

Full Length Research Paper

Some Swazi phytomedicines and their constituents

Oluwole O. G. Amusan*, Nonhlanhla A. Sukati, Priscilla S. Dlamini, and Fortunate G. Sibandze

Swaziland Institute for Research in Traditional Medicine, Medicinal and Indigenous Food Plants, University of Swaziland, Private Bag 4 Kwaluseni, Swaziland.

Accepted 15 January, 2007

Ethnobotanical surveys of Manzini and Shiselweni regions of Swaziland were conducted to document new phytomedicines used in Swaziland and to determine their chemical constituents with a view to provide the scientific basis of the use of the remedies in traditional medical practice and as a guide to bioprospecting for drugs. The plants collected in the surveys were extracted with suitable solvents and analysed for secondary metabolites. Sixty one medicinal plants from thirty five families used for treating thirty one diseases were analysed. The medicinal uses of these plants had never been documented in the pharmacopoeia of Swaziland. Different classes of secondary metabolites were found in the plants, namely alkaloids, anthranoids, flavonoids, glycosides, polyphenols, saponins, steroids and tannins. Some of the diseases the plants were used to treat are back ache, cardiac problems, chest pain, cough, diabetes, diarrhoea, headache, menorrhagia, snake bite, stomach ache and urino-genital problems. The presence of these secondary metabolites in the plants was of great importance in the understanding of the basis of the use of the plants in traditional medical practice and may provide a lead in bioprospecting for new pharmaceutical products of herbal origin.

Key words: Secondary metabolites; medicinal plants; Manzini and Shiselweni regions; Swaziland.

INTRODUCTION

Traditional medical practice is an immemorial mode of health care in Swaziland as in many parts of Africa (Green and Makhubu, 1983). Traditional medical practice is still the main vehicle of health care delivery today especially in the rural areas of the country where conventional medical facilities are not within the reach of most people. About 85% of the population rely on it for their medical care (Mdluli, 2002). Patronage of traditional medicine in Swaziland cuts across all social barriers with both educated and non-educated people embracing the practice. Makhubu (2003) observed that the first port of call for an average Swazi when ill is the traditional medical practitioner (TMP) even if the modern health clinic is not far. She gave the following socio-cultural reasons while most people in Swaziland embrace traditional medical practice: Firstly, the practice is anchored in the cultural and religious beliefs of the people; it is closely intertwined with beliefs of the causes of illness. The people, therefore, derive spiritual satisfaction from the practice which psychologically affects their health. Secondly, traditional medi-

cine has a holistic approach to the healing and prevention of diseases such that the whole person is treated. The Traditional Medical Practitioner (TMP) attends not only to the ailment of his/her patient but to other socio-cultural needs that may be bothering the patient which the TMP feels may be remotely connected with the patient's condition. Thirdly, modern health facilities are very far and are not accessible to many in the society, especially in rural communities where most of the populace reside. In addition, conventional drugs are very expensive and unaffordable by the rural people. Most Swazis would only consult orthodox medical practitioners when traditional medicine had failed (Mdluli, 2002). Increase in the patronage of herbal medicine is likely to continue because of global economic downturn and as bodies like the World Health Organisation Africa Region continue to advocate for its promotion and integration in the national health systems (Kasilo, 2001). Since such a large proportion of the population rely on herbal medicine, for their medical care, it is essential that information about the system should be preserved through proper documentation and the constituents of the phytomedicines should be analysed.

Traditional medical practice is shrouded with a lot of secrecy as most of the traditional medical practitioners

*Corresponding author. E-Mail: amusan@uniswacc.uniswa.sz.

Table 1. Summary of plants used in the preparation of ethnomedicines in Swaziland.

