3 ETHNOBOTANY OF HYPOXIDACEAE

3.1 Introduction

More than sixty percent of South Africans use medicinal plants in their health care needs and an estimated 3000 plant species are used in traditional medicines in South Africa (Van Wyk *et al*. 1997). *Hypoxis* is a time-honoured ingredient in some African traditional remedies. The genus is used by ethnic groups in Africa to heal various disorders but is mostly associated with the treatment of abdominal pains, impotency and internal tumours. One species in particular, *Hypoxis hemerocallidea* (*H. rooperi* T. Moore) [Figure 3.1] is a popular 'muthi' among the Zulus and is used as an emetic to treat dizziness and nervous disorders (Hutchings 1996). The species ranks among the top 60 most frequently traded medicinal plants in the Eastern Cape and is noted as 'heavily traded, unsustainably harvested and with a high price at the study sites' (Dold & Cocks 2002) and this implies its obvious exploitation in the wild.

By 1970, white South Africans realised the medicinal potential of *H. hemerocallidea* and this encouraged chemical investigations. A number of patents (Pegel 1973, 1977, 1979; Pegel & Colin 1979; Pegel & Liebenberg 1973; Pegel & Walker 1979) were published describing preparation of the rhizome as a remedy for prostate hypertrophy, gastro-intestinal diseases and urogenital infections. Hypoxoside, a phytosterol glucoside with potential for treating benign prostate hypertrophy (Pegel 1973) was isolated from the rhizomes of *H. hemerocallidea* by Drewes *et al*. (1984). When Drewes *et al*. (1984) isolated hypoxoside, they also showed that the diglucoside when hydrolysed converts to its aglycone which they named rooperol. These authors further ascribed the anti-tumour activity to rooperol. About ten years later, Albrecht *et al*. (1995) reported promising results in mice clinical trials that used rooperol as an oral prodrug for anti-tumour activity. When this finding reached the media in South Africa, the plant was tagged the 'African potato'. *H. hemerocallidea* is also the plant from which the properties of sterols and sterolins were correlated with enhancing the human immune system (Pegel 1997).

The purpose of this Chapter is to give an overview of the uses of members of Hypoxidaceae as medicinal, magical or ornamental plants in Africa and abroad, and this is drawn mainly from published literature and presented in Table 3.1. There has been considerable activity recently

concerning the isolation of compounds from species of *Hypoxis* and the overview attempts to introduce these as well.

3.2 Hype around *Hypoxis*

There was national excitement when the potential anti-tumour properties in the rhizomes (Figure 3.2) of *H. hemerocallidea* was made public (Figure 3.3) following the findings by Albrecht *et al*. (1995). The news enthused researchers, chemists, pharmacologists and laypersons alike. Media reports (as in Figure 3.3) alluded to significant results achieved from using *Hypoxis* rhizomes in cancer treatment as well as a booster to the immune system. The latter claim may be connected to the properties of sterols and sterolins in the species, which were correlated with enhancing the human immune system (Pegel 1997). This led the public to try preparations of the *Hypoxis* for immune-related ailments such as the common cold, flu, arthritis, tumours, cancer and HIV/AIDS. A number of over-the-counter products became available; among these were preparations called 'African potato', 'wonder herb' and 'miracle cure'.

The popularity of the species further intensified when the South African Health Minister, Manto Tshabalala-Msimang overtly advocated the use of beetroot, garlic, lemon, olive oil and the 'African potato' as a supplement for HIV/AIDS patients. The African potato's AIDS-related fame creates nervousness (Figure 3.4) as it seemingly withdraws the government's commitment to providing anti-retrovirals in the primary health care system in South Africa. The utterances by the minister are of concern to conservationists as well as such unsubstantiated statements drive a demand for rhizomes and lead to the further depletion of *Hypoxis* populations in the wild. The Minister's encouragement of use of African potato with vegetables also comes up against the clarification given by Drewes & Horn (1999) on the 'African potato: myth or muthi' where the authors caution the use of the "*complex mixture of compounds*" present in the rhizomes, the effects of which are not yet fully understood. The concern is further noted in Drewes & Khan (2004) who indicated that the toxicity of *Hypoxis* compounds to humans remain controversial and recommend a comprehensive toxicity study.

