COMPARATIVE ANALYSIS OF THE PHYTOCHEMICAL, PROXIMATE AND ELEMENTAL COMPOSITION OF *CALOTROPIS PROCERA* (Ait.F.) Ait.F. LATEX AND *MORINGA OLEIFERA* (LAM) SEED POWDER

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ABSTRACT

Comparative phytochemical screening and nutritional potentials of *Calotropis procera* (Ait.F.) latex and *Moringa oleifera* (LAM) seed powder were investigated. *C. procera* and *M. oleifera* are plants that have been frequently used as a medicine, food and as water purifiers. The latex of *C. procera* and seed powder of *M. oleifera* were analysed for their phytochemical, proximate and elemental composition using Folin-Denis spectrophotometric, gravimetric and energy dispersing x-ray fluorescence (EDXRF) transmission emission techniques respectively. Generally, higher values of tannins (322.9 mg/100g), alkaloids (8.24 mg/100g), saponins (9.13%), nitrogen (2.98%), crude proteins (18.63%), sodium (86.2±4.9 ppm) and lanthanum (0.73±0.13 ppm) were obtained in *M. oleifera* seed powder while calcium (826 ± 132 ppm), potassium (769 ± 152 ppm), manganese (25.5 ± 0.4 ppm), aluminium (228 ± 6 ppm), rubidium (41.7 ± 8.5 ppm), samarium (0.21 ± 0.8 ppm) and scandium (0.22 ± 0.06 ppm) were higher in *C. procera* latex. However, both plants had slightly varied values for bromine and phosphorus while magnesium, iron, chromium, arsenic, thorium and zinc were beyond detection limit in all the samples analyzed. The results of the study suggest the pharmacological and nutritional potentials of both the *M. oleifera* seeds and *C. procera* latex for human and other animal uses.

Keywords: Phytochemical, Nutritional, *M. oleifera*, *C. procera*, Latex, Seed powder.

INTRODUCTION

Man since time immemorial has been using herbs and/or plant as medicine for developing immunity or resistance against cold, joint pains, fevers, etc. Medicinal principles are present in different parts of plants like root, stem, bark, heartwood, leaf, flower, fruits, seeds or plant exudates. Plant-derived substances have obtained greater attention in the recent years to prevent and cure human diseases as they are considered to be more bio-friendly. It is generally estimated that over 6000 plants in Africa are in use in traditional folk and herbal medicine, representing about 75% of the medicinal needs of the third world countries (Veerachari and Bopaiah, 2011). According to Okoli *et al* (2007), traditional society in Africa has always used herbs to promote healing. A large body of evidence has accumulated to demonstrate the promising potentials of medicinal plants used in various traditional, complementary and alternate systems of treatments of human diseases (Alam, 2009).

The WHO in 1991 estimated that 70% of population from many countries are using traditional medicine to cure various ailments. Therefore, the useful products obtained from plants directly or indirectly, demonstrate their importance to man. Plants serve as a source of food (Saka and Msonthi, 1994; Katsayal *et al*., 2004; Kawo, 2007), medicinal product (Adoum *et al*., 1997; Ezeamuzie *et al*., 1996; Caceres *et al*., 1991; Kawo *et al*., 2009a; b), energy (Oladele and Yisa, 1989; Kawo, 2010) and shelter to man and his livestock (Ogunkunle and Oladele, 2004).

In the earlier stage man depended on wild food which is much abundant within his immediate environment. As the population grows, however, sources of food became more difficult to him, which necessitated domestication of many plants. Although more than 250,000 plant species have been described worldwide as sources of food, man depends only on a few species mainly cereals, particularly rice, wheat and corn as the major sources of his food and collectively supply nearly 60% of the world's food supply (Sena *et al*., 1998; Parvathin and Kumar, 2002; Oliveira *et al*., 2000).