Scientific name	siSwati name	Preparation and medical use	Chemical constituents							
			Alkaloids	Anthranoids	Flavonoids	Glycosides	Polyphenols	Saponins	Steroids	Tannins
<i>Acanthospermum australe</i> (Asteraceae)	<i>sanama</i>	Leaf and stem decoction for pubic lice and nausea.	+	-	+	+	+	-	+	+
<i>Acrotome hipsida</i> (Lamiaceae)	<i>sisefo</i>	Leaf infusion for gonorrhoea.	+	-	+	-	+	-	+	-
<i>Albizzia adiantifolia</i> (Fabaceae)	<i>inhlangushiyane</i>	Bark infusion for skin problems.	-	-	+	+	+	+	+	+
<i>Aloe arborescence</i> (Asphodelaceae)	<i>inhlaba lencane</i>	Leaf decoction for diabetes.	+	-	+	-	+	+	+	-
<i>Aloe marlothii</i> (Asphodelaceae)	<i>inhaba lenkhulu</i>	Leaf decoction for cardiac problems.	+	-	+	+	+	+	+	+
<i>Aloe saponaria</i> (Asphodelaceae)	<i>lihala</i>	Leaf decoction for cardiac problems.	+	-	+	+	+	+	+	+
<i>Anthospermum rigidum</i> (Rubiaceae)	<i>sambulela</i>	Leaf infusion for pubic lice.	-	-	+	-	+	-	+	+
<i>Artemisia afra</i> (Asteraceae)	<i>umhlonyane</i>	Leaf infusion for cough.	+	-	+	+	+	+	+	+
<i>Asclepias albens</i> (Asclepiadaceae)	<i>umdzayi</i>	Leaf infusion for asthma.	-	+	+	+	+	+	+	+
<i>Asclepias fruticosa</i> (Asclepiadaceae)	<i>lubetjane</i>	Stem bark concoction asthma.	+	-	+	-	+	+	+	-
<i>Berchemia zeyheri</i> (Rhamnaceae)	<i>umneyi</i>	Stem bark infusion for back ache.	+	-	+	+	+	-	+	-
<i>Bidens pilosa</i> (Asteraceae)	<i>chuchuza</i>	Leaf infusion or decoction for stomach ache	+	-	+	+	+	-	+	-
<i>Capparis tomentosa</i> (Capparaceae)	<i>indodebovu</i>	Stem bark concoction as emetics.	+	+	+	+	+	+	+	-
<i>Cardiospermum halicacabum</i> (Sapindaceae)	<i>likhambilemamba</i>	Root decoction for menorrhagia.	-	-	+	+	+	+	+	-
<i>Carica papaya</i> (Caricaceae)	<i>umphopho</i>	Leaf infusion for dysentery.	-	-	+	+	+	-	+	+
<i>Cassine transvaalensis</i> (Celastraceae)	<i>ngcotfo</i>	Stem bark infusion for stomach ache.	+	-	+	+	+	-	+	+
<i>Clausena anisata</i> (Rutaceae)	<i>umnukelambiba</i>	Stem bark concoction for cardiac problems.	+	-	+	+	+	+	+	-
<i>Clerodendron glabrum</i> (Verbenaceae)	<i>umphehlacwtsi</i>	Leaf infusion for stomach ache.	-	-	-	+	+	+	+	-
<i>Combretum zeyheri</i> (Combretaceae)	<i>imbondvo</i> <i>lemhlophe</i>	Root infusion for diarrhoea.	-	-	+	+	+	+	+	+
<i>Conyza ulmifolia</i> (Asteraceae)	<i>madacaza</i>	Leaf decoction for cough.	-	-	+	+	+	+	+	+
<i>Croton gratissimus</i> (Euphorbiaceae)	<i>mhuluka</i>	Stem bark infusion for stomach ache.	+	-	-	+	+	+	-	-
<i>Cussonia zuluensis</i> (Araliaceae)	<i>umsenge</i>	Root infusion for fever.	-	-	+	+	+	+	+	-
<i>Diospyros galpini</i> (Ebenaceae)	<i>umcafutane</i>	Root decoction for anus problems.	-	-	+	-	+	+	+	+
<i>Drimia altissima</i> (Hyacinthaceae)	<i>lukhovu</i>	Bulb concoction for waist and back pain.	+	-	+	+	+	+	+	-
<i>Ekebergia capensis</i> (Meliaceae)	<i>umnyamatsi</i>	Stem bark decoction for chest pain.	-	-	+	+	+	+	-	+

Table 1. contd.

