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Comparative Evaluation of Phytochemical and Mineral Constituents of the Leaves of some Medicinal Plants in Abia State Nigeria

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Abstract

The leaves of six medicinal plant species *Anacardium occidentale*, *Azadirachta indica*, *Carica papaya*, *Cymbopogon citratus*, *Psidium guajava* and *Vernonia amygdalina*, widely used in Abia State, Nigeria were analyzed with a view to compare their phytochemical and mineral constituents. Result indicates that the bioactive contents of the leaves varied significantly ($p < 0.05$) among the medicinal plants; *Cymbopogon citratus* contained significantly higher concentration of phenols ($0.27^a \pm 0.01$), steroids ($0.37^a \pm 0.02$) and flavonoids ($0.84^a \pm 0.02$) than the other medicinal plants used for this study while there was no significant difference in phenol concentration between *Cymbopogon citratus* and *Vernonia amygdalina*. The concentration of alkaloids was significantly higher in *Vernonia amygdalina* ($2.78^a \pm 0.02$) than other species. *Psidium guajava* had the lowest concentration of alkaloids ($2.78^a \pm 0.02$). While the result of minerals shows that the plants contained Ca, Mg, Na, K, and P. *Vernonia amygdalina*, *Carica papaya* and *Anacardium occidentale* have highest amount of Ca ($0.21^a \pm 0.02$, $0.20^a \pm 0.02$ and $0.19^a \pm 0.02$) respectively and there was no significant difference in their calcium contents. *Azadirachta indica* had highest significant amount of Mg ($0.45^a \pm 0.01$) and K ($0.34^a \pm 0.01$) while *Cymbopogon citratus* had the least of all the mineral contents analyzed *Vernonia amygdalina*, *Carica papaya* and *Anacardium occidentale* had highest amount of Ca ($0.21^a \pm 0.02$, $0.20^a \pm 0.02$ and $0.19^a \pm 0.02$) respectively, however, there was no significant difference of calcium contained in the three species. *Carica papaya* had highest significant amount of phosphorus ($0.38^a \pm 0.02$) and there was no significant difference between *Vernonia* sp ($0.30^b \pm 0.01$), *Psidium guajava* ($0.28^b \pm 0.01$) and *Anacardium* sp ($0.27^b \pm 0.02$). *Azadirachta indica* had the highest significant amount of Mg ($0.45^a \pm 0.01$) and K ($0.34^a \pm 0.01$) and *Vernonia* sp highest significant amount of Na ($0.46^a \pm 0.01$) while *Cymbopogon* sp had the lowest amount of Mg ($0.13^e \pm 0.01$), Na ($0.11^e \pm 0.01$), K ($0.18^c \pm 0.01$) and P ($0.15^c \pm 0.01$).

Keywords: Medicinal Plants, Phytochemical, Bioactive, Minerals, *Vernonia Amygdalina*

Introduction

Medicinal plants constitute the main source of new pharmaceuticals and healthcare products (Ivanova *et al.*, 2005). The use of medicinal plants in the industrialized societies has been traced to the extraction and development of several drugs from these plants as well as from traditionally used folk medicine (Shrikumar and Ravi, 2007). Medicinal plants have formed the basis of health care throughout the world since the earliest days of humanity and are still widely used and have considerable importance in international trade (Patrick *et al.*, 2008). The medicinal value of plants lies in some chemical substances that produce a definite physiological action on the human body. The most important of these bioactive compounds of plants are alkaloids, flavanoids, tannins and phenolic compounds (Veeramuthu *et al.*, 2006). Plants used for traditional medicine contain some important chemical constituents, which play a vital role in ethno medicinal life of the people. Traditionally, the use of plant parts as treatment of various ailments are based on experience passed from generation to generation, virtually by oral tradition and through practice and forms part of the indigenous knowledge of the people of any locality. It is generally assumed that the active constituents contributing to these protective effects are the phytochemical, vitamins and minerals (Okwu and Ekeke, 2003). Phytochemicals are present in a variety of plants utilized as important components of both human and animal diet. The importance of medicinal plants has been elucidated by Edeoga *et al* (2003) as well as their importance in the pharmaceutical industry Edeoga *et al* (2005) These medicinal plants have been under utilized in orthodox medicine but have been confirmed to be used worldwide in pharmaceuticals, food, cosmetics and perfume industries. Plant-based natural constituents can be derived from any part of the plant like bark, leaves, flowers, roots, fruits, seeds, (Gordon, 2001). Phytochemical which possess many ecological and physiological role are widely distributed as plant constituents and include alkaloids, saponins, tannins, steroids, phenols, flavonoids. Alkaloids are essential in medicine and constitute most of the valuable drugs. They have marked physiological effect in animals (Edeoga and Eriata, 2001). Saponins are glycosides widely occurring in a variety of plants. Flavonoids are the commonest phenolic constituents having 5 compounds generally distributed throughout the plant kingdom. Flavours are related to flavonoids and they promote particular taste to prepared food. They are widely used in insecticide and treatment of certain physiological disorder and disease control. Tannins are useful in medicine because of their astringent properties. According to Edeoga and Eriata, (2001), the presence of tannins and alkaloids in medicinal plants could be serving as a deterrent to grazers. Phenolic compounds are known to have anti fungal and anti bacterial effects. Phenolic compounds are believed to be the active ingredients found in some commercial herbicide formulations. Herbal medicines have become more popular in the treatment of many diseases due to popular belief that green medicine is safe, easily available and with fewer side effects. Indeed, the market and public demand has been so great that there is a great risk that many medicinal plants today, face either extinction or loss of genetic diversity (Misra, 2009). It is therefore, the objective of this study is to compare the percentage crude phytochemicals and mineral contents of the plants.