C. procera (Syn. *Asclepias procera* Aiton) is of the family Asclepiadaceae (Apocynaceae). It is a small to medium-sized shrub, up to 5.5 m high, occasionally branchless to a height of 2.5 m. The bark is fibrous, scaly, deeply fissured when old, grey to light brown. All parts of the plant exude white latex when cut or broken. It is commonly called the Sodom Apple and locally known as 'tumfafiya' in Hausa. The name 'aak' is vernacular. Its other local names are madar, akanda, arks, etc (Noatay, 2005). The different ethnic groups in Nigeria identify the plant by a series of other vernacular names. The Yorubas of western Nigeria call it 'Bomubomu' and the Kanuri of northwestern Nigeria know it as 'Kayou' (Adoum *et al*., 1997). It is a plant of the dry savanna and other arid areas, mostly anthropogene occurring around villages (Aliyu, 2006). The only two species of this genus are *C. gigantea* and *C. procera*. The main difference between the two siblings is that while *C. gigantea* has white flowers, *C. procera* has pinkish white flowers (Noatay, 2005).

Different parts of *C. procera* have been reported to exhibit ethnomedicinal and nutritional properties while phytochemical evaluation of the plant parts revealed the presence of essential and trace elements in varied quantities (Abhay *et al*., 1997; Adoum *et al*., 1997; Awune, 2000; Olasupo *et al*., 2004). Its use in West Africa was first documented by Dalziel (1937), who reported it as a local anaesthetic. Irvine (1961) reported the use of the decoctions derived from the root bark for the treatment of syphilis. In Nigeria, *C. procera* is either used alone or with other herbs to treat common diseases such as fever, rheumatism, indigestion, cold, eczema and diarrhoea. In addition, preparations from the latex with honey are used as antibodies and also in the treatment of toothaches and cough (Kew, 1985; Aworh *et al*., 2004). The leaf extract, chopped leaf and latex of *C. procera* have shown great promise as both *in-vivo* and *in-vitro* nematicides (Anver and Alam, 1992). Bouquet and Debray (1974) have earlier reported that though the leaf of *C. procera* is not known to be eaten by man as food, it is however taken as purgative and diuretic in Ivory Coast.

On the other hand, *M. oleifera* (Syn. *M. ptrygosperma* Gaertn.) is of the family Moringaceae. It is a small graceful tree with sparse foliage, often planted in compounds or used as hedge in northern Nigeria. It is a deciduous plant and could grow up to 8 m height (Keay, 1989). The plant is commonly called horseradish tree or the miracle tree and locally known as 'Zogale-gandi' in Hausa, 'Eweigbale' in Yoruba and 'Okweoyibo' in Igbo (Dalziel, 1956). *M. oleifera* is well known for its nutritional and medicinal values by many communities in northern Nigeria. The leaves of this plant are used as vegetables in soup preparation or cooked and mixed with ground groundnut cake and other spices, and then eaten as food. The present study was therefore aimed at determining the phytochemical, proximate and elemental composition of the *M. oleifera* seed powder and *C. procera* latex. This was with a view to establishing the nutritional potentials of the two plants.

MATERIALS AND METHODS

Collection and identification of the Plant Materials

C. procera latex was randomly collected from different areas in Gwazaye of Kumbotso local government area of Kano State, northern Nigeria whereas naturally dried, high quality dry pods of *M. oleifera* were randomly collected from different areas in Gabasawa and Tofa local government areas of Kano State, northern Nigeria. The plants were first identified at the field using standard keys and descriptions (Dalziel, 1956; Gill, 1987; Keay, 1989). Their botanical identities were further confirmed and authenticated at the Herbarium Section of the Botany Unit of the Department of Biological Sciences, Bayero University, Kano, Nigeria. Voucher specimens (Kawo-1-AH2006 and Kawo-2-AH2006 respectively) were preserved and stored at the Herbarium for future reference.

