Mineral analysis

The minerals in the young and mature leaves of *P. longifolia* were analysed from solution

Table 1: Proximate composition (%) of young and mature leaves of *P. longifolia*

	Polyalthia longifolia leaves	
	Young	Mature
Crude Protein	9.02 ± 0.02[a]	10.05 ± 1.14[b]
Total Ash	3.53 ± 0.03[a]	5.05 ± 0.05[b]
Crude Lipid	0.21 ± 0.01[a]	0.26 ± 0.05[a]
Crude Fibre	25.15 ± 0.15[a]	18.50 ± 0.05[b]
Moisture content	7.90 ± 0.70[a]	8.70 ± 0.50[b]
Carbohydrate	54.19 ± 1.14[a]	57.44 ± 1.14[b]

Values are mean ± SEM of three determinations. Test values carrying different superscripts are significantly different (P<0.05)

obtained when 2.0 g of the samples were digested with concentrated nitric acid and concentrated perchloric acid in ratio 5:3, the mixtures were placed on a water bath for three hours at 80°C. The resultant solutions were cooled and filtered into 100 ml standard flask and made to mark with distilled water (Asaolu, 1995). The minerals (sodium, potassium, calcium and magnesium) were determined using atomic absorption spectrophotometry.

Statistical analysis

Results were expressed as the mean ± SEM of three determinations. The data were analyzed using Duncan Multiple Range Test and complemented with Student's t-test. The differences were considered statistically significant at $P < 0.05$.

Results

Proximate composition

The results of the proximate analysis (%) of the young and mature samples showed that crude protein was significantly higher in the mature leaves of *P. longifolia* than its young leaves; 10.05% and 9.02% respectively (Table 1). The ash contents were 5.05% - 3.53% in the mature and young leaves, respectively. The young leaves contained 0.21% crude lipid while the mature leaves contained 0.26% lipid. Crude fibre was significantly greater in the young leaves (25.25%) of *P. longifolia* than what was obtained in the mature leaves (18.50%). Moisture content in both samples is fairly low 7.9 and 8.7 % for the young and mature leaves respectively. Carbohydrate is high in both samples; 54.19 and 57.44% in the young and mature leaves of *P. longifolia*, respectively.

Table 2: Phytochemical constituents of young and mature leaves of *P. longifolia*

Test	Result
Phlobatanins	Present
Saponins	Present
Steroids	Present
Flavonoids	Present
Tanins	Present
Phenolics	Present
Glycosides	Present
Alkaloids	Present
Anthraquinone	Present

Table 3: Some phytochemical contents of young and mature leaves of *P. longifolia*

P. longifolia leaves	Tanins (ppm)	Flavonoids (%)	Phenols (ppm)
Young	3.91 ± 0.50[a]	62 ± 1.10[a]	0.34 ± 0.10[a]
Matured	3.69 ± 0.40[a]	63 ± 0.10[a]	0.33 ± 0.10[a]

Values are mean ± SEM of three determinations. Test values carrying different superscripts are significantly different (P<0.05) for each parameter

Table 4: Some mineral composition of young and mature leaves of *P. longifolia*

	Mineral (mg/100g) composition			
P. longifolia leaves	Na	K	Ca	Mg
Young	20.30 ± 0.51[a]	16.93 ± 1.32[a]	57.03 ± 2.84[a]	14.48 ± 0.83[a]
Mature	30.03 ± 2.20[b]	23.55 ± 0.17[b]	89.18 ± 3.20[b]	27.55 ± 1.10[b]

Values are mean ± SEM of three determinations. Test values carrying different superscripts are significantly different (P<0.05) for each parameter

Phytochemical constituents

The phytochemical screening of the young and mature leaves of *P. longifolia* revealed that the leaves contained phytochemicals like alkaloids, tannins, phlobatannins, saponins, flavonoids and anthraquinones (Table 2). The young and the mature leaves of *P. longifolia* contain relatively the same amount of tannins (3.91 and 3.69 ppm), flavonoids (62 and 63%) and phenol (0.34 and 0.33%), respectively (Table 3).