Materials and Methods

The leaves of the plants were randomly collected from different parts of Abia state Nigeria. Only healthy fresh and succulent leaves of the plants were collected. Voucher specimens of the plants

have been deposited in Herbarium, Department of Plant Science and Biotechnology, Michael Okpara University of Agriculture for further references. Fresh leaves of *Anacardium occidentale*, *Azadirachta indica*, *Carica papaya*, *Cymbopogon citratus*, *Psidium guajava* and *Vernonia amygdalina* were harvested and washed with distilled water to remove foreign particles.

Table 1: Species list of the selected medicinal plants used in the study, their cultural uses and parts used

Plant species	Family	local names	Traditional uses	Parts used	References
<i>Anacardium</i>	Anacardiaceae	Shashu, Kaju	Toothache	leaves, bark	Federal
<i>Occidentale</i>		Kanju	Scurvy, pile	fruits	Ministry of Sciences and Technology (2008)
<i>Azadirachta indica</i>	Melvaceae	Neem Dongoyaro	Malaria, fever Dysentery	leaves bark roots	
<i>Carica papaya</i>	Caricaceae	Ibepe, Okworobeke	Malaria,Diabetes Stomach ache	Fruits, Leaves Seed, latex	
<i>Cymbopogon</i>	Poaceae	Achara	Fever, Jaundice Cough, mosquito repellent	leaves	
<i>Psidium guajava</i>	Myrtaceae	Ugwuoba	Check vomiting Diarrhea	Bark, fruits Leaves	
<i>Vernonia Amydalina</i>	Asteraceae	Onugbu	Laxative,Diabetes rheumatism	Leaves,bark	
<p>Sample preparation: The leaves were air dried and milled into a fine powder using Thomas-Willey milling machine and stored in air tight container. The powdered material was used for phytochemical and mineral screening.</p> <p>QUANTITATIVE DETERMINATION OF THE PHYTOCHEMICALS FROM LEAF SAMPLES Quantitative phytochemical compositions of the leaves were determined using the methods variously described by Obadoni and Ochuko, (2001), AOAC (2004) and Sofowara (2006).</p> <p>Mineral Determination of Leaf Samples Atomic Absorption spectrophotometer was used for the determination of Ca, Mg, Na, K and P using the methods of AOAC (2004). Laboratory procedures for the preparation and determination mineral contents were used as outlined by Shah <i>et al.</i> (2009) for plant samples.</p> <p>Statistical analysis Data collected were subjected to analysis of variance (ANOVA) using SPSS software and significant differences within the means of the treatment were calculated using the Least Significant Difference (LSD) statistical test at 5% level of probability.</p>					

