Reprinted from: Issues in new crops and new uses. 2007. J. Janick
and A. Whipkey (eds.). ASHS Press, Alexandria, VA.

Medicinal Crops of Africa

James E. Simon*, Adolfina R. Koroch, Dan Acquaye, Elton Jefthas, Rodolfo Juliani, and Ramu Govindasamy

The great biodiversity in the tropical forests, savannahs, and velds and unique environments of sub-Sahara Africa has provided indigenous cultures with a diverse range of plants and as a consequence a wealth of traditional knowledge about the use of the plants for medicinal purposes. Given that Africa includes over 50 countries, 800 languages, 3,000 dialects; it is a veritable treasure of genetic resources including medicinal plants. While the medicinal plant trade continues to grow globally, exports from Africa contribute little to the overall trade in natural products and generally only revolve around plant species of international interest that are indigenous to Africa. Africa is only a minor player in the global natural products market. We identified several key challenges facing the natural products sector in this region. These include the presently limited value-addition occurring within region and as a consequence exports tend to be bulk raw materials; local markets generally largely selling unprocessed/semi-processed plant materials; the industry is large but informal and diffuse and there is limited financial resources to support research and infrastructure for both the processor and a distinct but equally important issue in the lack of financial credit available in general to the farmer in much of this region for production investments; lack of private sector investment in processing and packaging facilities; and serious issues in parts of this region surround common property resource issues (ownership and rights to land tenure; threat of over-harvesting, etc.). In addition, there is limited technical support is available to growers, collectors, & post-harvest firms, limited expertise on appropriate germplasm and seed availability, inadequate and/or lack of processing equipment. This has resulted in a lack of or inadequate quality control and lack of product standardization. There is a very limited knowledge of foreign market demand, few market/business contacts and the perception that there is difficulty in protecting their intellectual property.

The objective of this paper is to present an overview to some of the leading African medicinal plants in sub-Sahara Africa that are in the international trade, plus an introduction to a number of lesser-known promising medicinal plants (Table 1).

CRYPTOLEPIS SANGUINOLENTA

Cryptolepis sanguinolenta (Lindl.) Schltr. (Periplocaceae) is a climbing shrub with blood-red colored juice in the cut stem (Paulo and Houghton 2003). The leaves are glabrous, oblong-elliptic or ovalate, shortly acuminate apex, rounded, sometimes acutely cuneate base. The flowers are greenish-yellow, the fruit is a follicle, linear 17–31 cm long, and the seeds are 10–12 mm long with a tuft of silky hairs at the end. The plant grows in the rainforest and deciduous forest belt (Iwu 1993) and is found in secondary forest from Nigeria, Ghana to Senegal (Dokosi 1998).

In local traditional medicine, the macerated roots are used as hypotensive and antipyrectic (colic) agents and as a tonic for rheumatism and against gastrointestinal problems (Oliver-Bever 1986). In Ghana, the root-bark is used in folk medicine to increase virility (Dokosi 1998). Root decoction has been used by traditional healers for the treatment of several fevers (malaria, infections of stomach) and the leaves as an antimalarial and for the cicatrizing of wounds (Oliver-Bever 1986; Iwu 1993; Iwu et al. 1999; Neuwinger 2000).

Roots contain a quinoline-derived indole alkaloid, cryptolepine, reported to have a marked hypothermic effect, as well as inducing prolonged vasodilatation, causing marked and durable hypotension. Cryptolepine