Mineral composition

The mineral analysis results showed that the young and mature leaves of *P. longifolia* contained sodium, potassium, calcium and magnesium (Table 4). Both samples contain appreciable amount of calcium and moderate levels of sodium, potassium, and magnesium but in all cases, the mature leaves contain about one and half fold the level found in the young leaves sample.

Discussion

Proximate Composition

Proteins play a central role in biological processes. They catalyze reactions in the body, transport molecules such as oxygen, keep the body healthy as part of the immune system and transmit messages from cell to cell. The result thus suggests that these leaves may not be able to supply adequate amount of dietary proteins.

Ash content is generally considered to be a measure of the mineral content of the original food (Onwuka, 2005). The ash content gives an indication of the amount of minerals present in a particular sample, which are important in many biochemical reactions functioning as co-enzyme and aid physiological functioning of major metabolic processes in the body. The higher percentage ash content observed in the mature leaves of *P. longifolia* than its young leaves is a reflection that the mature leaves contained higher amounts of the minerals and makes it suitable as source of minerals than the young leaves.

Lipids are very good sources of energy and aid in the transport of fat-soluble vitamins, insulate and protect internal tissues, and contribute to important cell processes (Pamela *et al.,* 2005). It also maintains membrane integrity. It supplies energy in calories when carbohydrate is deficient and provides about 9 calories of

energy per gramme (1 g of fully oxidized fat yields 37.5 Kcal of energy). Both samples contained a fairly low amount of crude lipid. This observation shows that the leaves are nutritionally valuable with moderate lipid because excess lipid consumption is dangerous. It should be noted that vegetable lipid is better than animal fat.

Epidemiological evidences have shown that consumption of reasonable amounts of dietary fibre (20 – 35 g/day) lowers the risk of a number of chronic diet-related diseases such as diverticular disease, coronary heart disease, obesity, type 2 diabetes mellitus, irritable bowel syndrome, etc. (Houghton, 2007). Dietary fibre prevents constipation, bowel problems and piles, therefore the fibre present in them can be of importance since fibre could aid quick bowel movement and digestion. The young leaves which contained a higher amount of fibre will be more suitable as a source of fibre than the mature leaves.

The moisture content gives an indication of the amount of water present in a sample. It is often used as a strong factor for food preservation. The moisture level found in both samples suggest that the plant leaves are likely to stay longer before use or processing due to their low moisture content since the low moisture content of the leaves coupled with drying could hinder growth of micro organisms, hence shelf life would be longer (Awogbemi and Ogunleye, 2009).

The carbohydrate content showed that both the young and mature leaves of *P.longifolia* contain appreciable amount of carbohydrates and can be good sources of carbohydrates and energy for human and livestock consumption.

The differences in the nutritional composition of the leaves may be due to the fact that at the mature stage, the rates of metabolism and photosynthesis are diminished thus the intermediates are stored in the leaves.

Phytochemical constituents

Phytochemicals are biologically active compounds, found in plants in small amounts, which are not established nutrients but, nevertheless, contribute significantly to protection against degenerative disease (Loliger, 1991; Omale and Okafor, 2008).

Alkaloids are the most efficient therapeutically significant plant substances commonly found to have antimicrobial properties due to their ability to intercalate DNA of the microorganisms (Kasolo *et al.*, 2010). Analgesic, bactericidal and antispasmodic effects have all been attributed to alkaloidal composition in plants (Ganellin and Roberts, 1993; Babajide *et al.*, 1999). The presence of alkaloids may be attributed to the acclaimed antibacterial property (Faizi *et al.*, 2003a, b ; Faizi *et al.*, 2008) of this plant.

Tannins have been suggested to be involved with antibacterial and anti-viral activity while tannins and flavonoids are thought to be responsible for antidiarrheal activity (Adisa *et al.*, 2004; Enzo, 2007; Adisa *et al.*, 2010).