Result and Discussion

The quantitative estimate of the percentage crude chemical constituents of the six medicinal plant species studied is summarized in Table 2. The result revealed the presence of a variety of

secondary metabolites such as alkaloids, tannins, saponins, steroids, phenol and flavonoids in all the species studied. This is in agreement with the work of Geyid *et al* (2005) and Tedong *et al* (2006)) who reported that plants generally have variety of secondary metabolites as mentioned above. The beneficial medicinal effect of the plant materials result from the combination of these metabolites present in the plants. However, results showed that the chemical constituents varied significantly ($p < 0.05$) among the plant species screened Alkaloids are essential in medicine and constitute most of the valuable drugs and are used as basic medicinal agents for their analgesic, antispasmodic and bactericidal effects. They have marked physiological effect on animals (Edeoga and Eriata, 2001). *Cymbopogon citratus* contained significantly higher concentration of phenols ($0.27^a \pm 0.01$), steroids ($0.37^a \pm 0.02$) and flavonoids ($0.84^a \pm 0.02$) than the other medicinal plants used for this study while there was no significant difference in phenol concentration between *Cymbopogon citratus* and *Vernonia amygdalina*. Epidemiological studies suggest that the consumption of flavonoids is effective in lowering the risk of coronary heart diseases. The antioxidant properties of plant extracts is attributed to their polyphenolic contents (Lu and Foo, 2001; Murthy *et al.*, 2002). As such plants containing a high level of polyphenols have a greater importance as natural antibiotics (Baravalia *et al.*, 2009). Natural antioxidants mainly come from plants in the form of phenolic compounds such as flavonoids, phenolic acids, tocopherols, etc. (Ali *et al.*, 2008). Many reports suggest that plants which have more phenolic content show good antioxidant activity that is there is a direct correlation between total phenol content and antioxidant activity (Brighente *et al.*, 2007; Salazar *et al.*, 2008). Also the presence of steroids in this plant makes the plant useful to many industries. It should be noted that steroidal compounds are of importance and interest in pharmaceutical companies due to their relationship with such compounds as sex hormone (Okwu, 2001). *Carica papaya* had significantly higher concentration of saponins ($1.27^a \pm 0.01$) than the other plant species while *Anacardium occidentale* had the lowest saponin concentrations ($0.44^f \pm 0.03$). Saponins which are responsible for numerous pharmacological properties (Estrada *et al.*, 2000) were also present in the plant leaves extract. Saponins are known to produce inhibitory effect on inflammation. These observations cited on phytochemical compounds support our findings on the usefulness of the medicinal plants screened in traditional medicine. Thus, these plants should be considered by pharmaceutical companies for the manufacturing of such drugs.

Table 2: Mean values of phytochemical contents of the six Nigerian medicinal plants studied
Phytochemicals (%)

Species	Alkaloids	Flavonoids	Phenols	Saponins	Steroids	Tannins
<i>Anacardium sp</i>	$0.86^c \pm 0.01$	$0.53^d \pm 0.08$	$0.15^c \pm 0.02$	$0.44^f \pm 0.03$	$0.18^c \pm 0.01$	$0.56^e \pm 0.02$
<i>Azadirachta sp</i>	$0.85^c \pm 0.02$	$0.63^c \pm 0.02$	$0.20^b \pm 0.01$	$0.54^e \pm 0.03$	$0.26^b \pm 0.01$	$1.16^a \pm 0.03$
<i>Carica papaya</i>	$1.29^b \pm 0.01$	$0.67^b \pm 0.01$	$0.04^d \pm 0.01$	$1.27^a \pm 0.01$	$0.26^b \pm 0.01$	$1.06^b \pm 0.03$
<i>Cymbopogon sp</i>	$1.27^b \pm 0.02$	$0.84^a \pm 0.02$	$0.27^a \pm 0.01$	$1.06^b \pm 0.01$	$0.37^a \pm 0.02$	$0.87^c \pm 0.03$
<i>Psidium guajava</i>	$2.78^a \pm 0.02$	$0.46^e \pm 0.01$	$0.04^d \pm 0.01$	$0.73^c \pm 0.01$	$0.17^c \pm 0.01$	$0.76^d \pm 0.01$
<i>Vernonia sp</i>	$2.78^a \pm 0.02$	$0.47^e \pm 0.01$	$0.25^a \pm 0.01$	$0.64^d \pm 0.02$	$0.17^c \pm 0.01$	$0.74^d \pm 0.02$
LSD	0.03	0.03	0.03	0.04	0.02	0.06

^{a-f} Means in the same column with different superscripts are significantly different ($P < 0.05$)