3.3 Economically useful members in the Hypoxidaceae

Curculigo orchioides Gaertn., an Asian species and *Hypoxis hemerocallidea*, the African member are probably the most popular medicinal plants of commercial value in the family. Both species are a potential source of drugs. *C. orchioides* is used in India to treat a variety of ailments including piles, jaundice, asthma, diarrhoea, skin infections, wounds and impotency (Dhenuka *et al*. 1999).

Figure 3.1.—*Hypoxis hemerocallidea* commonly called ‘african potato’.

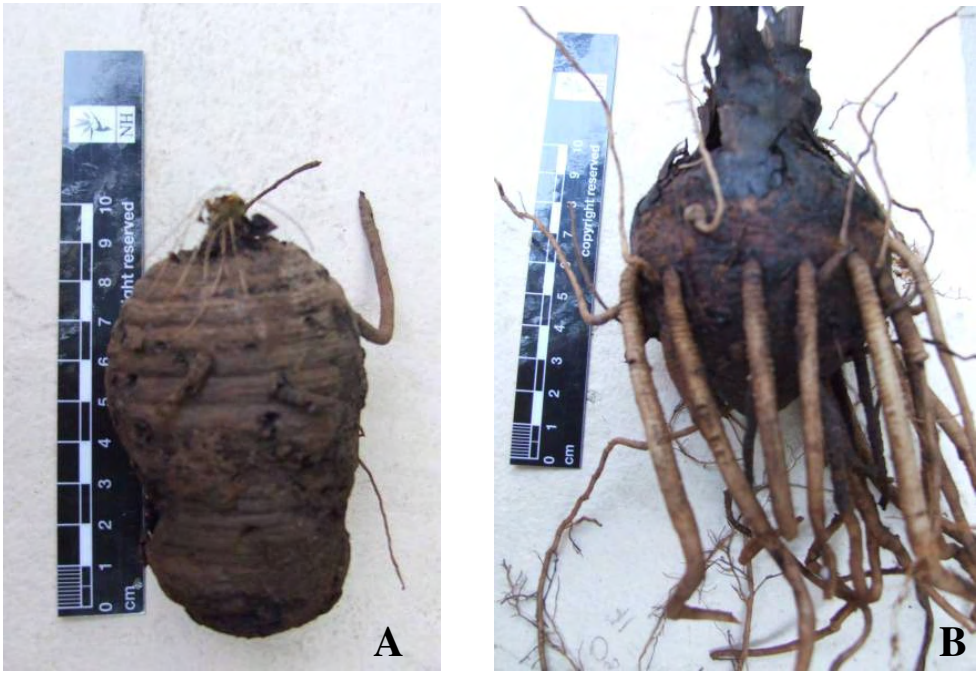

Figure 3.2.—*H. hemerocallidea* rhizomes. A, dormant season; B, at start of growing season.

MEDICAL FILE

WONDER PLANT: South Africa's "star plant", Hipoxis rooperi, is being hailed as a medicinal "wonder". Picture: DIE BURGER

Centuries-old muti shakes medical world

A tiny yellow flower holds promise for cancer patients, reports TONI YOUNGHUSBAND

An indigenous plant used for hundreds of years by traditional healers is making an unprecedented impact on conventional medicine, and university-trained doctors are battling to cope with patients' demands for treatment.

The six-petalled, star-shaped Hipoxis rooperi, which grows in abundance in KwaZulu-Natal, has shown significant results in cancer treatment and as a booster to the immune system.

Several oncologists have obtained partial registration under regulations laid down by the Medicines Control Council enabling them to treat patients with an extract derived from the plant's bulb.