Preparation of the Treatment Samples

This was carried out in accordance with the method of Kareem *et al* (2003). Here, the latex of *C. procera* plant was obtained as exudates by hand plucking of fresh leaves of actively growing plant using aseptic techniques. The latex was collected into sterile plastic containers by pressing and squeezing, in-between fingers, the apex of the leaves to release as much as possible latex into the containers. After collection, the containers were cotton-plugged and stored at a temperature of 4°C until required for use. Collections were made in the mornings on the days of each analysis. In the case of *M. oleifera* seed powder, the method of Folkard *et al* (2001) was used. The dried pods were broken using hands to expose the winged and coated seeds. This was left to stand for 24 hours after which period the seed coat was removed using local mortar and pestle. The broken seed coat and wings were blown off with the aid of gravitation while the bare seeds were obtained and dried. The dried seeds were ground using a clean, electronic blending machine. The grinding was repeated continuously until a fine powder was obtained to ensure homogeneity. The powder was sieved through 250 mm mesh size to remove any remaining coat. The grounded and sieved powder was then stored in airtight, plastic containers until required for use.

Phytochemical Screening, Proximate and Elemental Analysis of *C. procera* Latex and *M. oleifera* Seed Powder

The Folin-Denis spectrophotometric method was used for the determination of tannins while gravimetric method was used for the determination of alkaloids (Onwuka, 2005). Nitrogen, phosphorus, crude proteins and saponins were determined according to the method of the Association of the Official Analytical Chemists (AOAC, 1984). Elemental analysis was carried out according to the methods of Halilu (2005) and Jonah *et al* (2006) using energy dispersing X-ray fluorescence (EDXRF) transmission emission technique. Here, a certified reference material (for quality control and assurance), IAEA-359 cabbage (*Brassica oleracea* var. *Sabauda*), was used to determine the calibration factors for all the elements, for which standards were prepared in-house. Same methods were employed for the analysis of the *M. oleifera* seed powder.

RESULTS

The results of the phytochemical, proximate and elemental composition of *C. procera* latex and *M. oleifera* seed powder are presented in Table 1. The latex had the following phytochemical and proximate composition: nitrogen (0.186%), crude proteins (1.16%), tannins (70.0 mg/100g), alkaloids (1.38 mg/100g) and saponins (2.30%). The predominant mineral elements in the latex were: Al (228 ± 6 ppm), Ca (826 ± 132 ppm), K (769 ± 152 ppm), P (0.652 mg/kg), Na (71.3 ± 0.3 ppm), Mn (25.5 ± 0.4 ppm), Br (0.66 ± 0.12 ppm), La (0.57 ± 0.07 ppm), Sm (0.21 ± 0.80 ppm), Rb (41.7 ± 8.5 ppm) and Sc (0.22 ± 0.06 ppm). However, Mg, Fe, Cr, As, Th and Zn were beyond detection limits in all the samples analysed. On the other hand, the *M. oleifera* seed powder had the following phytochemical and proximate composition: nitrogen (2.98%), crude proteins (18.63%), tannins (322.9 mg/100g), alkaloids (8.24 mg/100g) and saponins (9.13%). The predominant mineral elements in the seed powder were: Al (144 ± 4 ppm), Ca (602 ± 122 ppm), K (732 ± 164 ppm), P (0.619 mg/kg), Na (86.2 ± 4.9 ppm), Mn (17.5 ± 0.4 ppm), Br (0.62 ± 0.09 ppm), La (0.73 ± 0.13 ppm), Sm (0.14 ± 0.01 ppm), Rb (37.5 ± 6.7 ppm) and Sc (0.17 ± 0.03 ppm) while Mg, Fe, Cr, As, Th and Zn were all beyond detection limits.