<i>Elaeodendron transvaalense</i> (Celastraceae)	<i>ingwavuma</i>	Stem concoction as emetics.	+	-	+	+	+	+	-	+
<i>Elephantorrhiza</i> □mbricate□e (Fabaceae)	<i>intfolwane</i>	Root infusion for diarrhoea.	+	+	-	-	+	-	+	-
<i>Euclea divinorum</i> (Ebenaceae)	<i>umgwali</i>	Stem bark decoction for constipation.	+	-	-	+	-	+	-	+
<i>Gardenia cornuta</i> (Rubiaceae)	<i>umvalasangweni</i>	Stem concoction as emetics.	+	-	+	+	+	-	+	-
<i>Gnidia kraussiana</i> (Thymelaeaceae)	<i>umsilawengwe</i>	Root decoction for stomach ache.	-	+	+	-	+	+	-	+
<i>Grewia caffra</i> (Tiliaceae)	<i>liklolo</i>	Roots for urino-genital problems.	-	+	-	+	-	+	-	-
<i>Grewia haxamita</i> (Tiliaceae)	<i>umsiphane</i>	Root infusion for urino-genital problems.	+	-	-	+	+	-	+	+
<i>Gymnosporia senegalensis</i> (Celastraceae)	<i>sibhubhu</i>	Stem bark decoction for infertility in women.	-	-	+	-	+	-	+	+
<i>Hypoxis hemerocallidea</i> . (Hypoxidaceae)	<i>Lilabatseka / zifozonke</i>	Tuber infusion or concoction for ulcer, all purpose remedy and HIV/AIDS related illnesses	-	-	-	+	+	+	+	+
<i>Hypoxis gerrardii</i> (Hypoxidaceae)	<i>inkhofe</i>	Tuber infusion for abdominal cramps.	-	-	+	-	+	+	+	+
<i>Lannea edulis</i> (Anacardiaceae)	<i>umntfokolovu</i>	Stem bark and root concoction for dysentery.	-	-	+	+	+	-	+	+
<i>Lantana camara</i> (Verbenaceae)	<i>bukhwebeletane</i>	Leaf infusion for cough	-	+	+	+	+	+	+	-
<i>Ledebouria ovatifolia</i> (Hyacinthaceae)	<i>umhlabelo</i>	Bulb decoction for abscess.	+	-	+	+	+	+	-	-
<i>Margaritaria discoidea</i> (Euphorbiaceae)	<i>madlozini</i>	Root concoction for headache.	-	-	+	+	+	-	-	+
<i>Melia azedarach</i> (Meliaceae)	<i>umsilinga</i>	Root infusion for diarrhoea.	-	-	+	+	+	+	+	+
<i>Myrica pilulifera</i> (Myricaceae)	<i>umlulama</i>	Root decoction for head ache.	+	-	+	-	+	-	-	+
<i>Ochna arborea</i> (Ochnaceae)	<i>mahlanganisa</i>	Stem bark decoction for fracture.	+	+	-	+	+	+	-	+
<i>Opuntia</i> □mbricate (Cataceae)	<i>umdodlofiya</i>	Root infusion for chest pain.	-	+	+	+	+	+	+	+
<i>Peltophorum afriocanum</i> (Fabaceae)	<i>sikhabamkhombe</i>	Stem bark decoction for menorrhagia.	+	-	+	+	-	-	+	-
<i>Perseca Americana</i> (Lauraceae)	<i>umkotapeni</i>	Stem bark decoction for palpitation.	+	-	+	+	+	+	+	+
<i>Prunus perseae</i> (Rosaceae)	<i>umpentjisi</i>	Stem bark infusion for general body pain.	+	-	+	-	+	-	+	+
<i>Psidium guajava</i> (Myritaceae)	<i>umgwawa</i>	Leaf infusion for diarrhoea and hypertension.	+	-	+	+	+	+	+	+
<i>Rhoicissus tridentate</i> (Vita- ceae)	<i>imboziso</i>	Root decoction for menorrhagia.	-	-	-	+	+	+	-	+
<i>Schizocarpus rigidofolius</i> (Hyacinthaceae)	<i>ingcino</i>	Leaf infusion for diarrhoea.	+	-	+	+	+	+	+	+
<i>Sclerocarrya caffra</i> (Anacardiaceae)	<i>umganu</i>	Stem bark decoction for diarrhoea.	+	-	+	+	+	-	+	+
<i>Solanum incanum</i> (Solanaceae)	<i>intfuma</i>	Root infusion for back ache.	-	-	+	+	+	+	+	-
<i>Stangeria eriopus</i> (Stan- geriaceae)	<i>imfingo</i>	Leaf infusion for general body pain.	+	-	-	-	+	+	-	+
<i>Strychnos madagacariensis</i> (Loganiaceae)	<i>umkhwakhwa</i>	Leaf decoction for snake bite.	+	-	+	+	+	+	+	-

Table 1. contd.