*This work was conducted as part of our Partnership for Food and Industry in Natural Products (PFID/NP) project with funds from the Office of Economic Growth, Agriculture and Trade (EGAT/AG) of the USAID (Leader Contract Award No. AEG-A-00-04-00012-00) and an Associate Award (Associate Cooperative Agreement No. 690-A-00-06-00126-00) from the USAID-Regional Center for Southern Africa. We thank Carol Wilson and Jerry Brown, USAID Cognizant Technical Officers for each of the PFID/NP for their active involvement, support and encouragement. This work originally began in 1999, as part of our ASNAPP program with funding from the USAID (Contract Award No. HFM-O-00-01-00116). As all our African research is implemented by the ASNAPP network (www.asnapp.org) we thank the ASNAPP organization as well as the New Jersey Agricultural Experiment Station, Rutgers University who each provided support for this work. Lastly, we give particular thanks and recognition to those African small farmers, scientists, researchers and traders and healers who have always opened their doors to us, and for whom this article is dedicated to generate awareness and interest in African natural products.

containing plants have been use by local peoples also as a natural dye. It has low toxicity and the aqueous extract of the root has antimicrobial activity against three urogenital pathogens (*Neisseria gonrrhoeae*, *E. coli*, and *Candida albicans*), but not against *Pseudomonas aeruginosa* (Oliver-Bever 1986).

Cryptolepine is the major alkaloid which occurs at a yield of 0.52% w/w in the roots, 0.48% in stems, 1.03% in leaves (Iwu 1993). Cryptolepine is a rare example of a natural product whose synthesis (1906) has been reported before its isolation (23 years later) (Bierer et al. 1998a).

Aqueous extracts of *C. sanguinolenta* are of interest today because of their antimicrobial (Paulo et al. 1994a,b; Silva et al. 1996; Sawer et al. 2005), antimycobacterial (Gibbons et al. 2003), antihyperglycemic (Bierer et al. 1998a,b; Luo et al. 1998), antimalarial (Tona et al. 1999; Paulo et al. 2000; Wright et al. 2001, 2005; Willcox and Bodeker 2004; Ansah et al. 2005), antiamoebial (Tona et al. 1998) and anticancer potential (Ansah and Gooderham 2002), supporting the plants multiple traditional uses in traditional medicine. Of particular interest is its application as a new potential antimalarial whose mode of action is distinct from that of chlorine and artemisinin-derived drugs. Preliminary clinical trials have shown promising results as a remedy against malaria in Ghana.

CINNAMOMUM CAMPHORA

Cinnamomum camphora (L.) J. Presl (camphor tree, Lauraceae) is native to China, Taiwan and Japan. Later introduced into several other regions, the tree has become naturalized in parts of Southern Africa (Van Wyk et al. 1997), Australia, Madagascar, and the United States.

Camphor tree is locally known under a variety of names including ravintsara (Madagascar); kanferboom (Afrikaans); and uroselina (Zulu). It is a dense broadleaved evergreen that can reach 26 m in height with shiny foliage, made up of alternate oval leaves. Each leaf has three distinct yellowish veins. The outer margins of the leaves tend to be somewhat wavy and turn upward. The new foliage starts out a rusty burgundy color, but the leaves soon turn dark green on the upper sides and paler green underneath. New branches emerging from the shallowly fissured grayish brown trunk are smooth and green. Inconspicuous tiny cream colored flowers are followed by small round purple berries (Coates Palgrave et al. 2000). Most noticibly, the camphor tree can be readily identified by the strong camphor aroma coming from all parts pf the plant (Van Wyk et al. 1997).

Camphor is widely planted as a shade tree or windbreak. In China and Japan, it is grown commercially for its aromatic volatile oil used in traditional medicine. Natural camphor is distilled from the wood of the camphor tree (Van Wyk et al. 1997). Camphor oil has a strong penetrating fragrance, a pungent bitter flavor, and feels

Table 1. Some of the leading exported African medicinal plants from sub-Sahara plus selected lesser-known promising medicinal plants.