Table 1: Phytochemical, Proximate and Elemental Composition of *C. procera* Latex and *M. oleifera* Seed Powder (all Units in ppm Except Where Otherwise Stated)

Constituent	*C. procera latex*	*M. oleifera* seed powder	*Cabbage IAEA-
Nitrogen (%)	0.186	2.98	NT
Crude proteins (%)	1.16	18.63	NT
Tannins (mg/100g)	70.0	322.9	NT
Alkaloids (mg/100g)	1.38	8.24	NT
Phosphorus (mg/kg)	0.652	0.619	NT
Saponins (%)	2.30	9.13	NT
Aluminium	**228 ± 6	144 ± 4	176 ± 14
Calcium	826 ± 132	602 ± 122	828 ±306
Magnesium	BDL	BDL	BDL
Potassium	769 ± 152	732 ± 164	30.9 ± 0.5
Iron	BDL	BDL	BDL
Sodium	71.3 ± 0.30	86.2 ± 4.9	794 ± 18
Manganese	25.5 ± 0.40	17.5 ± 0.4	57.2 ± 0.6
Chromium	BDL	BDL	BDL
Arsenic	BDL	BDL	BDL
Bromine	0.66 ±0.12	0.62 ±0.09	0.98 ± 0.17
Lanthanum	0.57 ± 0.07	0.73 ± 0.13	0.98 ± 0.17
Samarium	0.21 ± 0.80	0.14 ± 0.01	BDL
Rubidium	41.79 ± 8.50	37.5 ± 6.70	BDL
Scandium	0.22 ± 0.06	0.17 ± 0.03	BDL
Thorium	BDL	BDL	BDL
Zinc	BDL	BDL	BDL

Key: * = AEA-359 Cabbage (*Brassica oleracea var. Sabauda*) was used as a quality control and assurance (reference) material; ** = The reported uncertainty was calculated mainly from counting statistics and is not the normal standard deviation on triplicate analyses; NT = Not tested; BDL = Beyond detection limit.

DISCUSSION

The results show that both plants contain alkaloids, saponins and tannins. According to Duke (1992), Evans (1996), Lawal *et al* (2005), Wasagu *et al* (2005), Ibrahim *et al* (2006) as well as Magaji and Yaro (2006), phytochemical components are responsible for both pharmacological and toxic activities in plants. These metabolites are said to be useful to a plant itself but can be toxic to animals, including man. The presence of these chemical constituents in these plants is an indication that the plants, if properly screened, could yield drugs of pharmaceutical significance. This is better supported by the fact that members of the families of these plants have been known to be involved in ethnomedicine in the management of various ailments (Caceres *et al*., 1991; Ezeamuzie *et al*., 1996; Adoum *et al*., 1997; Aliyu, 2006). Tannins adversely affect protein digestibility but its minimum level required to elicit a negative growth response has not been fully established, hence it is still unclear as to what of it could be harmful (Elemo *et al*., 2001). However, the level of tannins obtained in this study was higher in *M. oleifera* seed powder (322.9 mg/100g) than in *C. procera* with only 70.0 mg/100g (Table 1). These levels are low when compared to the tannin contents of some other plants, e.g., sorghum grains were reported to have 28-43 mg/g (Elemo *et al*., 2001), *Cajanus cajan* had 5.50 ± 0.05 mg/g while *Sterculia setigera* and *Vigna dekindtiana* had 4.24 ± 0.04 mg/g and 16.16 ± 0.05 mg/g respectively (Ayodele and Kigbu, 2005). Saponins have been reported to be responsible for antimicrobial and anti-inflammatory activities while they are also believed to play a role in protecting plants against attack by potential pathogens (Sparg *et al*., 2004).

Considering the different elements analysed from the *M. pleifera* seed powder and *C. procera* latex (Table 1) and their wide uses, these plants have 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). For example, 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 normal required plasma calcium concentration of 10 mg/100ml has to be maintained within narrow limit for an animal to carry out its varied functions and survival (Rubin, 1974). The levels of calcium in these plants are therefore adequate for the required needs of the body. Potassium exists primarily as an intracellular constituent in the body. The requirement of this element is estimated to be 0.2 – 0.6% of the dry weight of animals. The levels of potassium in this study are therefore adequate and hence could be of advantage to the improvement of healthy conditions of an individual (Maynard *et al*., 1979).