<i>Talinum</i> (Portulacaceae)	<i>caffrum</i>	<i>umphunyuka</i>	Leaf infusion for stomach ache.	+	-	-	-	+	+	-	+
<i>Teucrium</i> (Lamiaceae)	<i>riparium</i>	<i>umnunu</i>	Root infusion for diarrhoea.	+	-	+	-	+	-	-	+
<i>Trichillia</i> (Meliaceae)	<i>emetica</i>	<i>umhkuhlu</i>	Stem bark decoction for back ache.	+	-	+	+	+	-	+	-
<i>Urginea</i> (Hyacinthaceae)	<i>sanguinea</i>	<i>gibizisila</i>	Crusted fresh bulb spread on skin for scabies.	-	-	+	+	+	-	-	-
<i>Vangueria</i> (Mimosaceae)	<i>infausta</i>	<i>umntulu</i>	Root decoction for chest pain.	+	+	+	+	+	+	-	+
<i>Vernonia</i> (Asteraceae)	<i>glabra</i>	<i>linyatselo</i>	Root decoction for diabetes.	-	-	-	+	+	+	-	+
<i>Vernonia</i> (Asteraceae)	<i>oligocephala</i>	<i>lihlunguhlungu</i>	Root decoction for diarrhoea.	-	-	+	+	+	+	+	-
<i>Xysmalobium</i> (Asclepiadaceae)	<i>undulatum</i>	<i>lishongwe</i>	Tuber infusion for diarrhoea and headache.	-	-	+	+	+	+	+	-

Key

+ = present. - = absent

(TMPs) are not always open in disclosing the art of the practice. Information about the practice is therefore scarce as it is stored mostly in the memory of the TMPs alone. The practice is also clouded with superstitions, myths and metaphysical powers such that the basis of therapeutic properties claimed by the (TMPs) for their herbal products is often very difficult to explain in a scientific manner. In a bid to document information about the traditional medical practice in Swaziland, an ethnomedical survey of the country has been embarked upon and some ethnomedicines were reported in our previous communications (Amusan et al., 2000, 2002, 2004, 2005ab).

Plants are the oldest known sources of human and livestock healthcare, and an important component of global biodiversity (Lambert et al., 2005). Medicinal plants are of great importance in traditional medical practice because they are the main ingredients used for preparing the remedies administered to patients who patronise the medical practice. Apart from being the major components of ethnomedicines, medicinal plants have also been major sources of drugs used in the orthodox medical practice. Most of the phytomedicines used in conventional medical practice today were discovered through the ethnobotanical route (Farnsworth, 1990) and about 74% of drugs developed from higher plants which are currently in the market were actually derived from the indigenous knowledge of traditional people on ethnomedicines (Mugabe, 1999).

Most of the plants used for preparing ethnomedicines in Swaziland have never been analysed. The medicinal values and the potential of the plants as rich sources of drugs are unknown. Therefore analysis of some of the plants collected from the ethnobotanical surveys of Manzini and Shiselweni regions of Swaziland was carried out. In continuation of the documentation of ethnomedicines

used in the country, new phytomedicines and their constituents are reported in this paper.

MATERIALS AND METHODS

Ethnomedical surveys of Manzini and Shiselweni regions of Swaziland were carried out from June 1998 to March 2000 and from November 2002 to June 2003, respectively, as reported in our previous studies (Amusan et al., 2002, 2005a). Manzini and Shiselweni regions are adjacent to each other and are located in the South-Western part of Swaziland. The regions are located between 26°15' – 27°18' S latitude and 30°45' – 31° 59' E longitude. Ethnomedical information was obtained from renowned TMPs of the regions through interviews at their homesteads where they practiced traditional medicine using an open-ended structured questionnaire. The Rural Health Motivators of the Ministry of Health and Social Welfare assisted the research team in identifying the renowned TMPs of the survey area. Each TMP was asked to give the names of the diseases he or she used to treat, the symptoms of the diseases, the recipes and mode of preparation of the medicine for each disease, signs of healing and any contraindications. The research team recorded in data collection sheets all the details including the ingredients used for preparing the medicines, route of administration and any ritual that should be carried out for each recipe that was given. After each interview, plants used by the TMP for the preparation of the remedies he or she used for treating various diseases and conditions were collected with the assistance of the TMP from where he or she used to collect the plants. The plants were put in vouchers and were authenticated by Mr. G. M. Dlamini, the Curator of the National Herbarium, Malkerns, Swaziland, with whom voucher samples of the plants were deposited.