Common name	Genus and species	Active components	Plant part used
African wormwood	*Artemisia afra*	Essential oils	Flowering tops (leaves and flowers)
Buchu	*Agathosma betulina*	Essential oils and dried leaves	Leaves
Camphor tree	*Cinnamomum camphora*	Essential oils	Leaves
Cryptolepis	*Cryptolepis sanguinolenta*	Alkaloids	Roots and leaves
Devil's claw	*Harpagophytum procumbens*	Phytosterols, triterpenoids, flavonoids	Roots
Grains of paradise	*Aframomum melegueta*	Essential oils, phenolics	Rhizomes, leaves, fruits, seeds
Hoodia	*Hoodia* spp.	Polyphenols	Stems
Pygeum	*Prunus africana*	Phytosterols, triterpenoids, aliphatic alcohols	Stem bark
Rooibos	*Aspalathus linearis*	Phenolics (flavonoids)	Leaves
Voacanga	*Voacanga africana*	Alkaloids	Stem, root, fruit, leaves
White's ginger	*Mondia whitei*	Alkaloids	Dried and fresh root, leaves

cool on the skin like menthol, though it also has irritating qualities as well as a numbing effect.

In traditional medicine camphor is used to treat coughs, fever due to flu (bark tea), malarial fever (leaf extract), malaria (leaf infusion is inhaled), and as an antiseptic, counter-irritant, stimulant, carminative, and analeptic. In Europe, camphor has mainly been used for the treatment of colds and inflammation, but also to treat heart conditions, infections, pneumonia (as antibacterial), and diarrhea. Infusion of dried leaves is used as a Zulu ritual emetic (Grieve 1967; Van Wyk et al. 1997; Neuwinger 2000). In modern medicine, camphor is used externally as topical antiseptic agent and antipruritic and internally as a stimulant and carminative (Merck 1989).

Camphor wood is prized for its attractive red and yellow striping, amenability to woodworking, and insect repelling properties. It is light to medium in weight and soft to medium in hardness. Wood from the camphor tree is not especially strong, but it takes polishing well. The wood is commonly used in making chests, closets, coffins, instruments, and sculptures. Camphor veneer is used in fine cabinetry. Oil of camphor is also used in perfumes, as an insect repellant, and in aromatherapy. The essential oil is produced by steam distillation of the wood, root stumps, branches, leaves, stems, and even fruit, then rectified under vacuum and filtered pressed to produce three fractions, known as white, brown, and yellow camphor. Wood from the tree is the principal source of natural camphor. Extracted oil from the leaves, stems and fruit also yields hydrocyanic acid as well as safrole, borneol, heliotropin, terpineol, and vanillin (Williamson and Evans 1988). Other compounds isolated from the plant include five lignins, two of which are secoisolariciresinol dimethyl ether and kusunokiol (Hutchings et al. 1996).

MONDIA WHITEI

Mondia whitei (Hook. F.) Skeels (Apocynaceae) is also known as mondia, or White's ginger. Mondia is a vigorous climber (3–6 m high) with attractive heart-shape leaves and a vanilla aroma. The flowers are arranged in panicles, yellow and reddish-purple. It is widely distributed in tropical Africa from Guinea through Cameroon to East Africa.

Mondia has been a popular medicinal in several African countries used by traditional medicine traders for a long time (Cunningham 1993). Extensively used for medicinal properties, in traditional medicine, the dried roots are chewed and the sap is swallowed for appetite stimulation, stomach pain, indigestion and body pain, gastrointestinal disorders, gonorrhea, post-partum bleeding, pediatric asthma, and to stop vomiting (Kokwaro 1976; Neuwinger 2000). In all countries and across all tribes, mondia finds itself also used as an aphrodisiac. In Cameroon, the fresh root bark is used to increase the libido, in Ghana to increase sperm production. Watcho et al. (2001, 2004, 2005, 2006) have reported that chronic administration of *M. whitei* root bark extract, showed androgenic properties in male rats.

Chemical studies of mondia from root extracts show both an unknown alkaloid and 2-hydroxy-4-methoxybenzaldehyde (Kubo and Kinst-Hori 1999) reported to exhibit tyrosinase activity (tyrosinase activity is involved in the melanin synthesis) (Nihei et al. 2004). A chlorinated coumarinolignan (5-chlopropacin) has been found in the roots of *M. whitei* **(**Patnam et al. 2005).