There are about 100 cancer sufferers currently taking the medication, but hundreds more are on a waiting list.

Doctors hope that within three months amendments to existing legislation will allow them to offer the medication to many more.

The plant is expected to be available as a scheduled drug in tablet form from pharmacies within the next few months.

Dr Carl Albrecht, researcher at the pharmacology unit at Stellenbosch University, says while conventional medicine has only recently appreciated the wonders of what he calls the "star plant", traditional healers have been using it for hundreds of years.

And evidence at archaeological diggings at the Sterkfontein Caves suggests that Hypoxis rooperi was popular among our earliest ancestors. Scratch marks on bone daggers found inside the caves suggest that early man dug the bulbs from between rocks. The plant still grows in the area.

Dr Albrecht said West Street vendors had been selling the plant in its rawest form for years. It was found to be particularly effective against constipation and inflammation.

However, he cautioned against laymen's buying huge quantities of the raw bulb in the hope of finding a cure for cancer. At best, it had shown results in terminal patients, usually prolonging life for 10 to 12 months, particularly in cases of pancreatic cancer where efficacy was easy to determine because there was no other treatment available for this form of cancer.

Cancer patients undergoing chemotherapy have also suffered fewer side effects after taking Hipoxis rooperi.

The plant grows well in summer rainfall areas, particularly in KwaZulu-Natal and in the Eastern Cape, and is found as far north as Kenya.

Dr Albrecht expects the tablets to cost around R180 for 90 when they go on sale.

Figure 3.3.—One of the many articles on 'african potato', featured in 'The Saturday' newspaper, 16 March 1997.

Figure 3.4.—Cartoon by John Curtis depicting objection to the South African Health Minister's persistence on including African potato, garlic, beetroot, lemon and olive oil in the diet as a remedy for HIV/AIDS, over anti-retrovirals (from the Cape Argus, 24 August 2006, with permission from the cartoonist).

A related species, *C. pilosa* (Schum. & Thonn.) Engl. that occurs in tropical Africa, is used in West Africa as a purgative and, to treat hernia and swellings (cited in Burkill 1994).

Hypoxis species are used by different cultural groups in Africa to treat a suite of ailments (Watt & Breyer-Brandwijk 1962). In tropical Africa, boiled rhizomes of *H. urceolata* Nel are used as a purgative for new born babies (Wiland-Szymańska 2001). In southern Africa, the two species, *H. colchicifolia* and *H. hemerocallidea* are mostly used in traditional medicine. Their uses include the treatment of impotency, intestinal parasites, stomach pains, headaches, dizziness and mental disturbances (Hutchings 1996). Other species are recorded to have uses for rope making, as food in times of famine or as a charm for protection. The uses of *Hypoxis* and that of other Hypoxidaceae in cultural and medicinal practices are summarised in Table 3.1.

3.4 Hypoxoside

On account of the wide use of *Hypoxis* plants in African traditional medicine and the rising interest in its medicinal properties, the chemistry of a few species was investigated and reported on. The most targeted species in the genus, *H. hemerocallidea*, was used by white farmers in South Africa to treat prostate cancer (Van Staden 1981). The plant was found to have phytosterol glycosides that show activity on benign prostate hypertrophy (Pegel 1973; Pegel & Walker 1979). The diglucoside called hypoxoside that has anti-tumour properties was isolated from *H. hemerocallidea* (Drewes *et al*. 1984). The species is a rich source of this compound and Bayley & Van Staden (1990) reported that the rhizome in the species contain the highest concentration of hypoxoside followed by the roots, whereas the leaves contained neglible levels. Albrecht (1996) indicated that hypoxoside is one of the best studied phytochemicals from an African plant. Hypoxoside is hydrolysed by β-glucosidase to give its aglycone called rooperol (Drewes *et al*. 1984), a compound that has been shown to inhibit specific cancer cells (Drewes & Khan 2004). Albrecht *et al*. (1995) consider rooperol as a promising compound for the treatment of cancer in humans following their results that showed inhibition of melanoma cell growth in mice. Albrecht (1996) reported on the success achieved when hypoxoside was used in a few trials on human patients with cancer, HIV and inflammatory conditions and claims that the diglucoside is a putative, non-toxic prodrug for the treatment of these conditions. He also explained that hypoxoside, a major component of *Hypoxis* plants, is not absorbed in the human gut but is first deconjugated by β-glucurosidase to form rooperol, and it is rooperol that inhibits cancer activity in cells and hypoxoside, although inactive, is a promising prodrug. As the results of such studies became known, a number of products extracted from the rhizomes of *H. hemerocallidea* were manufactured in the form of capsules,