Saponins are known to possess both antimicrobial (Soetan *et al.*, 2006) and anti-inflammatory activities (Hassan *et al.*, 2012). Studies have also reported the beneficial effects of saponins on blood cholesterol levels and stimulation of the immune system (Cheeke, 2000).

Flavonoids have been shown to have antifungal activity *in vitro* (Galeotti *et al.*, 2008). The potent antioxidant activity of flavonoids reveals their ability to scavenge hydroxyl radicals, superoxide anions and lipid peroxy radicals; this may be the most important function of flavonoids (Alan and Miller, 1996). They also induce mechanisms that may kill cancer cells and inhibit tumor invasion (Williams *et al.*, 2004). The flavonoids present may be responsible for the medicinal properties accorded the plant (Chen *et al.*, 2000; Faizi *et al.*, 2003; Saleem *et al.*, 2005; Chang *et al.*, 2006).

Phenols are strong antioxidants which prevent oxidative damage to biomolecules such as DNA, lipids and proteins that play a role in chronic diseases such as cancer and cardiovascular disease. Plant phenols may interfere with all stages of the cancer process, potentially resulting in a reduction of cancer risk (Hollman, 2001). The cardiac glycosides

therapeutically have the ability to increase the force and strength of the heart-beat without increasing the amount of oxygen needed by the heart muscle. They can thus increase the efficiency of the heart and at the same time stabilize excess heart beats without strain to the organ (David, 1983).

These chemical components detected in the leaves of this plant may therefore serve as the active substances appropriately responsible for the claimed therapeutic indications recorded against this plant, and is also an indication of preliminary validation of the claims.

Mineral composition

The results of the mineral analysis of both the young and mature leaves of *P. longifolia* revealed that they contain appreciable amount of the minerals examined, though; the mature leaves are richer and tend to supply more of these minerals than the young leaves.

Sodium is an important intracellular cation involved in the regulation of plasma volume, acid-base balance, and nerve and muscle contraction (Akpanyung, 2005). *P. longifolia* leaves are very rich in sodium, therefore they are very good sources of this mineral.

Both samples also contain appreciable amounts of potassium. Potassium is very vital in regulation of water, electrolyte and acid-base balance in the body, as well as responsible for nerve action and functioning of the muscles (Indrayan *et al.*, 2009).

Calcium plays a fundamental role in the constitution of biological systems; its presence in bones provides an animal with the required rigidity and support (Ibrahim *et al.*, 2001). The level of calcium in the young and mature leaves of *P. longifolia* shows that both are adequate for the required needs of the body. Calcium is essential for bone and teeth formation and development, blood clotting and for normal functioning of the heart, nervous system and muscles.

The level of magnesium obtained from the mature leaves in this study shows that the mature leaves are capable of supplying more magnesium than the young *P. longifolia* leaves. Magnesium has been found in some enzyme systems (Huheey et al., 1993) e.g enolase, pyruvate kinase, pyrophosphatase and Na^+-K^+ ATPase (Ryan, 1991) especially in nucleotides and protein synthesis where it enhances their action thereby enhancing the proper body metabolism (Altura, 1991).

Considering the different elements analysed from the *P. longifolia* leaves and their wide uses, this plant has the potentials for providing essential nutrients for human and other animal nutrition, since the nutritional activity of any plant is usually traced to the particular elements it contains (Sofowora, 1993).

Conclusion

This study therefore provides information that the mature leaves of *P. longifolia* have more nutritional values than the young leaves. Selection of nutrients from the mature leaves will provide a nutritional importance and therapeutic potential to improve health by targeting the compounds present. Therefore, *P. longifolia* could be considered as a valuable economic product.

The phytochemical studies on this plant will serve as a lead in establishing the active principles in it. Also by this, a more precise and highly targeted biological evaluation can be designed and studied for any plant with interesting therapeutic claims.

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