Due to the plants medicinal uses, recent interest has begun to explore the cultivation rather than only the collection of this plant. Little has been reported on the small-scale field cultivation of this plant, but it appears to be easily vegetatively propagated, grows well and easily under a range of soil and environmental conditions (pers. observ.). A successful *in vitro* propagation method was recently developed for several medicinal plants including mondia (Afolayan and Adebola 2004).

HOODIA SPP.

Hoodia currorii (Hook.) Decne. (Asclepiadaceae) is locally known as ghaap or "! khobab". Hoodia is a succulent plant that grows in the Kalahari Desert region of South Africa, including Namibia, Angola, and Botswana. Flowers smell strongly of decaying meat, and are pollinated by flies. It is known as the "stinky" plant with "miraculous" properties (Van Wyk and Gericke 2000). Several *Hoodia* spp. are eaten fresh as raw food. They are used as appetite and thirst suppressants to treat indigestion, hypertension, diabetes, and stomaches (Van Wyk and Gericke 2000). *Hoodia* spp. are used as a convenient emergency food and moisture source in harsh arid environments. As food, the spines are scraped off the succulent stems and the stems are eaten like

cucumber. The taste is bitter and texture mucilaginous. It is preferable to eat stems after a rain, when moisture content is highest. Sometimes they are soaked in water before being eaten. Hoodia has become recently very popular as a diet suppressant aid and can be found in the supermarkets and shops all across the US.

Other *Hoodia* species also are reported to have similar applications. For instance, *H. gordonii* (bitterghapp) is eaten fresh, and is used as an appetite-suppressant by shepherds (Van Wyk and Gericke 2000). Recently, it was shown that *H. gordonii* extract was able to induce weight loss or control appetite in mammals, and these extracts were dominated by chlorogenic acid and a sterol glycoside such as P57 (Holt 2006). This is the principal species or source of the *Hoodia* that is reported and listed as being traded, yet the lack of quality control and the ease of adulteration using other species and plant extracts has become a real concern. Plant extracts have been reported to control obesity and in the treatment of related health conditions including syndrome x (Holt 2006). Moreover, it has been cited as a meal replacement (Shatkina et al. 2006). *H. flava* (yellow flower ghaap) is eaten fresh, and as appetite–thirst suppressant. *H. officinalis* has been used to treat pulmonary tuberculosis and hemorrhoids. *H. pilifera* is also edible, suppresses thirst and hunger and is used in brandy tinctures, as a stomachic, and to treat hemorrhoids and pulmonary tuberculosis (Van Wyk and Gericke 2000). In African traditional medicine *H. currori* is also used to treat diabetes (Neuwinger 2000).

The Council for Scientific and Industrial Research (CSIR) in South Africa investigated the plant's effect and demonstrated in animal studies that an extract from the plant was highly effective in reducing weight. In 1997, the CSIR approached a company (Phytopharm, UK) to collaborate in the development of a prescription drug with the active ingredient P57. At one point Phytopharm had signed a licensing agreement with Pfizer who would have marketed P57 in the rest of the world (Habeck 2002). Maintaining intellectual property rights and providing benefits to the indigenous peoples who provided the traditional knowledge that led to the scientific discovery is a rather complex and entangled issue. Other issues facing the *Hoodia* industry and regions where it is cultivated are; difficulty in meeting consumer demand due to slow growth of this species; adulteration of commercial products with other *Hoodia* and non-*Hoodia* species; and using sustainable cultivation and harvesting practices.