Each plant organ used in the preparation of herbal medicine was dried in air under shade and was successively extracted with dichloromethane and methanol at 20°C for 48 h. After removing the solvents at reduced pressure in a rotatory evaporator, extracts of each plant organ were analysed qualitatively for secondary metabolites, namely alkaloids, anthranoids, flavonoids, glycosides, polyphenols, saponins, steroids and tannins using standard methods (Sofowora, 1982).

RESULTS

The respondents (TMPs) gave names of various diseases they treated in siSwati and described explicitly details of symptoms of the diseases and they gave evidences of cure after herbal treatment. A summary of the information gathered from the TMPs was as presented in Table 1. All the respondents collected medicinal plants for their practice from the wild. The plants from which the remedies were made were listed in alphabetical order of their scientific names, followed by the siSwati names, the mode of preparation of the remedies and their uses, and the chemical constituents of the particular organ of the plant used for the preparation of the remedy. Sixty one medicinal plants from thirty five families were given. The plants were used for treating thirty one diseases which included among others; abdominal cramps, asthma, back ache, cardiac problems, chest pains, cough, diarrhoea, headache, menorrhagia, snake bite, stomach ache, urino-genital problems and HIV/AIDS related symptoms. Three plants (*Capparis tomentosa*, *Elaeodendron transvaalense* and *Gardenia cornuta*) from different families were used for preparing concoctions that induced vomiting (emetic). *Hypoxis hemerocallidea*, popularly known as African potato, was used as an all purpose remedy and for illnesses which were related to HIV/AIDS.

The result of the chemical analysis of the plants showed that the medicinal plants contained different classes of secondary metabolites, namely alkaloids, anthranoids, flavonoids, glycosides, polyphenols, saponins, steroids and tannins. Most of the plants analysed (95%) contained polyphenols while 80% contained flavonoids, 77% contained glycosides, 69% contained steroids, 67% contained saponins, 61% contained tannins, 57% contained alkaloids and 15% contained anthranoids.

DISCUSSION

The Traditional Medical Practitioners interviewed were well versed in healthcare. They were able to describe succinctly various diseases and recipes for their treatments using mainly plant resources in their environment through their indigenous knowledge. Their power of identification of plants was also highly commendable; being able to distinguish between different species of the same plant genus with different siSwati names. Examples are the *Aloe* and *Hypoxis* species and having different ethnomedical uses for them (Table 1). In some cases, the name given to the medicinal plants in siSwati indicated what the plant could be used for in medicine. An example is *Hypoxis hemerocallidea* known in siSwati as *Lilabatsaka / zifozonke*. The word “zifozonke” means that the plant can be used to treat many diseases.

It was also noteworthy that the TMPs were able to give three ethnomedicines that could be used as emetics. The TMPs in Swaziland believe that by inducing vomiting

through the administration of herbal remedy (known as “*kuhlanta*” in siSwati) their patients would eliminate whatever the cause of the disease being treated and recover from the sickness (Makhubu, 1978). Inducing vomiting is therefore a very common practice in traditional medicine in the country.

The habit of collecting medicinal plants from the wild for the practice of herbal medicine has serious implication on the conservation of the biodiversity of the country. The practice is quite unsustainable and can lead to the extinction. An example from this study was that of *H. hemerocallidea* which was used as an all purpose medicine. The plant has become endangered species because its bulb was being dug and commercialised by many people without any thought of conservation. The plant has been over exploited by many in traditional medicine in the country. It was said to be one of the plants very much in high demand by many people because of the HIV/AIDS pandemic in the country. The infusion or decoction of the dried bulb was used for treating many ailments. People should be encouraged to cultivate medicinal plants and harvest them in a sustainable manner. Many of the plants especially those whose underground stems were used in this study for preparing remedies could be cultivated in gardens from where herbalists could do their collection and replant the species rather going to wild.