Azadirachta indica had significantly higher levels of tannins (1.16%) followed by *Carica papaya* (1.06%) while *Anacardium occidentale* had the lowest tannin concentration. The high tannin contents could be partly responsible the bitter taste of neem plant. Herbs that have tannins as their component are astringent in nature, hasten healing of wounds and are used for treating intestinal disorders such as diarrhoea and dysentery (Dharmananda, 2003) thus exhibiting antimicrobial activity. Tannins can also serve as antidotes for many poisons (Norton, 2000); therefore, *Azadirachta indica* could serve as a useful source of antidotes for poisons. The presence of tannins in all plant species supports the traditional medicinal use of this plant in the treatment of different ailments. Foods containing phytochemicals are already part of our daily diet. Many people are aware that eating plant based foods add much needed fiber, vitamins and minerals to the diet but what is less well known is the many benefits of the phytochemicals that these plants contain. Aside from the obvious dietary problems of high fat, protein and simple carbohydrate intake, is the considerably inadequate intake of plant based foods and all the health giving benefits they bring with them.

Table 3: Mean values of mineral contents of the six Nigerian medicinal plants studied

Species	Ca	Mg	Na	K	P
<i>Anacardium</i> sp	0.19 ^a ±0.02	0.37 ^b ±0.02	0.16 ^d ±0.01	0.25 ^b ±0.12	0.27 ^b ±0.02
<i>Azadirachta</i> sp	0.15 ^b ±0.01	0.45 ^a ±0.01	0.28 ^c ±0.01	0.34 ^a ±0.01	0.18 ^c ±0.01
<i>Carica papaya</i>	0.20 ^a ±0.02	0.18 ^d ±0.01	0.37 ^b ±0.01	0.28 ^b ±0.02	0.38 ^a ±0.02
<i>Cymbopogon</i> sp	0.17 ^b ±0.02	0.13 ^e ±0.01	0.11 ^e ±0.01	0.18 ^c ±0.01	0.15 ^c ±0.01
<i>Psidium guajava</i>	0.15 ^b ±0.01	0.25 ^c ±0.01	0.08 ^f ±0.01	0.23 ^b ±0.02	0.28 ^b ±0.01
<i>Vernonia</i> sp	0.21 ^a ±0.02	0.27 ^c ±0.01	0.46 ^a ±0.01	0.26 ^b ±0.01	0.30 ^b ±0.01
LSD	0.03	0.03	0.02	0.03	0.03

^{a-f} Means in the same column with different superscripts are significantly different (P<0.05)

Result of table 3 indicates that all the medicinal plants analyzed contained P, K, Na, Ca, Mg, this becomes very important when the usefulness of such minerals in the body are considered. However, there are significant variations of these minerals in some of the plants studied. *Vernonia amygdalina*, *Carica papaya* and *Anacardium occidentale* had highest amount of Ca (0.21^a±0.02, 0.20^a±0.02 and 0.19^a±0.02) respectively, however, there was no significant difference of calcium contained in the three species. *Carica papaya* had highest significant amount of phosphorus (0.38^a±0.02) and there was no significant difference between *Vernonia* sp (0.30^b±0.01), *Psidium guajava* (0.28^b±0.01) and *Anacardium* sp (0.27^b±0.02). *Azadirachta indica* had the highest significant amount of Mg (0.45^a±0.01) and K (0.34^a±0.01) and *Vernonia* sp highest significant amount of Na (0.46^a±0.01) while *Cymbopogon* sp had the lowest amount of Mg (0.13^e±0.01), Na (0.11^e±0.01), K (0.18^c±0.01) and P (0.15^c±0.01). Ca in conjunction with Mg, P, Mn, vitamin, chlorine and proteins are involved in the formation of bone (Abulude, 2001). Minerals are needed in the body because they form the structure of the body and help the body systems work effectively. Calcium also plays an important role in blood clotting, coordination of inorganic elements present in the body and balancing of Ca and P. It is very important that the normal Ca levels in the diet should be balanced throughout life. Increasing dietary K has lowered blood pressure in humans, which by itself should reduce the risk of stroke; however, some of the

protective effect of K appears to extend beyond its ability to lower blood pressure. Minerals are absolutely necessary for most metabolic processes. They serve as cofactors, help in transmission of nerve impulses and water balance (Brown, 2007).

Conclusion

The results of the quantitative phytochemical and mineral study of the percentage crude powder of six plants showed the presence of alkaloids, tannins, steroids, saponins, phenols and flavonoids. They also contain substantial amounts Ca, Mg, Na, K and P. The present study has verified the usefulness of the medicinal plants analyzed for their phytochemicals coupled with the presence of essential minerals.

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