VOACANGA AFRICANA

Voacanga africana (Apocynaceae) is an understory forest shrub reaching 6 m high with low widely spreading crown, distributed mainly in West Africa from Senegal to the Sudan and south to Angola (Iwu 1993). Known locally *kokiyar* (in Hausa), *pete-pete* (in Igbo); *kirongasi* (in Swahili); or *ako-dodo* (in Yoruba) the plant is a popular medicinal. The leaves are opposite obovate and acuminate, dark green and glossy and usually stalkless. Flowers are white borne in axiliary or terminal loosely branch glabrous inflorescence. Spherical, mottled green fruit occurs mainly in pairs, with seeds wrapped in yellow pulp.

Voacanga has a broad range traditional medicinal uses. In Cote d' Ivore this plant is used against leprosy, diarrhea, generalized edema, convulsions in children, madness (Tan et al. 2000), as a diuretic, and infant tonic (Iwu 1993). A decoction of the stem bark and root is used in the treatment of mental disorders and the latex is applied to carious teeth. The decoction of the bark is considered an analgesic and is added to embrocating mixtures used as pastes during fracture repair. Bark and root decoctions are also used to treat cardiac spasms. The fruit decoction is used as a disinfectant, and the leaf decoctions to treat asthma to children (Neuwinger 2000). In southeastern Nigeria the plant is featured in many healing rituals (Iwu 1993), including some to induce hallucinations and trances in religious rituals. In Congolese traditional medicine preparations of extracts containing *V. africana* are used as anti-amoebial. Intestinal amoebiasis is one of the current diseases in tropical regions causing diarrhea. It has been reported that *V. africana* has active activity against *Entamoeba histolytica* in vitro (Tona et al. 1998).

The anti-ulcer properties and the gastric protective effect of the aqueous bark extract of V. africana against HCl:ethanol solution was demonstrated (Tan et al. 1997, 2000). Finally, Voacanga alkaloids have been shown to have cardiotonic, sympatholytic, and hypotensive properties (Oliver-Bever 1986). Analysis of root and bark extracts of V. africana showed the presence of the alkaloids including voacamine, voacangine, and vobasine (Oliver-Bever 1986). Other compounds found in the plant include voacristine, voacamidine, and voacarine. Voaphylline, vobtusine, and voalfolidine occur in the leaves and tabersonine is a constituent of the seeds (Rolland et al. 1976; Iwu 1993). The alkaloid ibogaime, is a powerful hallucinogen also found in voacanga (Kombian et al.

1997), supporting its use in ritual in traditional medicine. Ibogaine affects the peripheral and central nervous system, and is being examined for use in the treatment of withdrawal symptoms and cravings in drug addicts (Glick et al. 1992). Many other natural products have been reported including flavonoids, tannins, steroids, and terpenes in the roots and bark (Tona et al. 1998). A difficulty in quality control of this product is the lack of commercially available standards of the specific alkaloids.

AFRAMOMUM MELEGUETA

Aframomum melegueta K. Schum, (Zingiberaceae) is a spice native to tropical West Africa (Iwu 1993). Locally it is known as melegueta pepper, *fomwisa*, *wisa*, *apokuo*, *efom wisa*, *obro*, (Yoruba), *chitta* (Hausa), and also as grains of paradise, guinea pepper, and alligator pepper. This aromatic plant is cultivated for its edible spicy fruit.

Grains of paradise is a tufted, leafy, herbaceous perennial. It has a short, scaly rhizome with a surface root system. The stem is 0.9 to 1.2 m high, covered by leaf sheaths up to 2 m in length. Leaves are alternate and sessile continuing into a sheath of the stem. The large pink flowers are trumpet shaped with a single stamen. The ovoid fruit tapers to a point, surrounded by a permanent calyx. The matured fruit is red in color and contains a white pulp that surrounds 1,200 to 2,000 seeds. Flowering begins in September and fruiting in December. The seeds are small (0.4 to 0.5 cm long), aromatic with grainy testa and white kernel. The seeds have a very hot taste (Iwu 1993; Dokosi 1998).