tinctures and teas and became available over-the-counter. Drewes & Khan (2004) provided a resourceful review on the usage of these extracts and their chemical constituents. They also reviewed the unravelling of the active compounds in the rhizomes from the 1960s to the present and succinctly covered the biological effect of hypoxoside in treating cancer, HIV, cardiovascular output, hypoglycaemia and ageing. In a recent study, Nair & Kanfer (2008) compared the content of sterols and sterolins in *H. hemerocallidea* rhizomes and some commercially available products. They argued that the quantities of sterol and sterolins in *Hypoxis* and the preparations are too low to have any nutritional or healing effect.

Apart from its use in treating benign prostate hypertrophy, whole extracts of *H. hemerocallidea* rhizomes are being used in antioxidant, anti-convulsant and anti-diabetic agents (Drewes *et al.* 2008). In 2006, Laporta *et al.* analysed hypoxoside from an extract of *H. hemerocallidea* and rooperol derived by enzymatic digestion of hypoxoside, and reported that both compounds showed strong antioxidant activity. They also reported that *H. hemerocallidea* extracts showed higher antioxidant efficacy in comparison to other strong herbal extracts like olive oil and green tea. The results obtained by Laporta *et al*. (2006) indicate that there was no evidence of acute oral toxicity nor adverse effects when *H. hemerocallidea* commercial extracts containing 45% hypoxoside was used at a dosage of 2000 mg/kg. Investigations on the activity of *H. hemerocallidea* extracts on diabetes, convulsions and diarrhoea in rodents are being conducted in the Department of Pharmacology at the University of KwaZulu-Natal, Durban. From these investigations, it was reported that the aqueous extract of *H. hemerocallidea* shows activity against type 2 diabetes (Mahomed & Ojewole 2003), seizures and convulsions (Ojewale 2007) and diarrhoea (Ojewale *et al.* 2008). These studies also suggest the need for further research on the mechanism of the active compounds in *Hypoxis* extracts to confirm its effect on these disorders.

During the present study, it was noted that the two species, *H. hemerocallidea* and *H. colchicifolia*, are sold as ‘inkomfe’ and ‘ilabetheka’ respectively at the Warwick Avenue Muthi Market in Durban. These species are used mainly by the Zulu in KwaZulu-Natal to treat mental disorders, heart weakness, impotency and barrenness (Hutchings 1996). In table 3.1, it is noted that both *Curculigo orchioides* and *Hypoxis colchicifolia* are used for treating impotency. As part of this study, a preliminary chemical analysis using Thin Layer Chromatography was undertaken for 14 species of *Hypoxis* in collaboration with Prof. Ben-Erik van Wyk and Dr Alvaro Viljeon at the then Rand Afrikaans University (now University of Johannesburg). The results from the study are reported in more detail in Chapter 8. The five robust species, *H. hemerocallidea*, *H. obtusa*,

Table 3.1.—Traditional ethnobotanical uses of members of Hypoxidaceae

As original literature citing vouchers where not consulted, species names except for known synonyms were not updated. Terms for plant parts are as in literature cited.

