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Full Length Research Paper

Evaluation of the chemical composition of *Mucuna utilis* leaves used in herbal medicine in Southeastern Nigeria

Ujowundu C. O.[1]*, Kalu F. N.[2], Emejulu A. A.[1], Okafor O. E.[2] Nkwonta C. G.[2] and Nwosunjoku E. C.[3]

[1]Biochemistry Department, Federal University of Technology Owerri, Imo State, Nigeria.
[2]Biochemistry Department, University of Nigeria Nsukka, Enugu State, Nigeria.
[3]Environmental Health Department, Imo State College of Health Science and Technology, Amigbo, Imo State, Nigeria.

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The increased interest in the biological activities of the leaves of *Mucuna utilis* necessitated this study which evaluated the chemical composition, especially the presence of antiphysiological and toxic factors in the leaves. The results of the phytochemical analyses were: alkaloid, 9.60 ± 0.141%; flavonoids, 4.90 ± 0.20%; saponins, 24.60 ± 1.979%; tannins, 32.55 ± 0.778% and cyanoglycosides 20.736 ± 0.91%.The results showed crude protein to be 31.91 ± 2.60%; carbohydrate, 53.65 ± 2.11%; crude fibre 14.80 ± 0.42%; moisture, 11.37 ± 0.632%; ash, 0.11 ± 0.01% and crude fat, 2.97 ± 0.009. The results also showed appreciable presence of macro and micro-elements, while the ascorbic acid and vitamin A contents were 25.36 ± 0.212 and 9.83 ± 0.15 mg/100 g respectively. These results showed that the leaves of *M. utilis* are a veritable source of useful phytochemicals of high medicinal value for human and animals. It also showed that the leaves of *M. utilis* can be used to fulfill the growing demands of plant-based proteins for humans and livestock and source of important minerals and nutrients. The importance of effective processing to reduce the level of toxic and inhibitory substances was emphasized.

Key words: *Mucuna utilis*, leaves, phytochemicals, medicinal, nutritional, toxic.

INTRODUCTION

Medicinal plants have been used for centuries before the advent of orthodox medicine. Leaves, flowers, stems, roots, seeds, fruit, and bark can all be constituents of herbal medicines. The medicinal values of these plants lie in their component phytochemicals, which produce definite physiological actions on the human body. *Mucuna utilis* is a native of South Asia and Malaysia, but presently it is widely grown throughout the tropics (Skerman, 1977). It is a vigorously growing and twining annual plant and has a number of species and hybrids (Skerman, 1977; Oyenuga, 1969). The trailing vines and leaves are grown mostly for green manuring or temporary pasture (D'mello and Devendra, 1995; Skerman, 1977; Oyenuga, 1969). *M. utilis*, is a legume with a low human preference for food, but has a high potential as an energy and protein source in livestock feed. It is comparable to soybean in terms of amino acids and mineral profile (Siddhuraju et al., 1996; Iyayi and Taiwo, 2003).

However, the use of *M. utilis* (seeds) as a source of protein for monogastrics is limited by the presence of antinutritional factor like trypsin inhibitors, haemagglutinins, phytic acid, hydrocyanic acid and tannins (Siddhuraju et al., 1996). *M. utilis* is one of the popular medicinal plants of India and it is a constituent of more than 200 indigenous drug formulations. All parts of *M. utilis* plant are known to have high medicinal value (Caius, 1989; Warrier et al., 1996) and there is heavy demand of Mucuna in India drug markets. After the

*Corresponding author. E-mail: ujowundu@yahoo.com.

discovery that Mucuna seeds contain 3, 4-dihydroxy-L-phenylalanine (L-DOPA) an anti-parkinsons disease drug, its demand in international market has increased many folds (Farooqi et al., 1999) and demand has motivated Indian farmers to start commercial cultivation. There are a number of value-added phytochemicals of Mucuna utilis leaves of medicinal importance (e.g. alkaloids, hen, alkylamines, saponins, tannins, flavonoids etc. (Morris, 1999). Serotonin is confined to fresh leaves and stem (Szabo, 2003). The leaves are aphrodisiac, anthelmintic and useful in treating ulcers.

The issues of *M. utilis* (e.g. leaf, stem, seed Kernel, fruit coat) have shown antibacterial activity against *Bacillus cereus*, *Escherichia coli*, *Proteus vulgaris* and *Staphylococcus* (Manjunatha et al., 2006). Many varieties of *Mucuna* are in great demand in food and pharmaceutical industries. The immature pods and leaves serve as vegetables, while seeds are used as condiment and main dish by ethnic groups in Nigeria (Adebowale and Lawal, 2003). We have observed that most users of *M. utilis* leaf extracts in southeastern Nigeria use it raw without heat treatment or any form of treatment to reduce the high concentration of some antinutritional constituents.