In the 13th century, traders from West Africa carried the spice across the desert to sell in Tripoli and then Italy. The Italians called it "grains of paradise" because of the high value of the product, and the secrecy of the country of its origin. Europe acquired a taste for the spice as a substitute for real pepper (Enti 1998). In England during the reign of Queen Elizabeth I, many foodstuffs and drinks were flavored with grains of paradise along with other spices such as cinnamon and ginger. While its popularity in Europe declined over time, its use in West and North Africa continues. In North Africa, the extract of the pepper, mixed with other ingredients like butter, honey, peanuts, and almonds, was used in after-dinner coffee. The spice is also used to flavor rum and brandy and beer. In Ghana, the seeds are widely used in spicing meat, sauces, and soups and mixed with other herbs for the treatment of body pains and rheumatism.

The genus has been extensively used in popular medicine in West and Central Africa. Leaves are used internally in treatment of measles and externally for leprosy, fresh fruit is used as an aphrodisiac, and the root decoction is taken by nursing mothers to control lactation and postpartum hemorrhage (Iwu 1993). Traditionally, the seeds are chewed to cure dysentery, as a sedative against toothache, to guard against rheumatism and migraine, and to cure fever. The rhizomes are used in the treatment of dysentery and diarrhea (Dokosi 1998). The seed is ground into a soft paste that has exhibited antibiotic properties (Enti 1998). The essential oil of *Aframomum* has exhibited activity against gram positive and gram negative bacteria as well as *Candida albicans*. The essential oil appears to be more active against gram-positive bacteria than gram-negative types, and the essential oil in a water soluble cream showed higher anti-microbial activity than the oil based cream. Moreover, seed extracts have shown strong termite antifeedant activity (Escoubas et al. 1995).

Chemical analysis of the seed have shown that hexanic and methanolic extracts are rich in (6)-paradols, (6)-gingerols and (6)-shogaols (Ghana Herbal Pharmacopoeia 1992; Escoubas et al. 1995; Juliani et al. 2007). The acetone extract of Ghanain grains of paradise contains hydroxyphenylalkanones (6)-paradole, (7)-paradole, and (6)-shoagole (Tackie et al. 1975).

ASPALATHUS LINEARIS

Aspalathus linearis (N.L. Burm.) R. Dahlgr. (Fabaceae) is known locally as rooibos tea, African red tea, red bush, or mountain tea. Rooibos is a shrub of up to 2 m high, with bright green needle shaped leaves which become reddish-brown after processing. The flowers are small and yellow (Van Wyk and Gericke 2000). The genus *Aspalathus* comprises about 278 species and is endemic to South Africa. *A. linearis* present a high degree of polymorphism, in terms of morphological and ecological characters and also in its chemical (phenolic) constituents (Van Heerden et al. 2003).

The plants are harvested with sickles and tied into bundles. Then they are chopped in small segments, moistened, and left in heaps to "ferment" for several hours until a sweet smell develops. The green leaves turn

a characteristic red after fermentation (Van Heerden et al. 2003).

Rooibos tea contains no colors, additives, or preservatives, making it a natural beverage (Dos et al. 2005). Rooibos is a traditional beverage of the Khoi-descended people from the ClanWilliam region in the Cape (South Africa). Traditionally the leaves and twigs are used as a milk substitute for babies with colic, as antispasmodic, to block the nose (root pulp is put into the nose), and as an emetic. Also, Rooibos has been traditionally used for years to help with insomnia, disturbed sleeping patterns, and headaches. Rooibos tea contains no caffeine (chemical analysis conducted in our lab, data not presented) and has a relaxing effect on the central nervous system. Moreover, rooibos makes a great thirst-quencher and sports and endurance drink because of its abundant mineral content of iron, potassium, zinc, manganese, and sodium (Van Wyk et al. 1997; Neuwinger 2000; Van Wyk and Gerike 2000).