Species	**Locality**	**Used by**	**Common names**	**Plant part used**	**Uses**	**Chemical constituents and biological properties**
Curculigo capitulata (Lour.) Kuntze	Tropical Africa Phillipines North Australia				- Ornamental, cultivated in Africa (Wiland 1997)	
C. latifolia Dryand					- Garden ornamental cultivated in the Flora Zambesiaca area for its attractive foliage (Nordal & Zimudzi 2001)	
C. orchioides Gaertn.	Asia	Indians	kali musli (Wala & Jasrai 2003)	rootstock (mainly), roots, leaves	- Used to treat piles, jaundice, asthma diarrhoea (cited in Dhenuka *et al*. 1999) and pimples (cited in Wala & Jasrai 2003) - Used as a poultice to treat itchiness and skin complaints (cited in Dhenuka *et al*. 1999) - Applied as a powder externally to wounds (cited in Dhenuka *et al*. 1999) - Taken as a tonic for impotency (cited in Dhenuka *et al*. 1999)	- Crude extract inhibits replication of Hepatitis B virus DNA and other stages of viral replication such as RNA and protein synthesis (cited in Dhenuka *et al*. 1999). - A new phenolic glucoside called corchioside A was isolated from the species by Garg *et al*. (1989) (cited in Dhenuka *et al*. 1999) - Triterpinoid sapogenins and saponins used as tonic in Chinese medicine (cited in Dhenuka *et al*. 1999) - Curculin, a sweet tasting and taste modifying protein is present in the fruits of *C. latifolia* (cited in Dhenuka *et al*. 1999)
C. pilosa (Schum. & Thonn.) Engl.	Tropical Africa		badia nseka, besakasana, lilanga (Turumbu dialect), fundusjele (Ngwaka dialect) gbalabadoli, mulumba, orangba (Azande dialect) (Wiland 1997a)	roots	- Used in Northern Nigeria as a purgative (Dalziel 1937; cited in Burkill 1994) - Used in Congo-Brazzaville for treating hernia (cited in Burkill 1994) - In the Central African Republic, root reduced to a pulp is applied topically to swellings (cited in Burkill 1994)	

Table 3.1.—cont.

Species	Locality	Used by	Common names	Plant part used	Uses	Chemical constituents and biological properties
				rhizome seed capsules	- Used as a remedy for itchiness (Wiland 1997a) - Fresh seed capsules are edible (Dalziel 1937)	
	Ghana		ground star, African crocus		- Infusion used as an enema for stomach aches (Dokosi 1998)	
C. recurvata Dryand				rootstock		- Isolation of nyasicoside (Chifundera *et al*. 1991)
Empodium plicatum (Thunb.) Garside	South Africa	Zulu	golden star, ploegtydblommetjiest erretjie, isidwa, esincane senkangala (Zulu)	rootstock	- Decoctions taken for chest trouble thought to be caused by evil charms or poison (Hulme 1954) - Eaten raw in Lesotho (Guillarmod 1966). Note the species is not present in Congo, so it could possibly refer to *E. elongatum* (Nel) B.L.Burtt.	
Hypoxis angustifolia Lam.	Africa	Shona	hodo	rootstock	- Fibres removed, washed and eaten raw or grated, boiled or roasted (Tredgold *et al*. 1986)	- Isolation and identification of nyasol, (Z)-1-(4-hydroxyphenyl)-3-(4-hydroxyphenyl)-1,4- Pentadiene, hypoxoside, nyasoside, nyaside and mononyasine A and B (Sibanda *et al*. 1990)
	Swaziland	Masai and Kipsigi			- Flesh of rootstock eaten by children in Kenya (cited in Burkill 1994) - Used for making good luck charm (Adeniji *et al*. 2003)	
H. argentea Harv. ex Baker	Africa	Sotho	letsikitlane, leihlo-khoma le leholo (Phillips 1917)	rootstock	- Eaten by children in Lesotho (Phillips 1917) - Dried, crushed, mixed with fat, and used to anoint cracks on the teats of cows by the Sotho in Lesotho (Phillips 1917) - Rootstocks are heated to obtain an oil	

Table 3.1.—cont.