The users of this leaf extract as herbal remedy claim that it is a blood booster. They also claim that users do not need to go for blood transfusion because it increases the rate of red blood cell formation. According to Arnold et al. (1971), the edibility of Mucuna varieties is dependent on the heat labile antinutritional factors. The presence of antiphysiological and toxic factors in legumes decreases the overall nutritional qualities. According to the work of Akinmutimi and Okwu (2006) on Mucuna utilis seeds, there was a general reduction in the quantity of anti-nutrients due to cooking. Similar reduction was observed by Ukachukwu et al. (1999). Also, wet heat treatment reduces antinutrients, especially heat labile anti-nutrients (Udedibie and Carlini, 1998; Ewa, 1999). The present study was undertaken to evaluate the chemical constituents of *M. utilis* leaves, especially the phytochemicals, which in high concentration may produce adverse physiological and biochemical actions in humans. It is hoped that this study will expose the pharmaceutically valued compounds of *M. utilis* leaves and also encourage the proper treatment and processing of the leaves before use.

MATERIALS AND METHODS

Sample collection and preparation

The plant samples of *M. utilis* was collected from a farm around Obinze in Owerri West L.G.A., Imo State, Nigeria. The plant was identified by Dr A.E. Ibeh of the Department of Crop Science, Federal University of Technology Owerri, Nigeria. The fresh leaves of *M. utilis* were plucked out from the plant stalk, rinsed in clean water and dried at room temperature. The dried leaves were ground to fine powder with an electric blender, packaged in air-tight glass jar and stored at 4°C until analysis was carried out.

Phytochemical test

Phytochemical test for the quantitative presence of alkaloids, flavonoids, tannins, saponins, and cyanogenic glycosides were measured by methods described by Harborne (1973) and Trease and Evans (1989).

Proximate analysis

The proximate composition of the leaves for carbohydrate, ash, and moisture were determined by methods described by AOAC (1995). Crude protein, fibre and fat content were determined by methods described by Pearson (1976). Total ash content was determined by furnace incarnation using the method of James (1995). All determinations were done in triplicates.

Vitamin and mineral analysis

Vitamins A and C in the leaves were determined by High Performance Liquid Chromatography (HPLC, model CO30). Sodium and Potassium were determined by Digital flame photometer (model 2655-00). The other minerals; Calcium(Ca), Phosphorous(P), Magnesium(Mg), Manganese(Mn), Iron(Fe), Zinc(Zn) and Selenium(Se) were determined using the Atomic Absorption Spectrophotometer (AAS-model-Alpha 4) as described by AOAC (1995).

Statistical analysis

The results obtained are presented as mean ± standard deviation and analyzed as simple percentages.

RESULTS

Table 1 showed the results of the phytochemical contents, of the dried ground leaves of *M. utilis.* From the analyses *M. utilis* leaves contains alkaloids, flavonoids, tannins, cyanogenic glycoside and saponins. The saponins content was 24.60 ± 1.98%, cyanogenic glycoside was 20.74 ± 0.91%. The value of tannins was 32.55± 0.778% and alkaloids 9.60 ± 0.141%. Table 2 showed the proximate composition of the leaves. The results showed that the leaves are rich in carbohydrate with a value of 53.65 ± 2.11%, Protein content was 31.91 ± 2.6% and moisture content was 11.37 ± 0.632%. Crude fibre was 14.80 ± 0.42%, Ash content of 0.11 ± 0.01% and the Crude fat was 2.97 ± 0.009%. Table 3 presented the vitamin content in the leaves of *M. utilis*. Ascorbic acid was 25.36 ± 0.212 mg/100 g and the level of vitamin A was 9.83 ± 0.15 mg/100 g.

Table 4 showed the mineral concentration of *M. utilis* analyzed on dry weight basis. Mineral compositions of plants are dependent on the soil edaphic factors, including the generic origin and geographical source (Vadivel and Janardhanan, 2001). The leaf contains appreciable quantities of some of the mineral analyzed. They include, calcium- 108.678±1.05 mg/100 g; phosphorous - 11.06 ±1.51 mg/100 g; magnesium - 4.27 ±0.17 mg/100 g; manganese - 0.23± 0.01 mg/100 g; iron - 0.95 ±0.10 mg/100 g. Also zinc content was 0.02± 0.01

Table 1. Phytochemical composition of leaves of *M. utilis.*

Phytochemical	% composition
Alkaloids	9.60 ± 0.141
Flavonoids	4.90 ± 0.200
Saponins	24.60 ± 1.979
Cyanogenic glycosides	20.74 ± 0.452
Tannins	32.55 ± 0.778

Values are means ± standard deviation of triplicate determinations.