The presence of these elements in *M. oleifera* seed powder correlates with the work of Ramachandran *et al* (1980) and Council of Scientific and Industrial Research (CSIR, 1962) who reported the presence of calcium (30 mg/100g), magnesium (24 mg/100g), phosphorus (110 mg/100g) and potassium (259 mg/100g) in *M. oleifera* fruits. On the other hand, Adoum *et al.* (1997) reported the presence of varying concentrations of calcium (565 ppm), phosphorus (1900 ppm), potassium (21250 ppm) and magnesium (6875 ppm) in the crude water extract of the root bark of *C. procera* collected from six different locations in Borno State, north-eastern Nigeria. The variability observed in the amounts of the elements reported by Ramachandran *et al.* (1980), CSIR (1962) and Adoum *et al.* (1997) with those obtained in the present study could be attributed to variability in geographical location of the plants as well as the part of the plant examined. The amounts of crude protein (18.63%) obtained in the *M. oleifera* seed powder is within the range of 16-65 mg/l recommended dietary allowances (RDAs) in children and lactating women (Table 2) reported by WHO (1999). However, the value in the *C. procera* latex (1.16%) is low. It could therefore be suggested that *M. oleifera* seed powder could be utilised as a better and cheap source of protein supplement in comparison with the *C. procera* latex.

The presence of such reportedly harmful elements such as arsenic and chromium in the plants seems to be within beyond detection limit (Table 1). It could thus be concluded that consumption of these plants' parts collected from around Gwale and Gabasawa local government areas of Kano State, Nigeria as food might be safe. The results further support the earlier claims by Ogundiwin and Oke (1983), Kareem *et al.* (2003) and Eghianruwa *et al.* (2006) that there seems to be no danger of toxicity of *C. procera* latex extracts as they are widely used locally in milk and cheese processing as well as enzyme purification respectively. However, this could serve as pointer to the work of Katsayal *et al.* (2004) who reported the presence of such harmful elements as Sr (69 ± 3.0), Rb (122 ± 0.0) and Zr (11 ± 2.0) in the leaves

Table 2: Mineral composition of *M. oleifera* seed powder and *C. procera* latex (all units in ppm except where otherwise stated) in comparison with FAO/WHO (1999) recommended dietary allowances

Constituents	*Concentration		FAO/WHO recommended dietary allowances for children aged 1-3 years and a woman during lactation (WHO, 1999)	
	C. procera	*M. oleifera*	Children	Lactating mothers
Proteins (%)	1.16	18.63	16.0	65.0
Calcium	*826±132	602±122	400.0	1200.0
Iron	BDL	BDL	10.0	15.0
Potassium	769±152	732±164	800.0	3000.0
Magnesium	BDL	BDL	150.0	340.0
Phosphorus (mg/kg)	0.652	0.619	800.0	1200.0
Zinc	BDL	BDL	3.90	137.0

Key: * = The reported uncertainty was calculated mainly from counting statistics and is not the normal standard deviation on triplicate analyses; BDL = Beyond detection limit.

CONCLUSION AND RECOMMENDATIONS

Quantitative evaluation of bioactive components of a plant is an important parameter in setting standard for crude drugs (Trease and Evans, 2002). Thus, the values of solvent extractives could be a means of providing preliminary information on the quality of the drug. Therefore, based on the results obtained in this study, it could be said that *C. procera* latex and *M. oleifera* seed powder contain chemical constituents of pharmacological and nutritional significance. However, it is recommended that further work be carried out to isolate and purify the bioactive constituents in these plants' parts using various extraction solvents with a view to characterizing their molecular structure, formula, weight and charge as well as evaluating their safety or otherwise (toxicity) for human and other animal use.

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