Species	Locality	Used by	Common names	Plant part used	Uses	Chemical constituents and biological properties
		Xhosa			which is used to anoint chafes on horses (cited in (Watt & Breyer-Brandwijk 1962) - Eaten in times of famine, roasted or boiled by children (Watt & Breyer-Brandwijk 1962)	
H. colchicifolia including *H. latifolia*	Subsharan Africa	Zulu	ilabetheka, igugu, ingcobo	rootstock	- Reported to be poisonous (cited in Watt & Breyer-Brandwijk 1962) - The Zulu use it as a remedy against barrenness (cited in Watt & Breyer-Brandwijk 1962) and sometimes in a mixture with other roots for barrenness (Bryant 1966). - Plant is regarded by Zulus to produce delirium and is also used by them for treating the condition (cited in Watt & Breyer-Brandwijk 1962) - Plant is used medicinally by the African in Congo (Watt & Breyer-Brandwijk 1962). Note the species is not present in Congo, so it possibly refers to *Curculigo pilosa* with which it may be confused. - Hot infusion of the rootstock is taken as an emetic against dreams disagreeable dreams said to accompany heart weakness (Gerstner, 1938, Bryant 1966) - Boiled rootstock is taken as a emetic (Bryant 1966) - Whole rootstocks are placed in snake holes as traps (Gerstner, 1938, Bryant 1966)	- Plant is said to contain haemanthine and used as a purgative and ascarifuge in unspecified parts of Africa (cited in Watt & Breyer-Brandwijk 1962) - Pentenye-*bis*-glucosidophenol extracted from rhizome (Drewes & Liebenberg 1983)

Table 3.1.—cont.

Species	Locality	Used by	Common names	Plant part used	Uses	Chemical constituents and biological properties
					- Rootstock is ground and placed in food to destroy all small vermin (Bryant 1966) - Used as a diuretic and in the treatment of psychiatric disturbances (Hutchings 1996) - Used for nausea/vomiting and for insect bites (Felhaber 1997). Note in this publication, illustration depicting species matches *H. hemerocallidea* but common names correct for *H. colchicifolia*.	
H. gerrardii Baker	South Africa			rootstock	- Decoction made by pounding and boiling rootstocks used to treat stomach trouble (Riley 1963), such as gripe and dysentery (Hulme 1954)	
H. goetzi Harms	Tropical Africa				- Useful plant with an edible rhizome (Wiland-Symańska 2001)	
H. hemerocallidea Fisch., C.A. Meyer & Avé-Lall. (synonym *H. rooperi*)	Subsaharan Africa	Sotho	mola kharatsa lotsane	rootstock leaf	- Used as a cure for headaches: the rootstock is shaped into a small hollow receptacle in which some blood from the afflicted person's forehead is collected The receptacle is buried and the headache cured (Phillips 1917) - Is a constituent of a medicine used in Lesotho as a charm against thunder and storms (Watt & Breyer-Brandwijk 1962) - Rope made from the leaf is used in the building of huts and reed enclosures and for sewing grain-baskets (Phillips 1917)	- Rootstock contains organic acids (Watt & Breyer-Brandwijk 1962) - Phytosterol glucosides mainly β-sitosterol (Pegel 1973) - Pentenye-*bis*-glucosidophenol extracted from rhizome (Drewes & Liebenberg 1983) - Diglucoside hypoxoside (Drewes *et al*. 1984) - Aglycone rooperol (Drewes *et al*. 1984) - Leaves are not an alternative source to rhizomes for sterols and sterolins. Leaves may be more effective for the

Table 3.1.—cont.