Table 2. Proximate composition of leaves of *M. utilis*.

Nutrients	% composition
Moisture	11.37 ± 0.632
Ash	0.11 ± 0.01
Crude protein	31.91 ± 2.6
Crude fat	2.97 ± 0.009
Crude fibre	14.80 ± 0.42
Total carbohydrate	53.65 ± 2.11

Values are means ± standard deviation of triplicate determinations

Table 3. The vitamin content of leaves of *M. utilis.*

Vitamin	Values
Vitamin A (mg/100 g)	9.83 ± 0.15
Ascorbate (mg/100 g)	25.36 ± 0.212

Values are means ± standard deviation of triplicate determinations.

Table 4. Mineral composition of leaves of *M. utilis* (mg/100g).

Mineral	Composition (mg /100 g)
Calcium (Ca)	108.68 ± 1.05
Phosphorous (P)	11.06 ± 1.51
Magnesium (Mg)	4.27 ± 0.17
Manganese (Mn)	0.22 ± 0.01
Iron (Fe)	0.95 ± 0.10
Zinc (Zn)	0.02 ± 0.01
Selenium (Se)	0.09 ± 0.002
Potassium (K)	177.50 ±2.82
Sodium (Na)	16.50 ± 0.42

Values are means ± standard deviation of triplicate determinations.

mg/100 g; selenium 0.091 0.002 mg/100 g; potassium 177.50±2.82 mg/100 g and sodium 16.5±0.42 mg/100 g.

DISCUSSION

The saponins value obtained were higher than the range 1.2 - 1.3% reported by Siddhuraju and Becker (2005) for the seeds. Saponins possess a carbohydrate moiety attached to a triterpenoid or a steroidal aglycone. Saponins form a group of compounds, which on consumption causes deleterious effects such as heamolysis and permeabilization of the intestine (Cheeke, 1996; Price et al., 1987). Saponins have also been shown to have hypocholesterolemic as well as anticarcinogenic effects (Koratkar and Rao, 1997). The cholesterol lowering effect in animals and humans is reported to be through the formation of mixed micelles and bile acids into miceller-bile acid molecules (Okenfull et al., 1984). The cyanogenic glycoside value is higher than the value reported for *M. utilis* seeds by Akinmutimi and Okwu (2006). It is also higher than the values reported for the leaves of *Asystasis gangetica* and *Phyllantus amarus* (Nwaogu et al., 2007; Igwe et al., 2007). Cyanogenic glycosides are toxic and on hydrolysis release Hydrogen Cyanide (HCN) which has been reported to have the ability to cause marked weight change (Aletor and Fetuga, 1988; Aletor, 1993).

The Cyanide detoxification route in man and animals is through Cyanide Thiocyanate sulphur-transferase (Rhodenase pathway) which generally requires organic sulphur donors in the form of Methionine and Cysteine, thereby precipitating methionine deficiency in an otherwise balance diet (Aletor and Fasuyi, 1997). It is this methionine deficiency that results in poor growth in poultry animals (Akinmutimi and Okwu 2006). Our result showed that the concentration of taninins in the leaves is also higher than the value reported for the seed by Siddhuraju et al. (2000). Tannins have been reported to cause poor palatability in high Tannin diet due to its astringent property as a result of its ability to bind with protein of saliva and mucosa membranes (Melansho et al., 1987; D'mello and Devendra, 1995). Tannins also have the ability to bind dietary proteins and digestive enzymes into complexes that are not readily digestible (Melansho et al., 1987; D'mello and Devendra, 1995). Flavonoids are simple phenolic compounds which have been reported to possess a wide spectrum of biochemical activities such as antioxidant, antimutagenic, anticarcinogenic, as well as ability to modify the gene expression (Beta et al., 2005; Marinova et al., 2005). The flavonoids content of 4.90 ± 0.200% obtained from the *M. utilis* leaves may confer some of the biochemical advantages mentioned earlier to its users. Epidemiological studies have also correlated the consumption of plant produce with high phenolics to reduction of cardio-cerebrovascular diseases and cancer mortality (Hertog et al., 1997). Polyphenols are important phytochemicals due to their free radical scavenging and in vivo biological activities as reported by many investigators (Rice-Evans et al., 1996; Bravo, 1998). *M. utilis* leaves also contain appreciable amount of alkaloids. Plant alkaloids and their synthetic derivatives are used as a basic medicinal agent due to its analgesic, antispasmodic and antibacterial properties (Okwu, 2004). Most plants used in the cure of diseases contain traces of alkaloids. *Azadirachta indica* (Meliaceae) employed in the treatment of malaria and fever in Nigeria contains gedunin, an alkaloid (Adesegun and Coker, 2001).