The difference in the chemical constituents from one plant to another showed the individuality of the different species. The very high percentage of plants containing polyphenols was in conformity with the fact that polyphenols are ubiquitous in vascular plants. Many polyphenols are bioactive and they have been found to be responsible for the antimicrobial properties of some medicinal plants (Harborne, 1984; Amusan et al., 1994). Flavonoids are also polyphenolic substances and they are found useful in health care because of their antioxidant and anticancer properties. The other secondary metabolites detected in the plants analysed are also important in our understanding of the therapeutic properties claimed for them by the TMPs. These classes of secondary metabolites have many pharmacological properties which have been found useful and exploited in developing pharmaceutical products of plant origin.

This study has provided new ethnomedicines used in traditional medical practice in the Manzini and Shiselwini regions of Swaziland and the secondary metabolite contents of the medicines. The information would guide in bioprospecting for new drugs from the medicinal plants for some of the diseases the plants were used.

The conclusions that can be drawn from this study are that plant resources are used widely for health care in Swaziland. The TMPs in Swaziland are knowledgeable and their indigenous knowledge on plants and diseases could be explored in the search for bioactive compounds. There should be awareness campaigns especially among the TMPs of the need for the conservation of biodiversity.

ACKNOWLEDGEMENTS

We are grateful to the TMPs who provided information during the surveys, the Rural Health Motivators who identified the TMPs and Mr. Gugu Mavuso who assisted in plant collection. Our gratitude also goes to Mr G. M. Dlamini who identified the plants.

REFERENCES

- Amusan OOG, Bhembe FN, Mkhathwa FT, Thwala EZ (1994). Antibacterial activity of *Annona senegalensis*, *Andrachne ovalis*, and *Spathodea campanulata* against *Pseudomonas solanacearum*, UNISWA J. Agric. 3: 62 – 66.
- Amusan OOG, Dlamini P, Msonthi JD, Makhubu LP, Dlamini BB (2000). Some medicinal plants used in traditional medicine in Swaziland. UNISWA J. Agric. Sci. Tech. 4: 20 – 26.
- Amusan OOG, Dlamini P, Msonthi JD, Makhubu LP (2002). Some herbal remedies from Manzini region of Swaziland. J. Ethnopharmacol. 79: 109 – 112.
- Amusan OOG, Dlamini PS, Makhubu LP, Shongwe MS (2004). Herbal medicines from Mafutseni area of Swaziland. UNISWA J. Agric. Sci. Tech. 7: 70-76
- Amusan OOG, Sukati NA, Hlophe FG (2005a). Herbal Remedies from Shiselweni Region of Swaziland. *Phytotherapeutics, Recent Progress in Medicinal Plants. Therapeutic Research Vol. 10 (24):451-471*
- Amusan OOG, Sukati NA, Shongwe MS (2005b). Some Phytomedicines from Shiselweni Region of Swaziland. J. Nat. Rem. 5: 19-25
- Farnsworth NR (1990). Bioactive Compounds from Plants In: Chardwick DJ, Marsh J (Eds.) Ciba Foundation Symposium 154. Wiley, Chichester; 42-51.
- Green EC, Makhubu LP (1983). Traditional Healers in Swaziland: Towards improved cooperation between the traditional and modern health sectors. Ministry of Health, Mbabane.
- Harborne JB (1984). Phytochemical methods, 2nd edition, Chapman and Hall, London, 37 – 99.
- Kasilo O (2001). Integration of traditional medicine in national health systems. World Health Organisation regional meeting on traditional medicine. Harare. 26 – 29 November 2001.
- Lambert JDH, Ryden PA, Esikuri EE (2005). Capitalizing on the bio-economic value of multi-purpose medicinal plants for rehabilitation of dry lands in sub-Saharan Africa. The international bank for reconstruction and development. The World Bank, Washington, DC, USA. 11-14.
- Makhubu LP (1978). The traditional healer. University of Swaziland Publication, University of Swaziland, Kwaluseni, Swaziland.
- Mdluli K (2002). Management of HIV/AIDS with traditional medicine. In: Makhubu L P, Amusan OOG, Shongwe MS (Eds). Proceedings of the workshop on the management of HIV/AIDS with traditional medicine, Kwaluseni, Swaziland. February 2002.
- Mugabe J (1999). Intellectual property protection and traditional knowledge: An exploration in international policy discourse. African Centre for Technology Studies. ACTS Press. Nairobi, Kenya.
- Sofowora S (1982) Medicinal plants and traditional medicine in Africa. John Wiley and Sons, Chchester. 128 – 161.