Species	Locality	Used by	Common names	Plant part used	Uses	Chemical constituents and biological properties
					- Pounded decoctions taken for stomach ailments and dysentery (Hulme 1954)	treatment of wounds than rhizomes (Katerere & Eloff 2008).
		Tswana and Kwena		rootstock	- Decoction given as a tonic to weakly children and it works as a purgative (Watt & Breyer-Brandwijk 1962) - Juice from the rootstock is applied to burns (Watt & Breyer-Brandwijk 1962)	
		Zulu			- Infused with Andropogon, Clausena, Ekebergia and Xanthoxylon to treat intestinal parasites, used as a purgative (Bryant 1966) - Infusions used as emetics for dizziness and mental disorders (Hutchings 1996)	
		Afrikaners			- Hot aqueous extracts of fresh or dried rootstocks used by white farmers in southern Africa to treat symptoms of benign prostate hypertrophy (Van Staden 1981)	
	Eastern Cape of South Africa	Xhosa	inongwe, ilabatheka		- Infusion taken orally for kidney pain, high blood pressure, diabetes and arthritis; also taken as a general tonic for good health (Cocks & Dold 2006) - Paste used to treat pimples, acne and skin rash (Cocks & Dold 2006)	
	Swaziland				- Used to treat infective dermatitis (cited in Adeniji et al. 2003)	

Table 3.1.—cont.

Species	Locality	Used by	Common names	Plant part used	Uses	Chemical constituents and biological properties
H. multiceps Buchinger ex Baker	Lesotho	Sotho	molimotsane, morethetho	rootstock	- Mixture of this species and *Ipomoea oblongata* E. Meyer ex Choisy smeared on pegs placed in the ground around a kraal as a charm against lightning (Phillips 1917)	
H. nyasica Baker	Africa	Nyanja		rootstock	- Used as a cough remedy that is said to induce perspiration - Used as an African medicine in the Congo (Watt & Breyer-Brandwijk 1962)	- The plant is said to contain an alkaloid (Watt & Breyer-Brandwijk 1962) - Monoglucoside named nyasicoside was isolated (Galeffi *et al*. 1987) - Mononyasine A and B, glucosides of nyasol and hypoxoside (Messana *et al*. 1989)
H. obliqua Jacq.	South Africa	Xhosa		rootstock	- Water boiled in the scooped-out rootstock is used as a lotion for septic wounds - Resinous material extracted from the rootstock by roasting it has been used for fixing assegai heads on the shaft - The plant is an African medicine in the Congo (Watt & Breyer-Brandwijk 1962)	
H. obtusa	Subsaharan Africa	Karanga children in Zimbabwe		rootstock	- Used in mock bull fights, called 'nhindiri'. A hole is made through the length of the tuber and a forked stick pushed through this. The fork represents the horns of the bull, and the tuber the body. Pairs of boys aim at damaging their opponents bulls (Wild *et al*.1972)	- Isolation of hypoxoside (Marini-Bettolo *et al*. 1982) - Isolation of obtusaside (Msonthi *et al*. 1990)
	Zimbabwe	Shonga	hodzori		- Used to treat abdominal pains, backache and infertility, also as an aphorodisiac taken orally (Gelfand *et al*. 1993)	

Table 3.1.—cont.

Species	Locality	Used by	Common names	Plant part used	Uses	Chemical constituents and biological properties
H. rigidula Baker	Southern Africa	Sotho	tieane	leaf	- In Lesotho, used to make a strong rope (Phillips 1917) - Strong fibrous leaves used by the natives as string or rope and long cords are made by plaiting strands together (Verdoorn 1947)	
				rootstock	- Used as a remedy for gall-sickness in cattle - In the Congo, the plant is a traditional medicine (Watt & Breyer-Brandwijk 1962)	- Rootstocks have given negative tests for haemolysis, alkaloid and organic acid (Watt & Breyer-Brandwijk 1962)
H. urceolata Nel		Narok District, Kenya	chepkimniet (Kipsigis), engaimalasiyai (Masai)	rootstock	- children eat small tubers attached to roots - children fix sticks into rootstocks to make toy wheels - children cut out middle of rootstock to make miniature gourds which they fill with milk and pretend to drink Notes on *Clover, Gwynne & Samuel 614* (EA)	
H. villosa L.f.		Southern Sotho	moli letaha, lehlaba kolobe, khuoa ke maoatle	rootstock	- Used as a charm against thunder	
		Lobedu		leaf	- Sometimes used for making rope but these are weaker and rot sooner than those made from *H. rigidula* (Phillips 1917) - For magical purposes, the rootstock is planted on mounds dedicated to the Gods	

Table 3.1.—cont.