Over the last decade rooibos tea has gained popularity on international markets, largely because it is a versatile, caffeine-free tea with unique taste (Wilson 2005). Rooibos tea has proven antioxidant activity (Inanami et al. 1995; Joubert et al. 2004, 2005), is hepatoprotective (Ulicna et al. 2003), and suppresses skin tumor formation (Marnewick et al. 2000, 2005; Standley et al. 2001). In addition, rooibos is used as an ingredient in cosmetics, in diet products, as a flavoring agent in baking and cooking, and even as a milk substitute for infants who are prone to colic (Van Wyk and Gericke 2000).

The beneficial properties of rooibos teas are mainly attributed to low tannins, high mineral content, and the presence of the unique flavonoids such as aspalatin and nothofagin among others (Joubert 1996; VonGadow et al. 1997). While rooibos is considered a new crop it has a long history of export from South Africa to Europe. Value-added waste products remaining after the fermented tea is prepared may provide products for the cosmetic and personal heath care industries. Products such as shampoos, soaps, and more can be made with rooibos extracts to utilize the rich red natural pigments and the antioxidant properties of this unique South African product.

HARPAGOPHYTUM PROCUMBENS

Harpagophytum procumbens DC (Burch.) DC. ex Meisn. (Pedaliaceae) is also known as devil's claw or harpago. It is a native South African herb, mostly known from the Namibian deserts (Hachfeld 2003). A perennial plant with annual stems spreading from a central tap root, its leaves are grayish-green, flowers are tubular either yellow and violet or violet. The characteristic fruits have numerous long arms with sharp, hooked thorns. The common names are derived from the claw-like fruit (Van Wyk et al. 1997; Van Wyk and Gericke 2000). This clinging fruit may cause injury when attached to the foot or hoof of an animal, while it also acts as a method of seed dispersal. Seed germination peaks in the rainy season, between November and March. During this time, the taproot develops and can grow up to 2 m deep. To be able to survive the long dry and severe dry periods, the plant forms water-storing secondary roots branching off from the primary taproot. The secondary roots are the plant parts used for medicinal purposes (Van Wyk et al. 1997).

Harpago has been used for centuries by Africans to treat fever, indigestion, malaria, allergies, rheumatism, and arthritis. In Europe, the root extract is recommended for arthritis, diabetes, allergies, and senility, and is widely utilized as a digestive aid and appetite stimulant (Iwu 1993; Neuwinger 2000). Harpago has been widely used in European herbal tea formulations, and in recent years, many health food marketing centers carry formulations containing the harpago extracts or root powders. The British and German Herbal Pharmacopoeias recognize harpago as possessing analgesic, sedative, and diuretic properties (Van Wyk et al. 1997; Van Wyk and Gericke 2000).

A clinical study carried out in Germany using root extracts, showed anti-inflammatory activity, comparable in many respects to the well-known anti-arthritic drug, phenylbutazone. In Europe a home remedy containing secondary roots is used for lack of appetite, dyspeptic complaints, and in supportive therapy for degenerative disorders of the locomotor system (Poukens-Renwart et al. 1996). Analgesic effects of secondary roots of harpago were also observed along with reductions in abnormally high cholesterol and uric-acid blood levels. Harpago is reported to help with joint pain while improving vitality in the joints. Current use in the western world has focused on its application to painful conditions of the muscular-skeletal system and digestive problems. It is an active ingredient found in some prescriptions for arthritis, rheumatic complaints, and for low back pain, especially associated with spondylosis, lumbago, sciatica, fibrositis, neuralgia, and polymyalgia. A double blind

placebo controlled clinical study with devil's claw in tablet form was carried out on 118 patients who suffered with acute low back pain. After a six-week study, a greater number of patients on the *Harpagophytum* treatment became pain-free compared to the placebo group (Chrubasik et al. 1996). In rats, crude methanolic extracts of *H. procumbens* showed a significant dose-dependent, protective action towards hyperkinetic ventricular arrhythmias (Costa et al. 1985). Swiss Pharmacopoeia and European Pharmacopoeia recommended a minimum suitable level of 1.2% harpagoside content in the secondary roots (Poukens-Renwart et al. 1996).