The carbohydrate value is within the range (9.2-105%) reported by Siddhuraju et al. (2000). Ravindran and Ravindran (1988) reported 59.50%. Carbohydrates of legumes are known to reduce the plasma cholesterol and gradually elevate the levels of blood glucose (Leeds 1982; Walker, 1982). The protein value is within the range (26.40-30.62%) reported by Ravindran and Ravindran (1988). The crude fibre is higher than 6.30% reported by Ravindran and Ravindran (1988). High crude fibre in diet is known to enhance digestibility, decrease the blood cholesterol and reduce the risk of large bowel cancers (Anderson et al., 1995; Salvin et al., 1997). The Ash content is lower than 3.70% reported by (Ravindran and Ravindran, 1988). Crude lipid was within the range (2.8-4.9%) as reported by Siddhuraju et al., (2000) but lower than the range (8.47-14.0%) reported by Janardhanan and Lakshmanan (1985) and Vijayakumari et al. (2002). *M. utilis* contained appreciable amount of Ascorbic acid and vitamin A. Lack of ascorbic acid impairs the normal formation of intracellular substances throughout the body, including collagen, bone matrix and tooth dentine. A striking pathological changes resulting from this defect is the weakening of the endothelial wall of the capillaries due to a reduction in the amount of intracellular substance. Consequently, the clinical manifestation of scurvy from mucous membrane of the mouth and gastrointestinal tract, anemia, pains in the joints and defect in skeletal calcification can be related to the association of ascorbic acid and normal connective tissue metabolism (Hunt et al., 1980). These functions of ascorbic acid also accounts for its requirement for normal wound healing. Ascorbic acid is essential to prevent diseases associated with connective tissue and to improve the immune functions (Zhao, 2007). Though the vitamin A is low, it can however help to alleviate symptoms of vitamin A deficiency.

It is known that iron, selenium, zinc and manganese strengthen the immune system as antioxidants (Talwar et al., 1989). Iron is a component of heamoglobin necessary for oxygen transport. Heamoglobin and ferrodoxin play vital roles in man's metabolism. Similarly, magnesium, zinc and selenium are also known to prevent cardiomyopathy, Muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy, impaired spermatogenesis, congenital malformations and bleeding disorders (Chaturvedi et al., 2004). Cellular calcium concentrations are very important for blood coagulation (Okaka and Okaka, 2001). Lack of calcium or phosphorus causes Rickets (Fliedner and Teichman, 1965) and Osteoporosis (Hunt et al. 1980; Okwu and Emenike, 2007). The concentration of iron and zinc is very low considering the daily requirements for adult of 15 and 18 mg, respectively (Kampali and Pali, 2004). This low concentration of iron in *M. utilis* leaves does not support the traditional believe that the leaves are blood boosters and tonic. The combination of magnesium, zinc, sodium, phosphorus and calcium in the presence of fluoride has been reported to have therapeutic, protective and preventive roles in teeth (Olabanji et al., 1996; Okwu and Ekeke, 2003).

These results showed that leaves of *M. utilis* is a good source of medicinal and nutritional substances but the high concentration of some antiphysiological factors in it could decrease the overall benefits of this plant. Some researchers have been able to develop methods to reduce the toxic and inhibitory substances in seeds of *Mucuna* spp. The processing methods included application of chemicals, water, and thermal treatments before consumption (Bressani, 2002; Diallo and Berhe, 2003). Wanjekeche et al. (2003) reported that boiling seeds of *Mucuna pruriens* in alkaline solution (hydrated sodium carbonate) reduced L-DOPA. The hydrogen cyanide (HCN) from cynoglycosides was reduced by dry heat treatment and autoclaving in Mucuna pruriens seeds. The liberated HCN may be lost through volatilization during cooking or converted to thiocyanides (Montgomery, 1980). Soaking followed by irradiation can reduce total phenolics (tannins) and hemagglutinin activity against human (Agbede and Aletor, 2005). The use of any of these processing methods on the leaves may be of value. Our results have shown that *M. utilis* leaf extracts are a good source of phytochemicals which have been reported to have varying biochemical and physiological activities. The benefit of these phytochemicals can only be derived with proper processing of the extracts or moderation on dosage. This work has also shown that the use of properly processed leaf extracts of *M. utilis* will not only offer medicinal and chemoprotective benefits but also nutritional benefits to its users.

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