The main active ingredients in harpago include harpagoside and β-sitosterol, which possess anti-inflammatory properties and create support for joint, ligament, and tendon problems. Of the principal constituents, the iridoid glycosides have been investigated, focusing in particular on the anti-inflammatory effects (Van Wyk et al. 1997; Van Wyk and Gericke 2000).

As with many other wild-harvested medicinal plants, the demand for devils claw has grown to the extent that native populations are now becoming scarcer and face potential threat of depletion (Hachfeld 2003). The threats to harpago and to the livelihoods of the people who are its principal harvesters are clearly linked to the nature of a trade dominated by unsustainable harvesting practices. Traditionally, the plants are harvested from the wild, while now there is some cultivation in southern Africa, largely in the Republic of South Africa (Cunningham 1993).

PRUNUS AFRICANA

Prunus africana Hook. f. (Rosacea) Kalkm. (syn. *Pygeum africanum* Hook) is commonly known as pygeum, bitter almond, red stinkwood, bitteramandel, rooistinkhout, and nuwehout. It is an evergreen tree that can reach 24 m with a trunk diameter >1 m. The bark is dark and rugged, the branches are brown and corky and the twigs knobby. The foliage is composed of shiny simple dark green leaves, arranged alternately, and have an aroma of almonds when crushed. The leaf stalks are often pink or red. White flowers are arranged in clusters (Palmer and Pitman 1972; Van Wyk et al. 1997). *Prunus* or pygeum are found mainly in the forests along the mistbelt regions of South Africa and it occurs further north into tropical Africa (Van Wyk et al. 1997). Its range extends into Eastern Africa (e.g. Kenya) as well as Western/Central Africa (e.g. Cameroon) and Madagascar.

Active principles come from the red or dark brown bark of the trees which has a weak aroma of hydrocyanic acid. The bark is extracted with an organic solvent, yielding a lipid and sterol extract. The active ingredients are phytosterols (free and conjugated beta-sitosterol, campesterol); tripterpenoid esters; pentacyclic acids (ursolic, oleanolic, crateaegolic, epimaslinic); and aliphatic alcohols (such as n-tetracosanol and n-docosaonol) and their ferulic acid esters. Bark decoctions are traditionally used in Zulu medicine, while lipid and phytosterol extracts are most commonly used in Europe (Van Wyk et al. 1997).

Traditionally, leaves of *P. africana* are employed as an inhalant for fever, to improve appetite, to treat chest and stomach pain, gonorrhea, inflammations, kidney diseases, urinary tract complains, and in Europe it become popular for the treatment of benign prostate hypertrophy (Kokwaro 1976; Van Wyk et al. 1997; Neuwinger 2000).

Pharmacological studies show antiedema activity, increase in bladder elasticity, and stimulation of prostatic secretion. This medicinal extract is nontoxic and lowers the plasma concentrations of LH and testosterone; no androgenic and estrogenic action detected. Clinical trials have shown that the extract provides significant impact on nocturnal pollakiuria and other symptoms of benign prostrate hypertrophy. It is similar to or comparable to saw palmetto, *Serenoa repens* fruit extracts.

CONCLUSIONS

Africa is a continent rich in medicinal plants and a treasure of biological diversity. The richness in the myriad of cultures and traditions integrally link their use of plants within their communities. As we continue to search for new plant-based therapies and products to improve health and nutrition, there is much to be learned scientifically from the traditional healers and indigenous peoples that use and treasure these medicinal plants. The ability to develop African medicinals in a manner that both leads to increased science, trade and respect of African traditional applications while doing so in a manner that economically benefits Africans and in an environmentally sustainable manner is the challenge now facing the awakening of African medicinals into the global market.

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