Species	Locality	Used by	Common names	Plant part used	Uses	Chemical constituents and biological properties
					- Sometimes a rootstock is stuck onto a stick and planted outside a kraal to repel witches - Sometimes used to induce diarrhoea in domestic stock (Watt & Breyer-Brandwijk 1962)	
Hypoxis sp.	Malawi					- Rootstock contains haemolytic sapogenin and organic acids (Watt & Breyer-Brandwijk 1962)
Hypoxis sp.				leaf	- Fibre traditionally used for binding on Zulu spears (Cunningham & Terry 2006). The picture in the publication shows *H. obtusa* but does not mention a species.	
Hypoxis sp.	Manyika			rootstock	- Ash prepared from rootstocks are applied to wounds - Decoction given to babies who accidentally drink the milk of a woman who has conceived (Watt & Breyer-Brandwijk 1962)	
		Karanga			- Remedy for vomiting, loss of appetite, abdominal pains and fever - It is used by sprinkling salt on cut surfaces of the rootstock and licking off the bitter juice (Watt & Breyer-Brandwijk 1962)	
		Zulu			- Ingredient of an infusion taken as a purgative and as remedy for internal parasites, also for delirium (Watt & Breyer-Brandwijk 1962)	

Table 3.1.—cont.

Species	Locality	Used by	Common names	Plant part used	Uses	Chemical constituents and biological properties
Molineria capitulata (Lour.) Herb.	Phillippines			leaf	- Fibre of leaves used by hill tribes to make false hair (cited in Burkill 1994) - Used to make fish-nets (Burkill 1994)	
	Borneo			flowers/ fruit	- Fruit is edible (cited in Burkill 1994). - Plant cultivated for its attractive foliage (Burkill 1994)	
	Argentina and Chile				- Widely cultivated in these countries (Ravenna 2003)	
Molineria recurvata (Dryand) Hebbert	India, Himalaya	Apatani		leaves	- to treat body aches (Kala 2005)	

H. rigidula, *H. galpinii* and *H. acuminata* were found to have a similar set of compounds. These species are closely related morphologically. In addition, the rhizomes in these species are large, yellow to orange internally as opposed to the more slender rhizomes that are white to cream-coloured in the smaller species like *H. angustifolia, H. argentea* and *H. filiformis*. With the depletion of the target species, *H. hemerocallidea* and *H. colchicifolia* in the wild, it is likely that the related species will be collected and sold as 'inkomfe' and 'ilabetheka'.

Glucosides were also isolated from *H. obtusa* and *H. nyasica* Baker through the works of Msonthi *et al*. (1990) and Galefi *et al*. (1987, 1989) respectively. Of interest, is the monoglucoside nyasicoside that was first isolated from the rhizomes of *Hypoxis nyasica* (Galefi *et al*. 1987) and then later isolated from the rhizomes of *Curculigo recurvata* Dryand (Chifundera *et al*. 1991). The rhizome of *C. recurvata* is reported to be used orally by the Bashi tribe in Zaire as a treatment for snake bites and arthropod stings (Chifundera *et al*. 1991). Furthermore, hypoxoside was extracted from *H. obtusa* (Marini-Bettolo *et al*. 1982), the species most closely related to *H. hemerocallidea*. Marini-Bettolo *et al*. (1985) isolated hypoxoside and a new glucoside called nyasoside which is biologically related to hypoxoside from *H. nyasica*.

3.5 Commercially available products from rhizomes of *Hypoxis*

Hypoxis fits into a small fraction of plants that is used in African traditional remedies and is also being studied by pharmacologists. It is also a genus from which a number of untested over-the-counter products are manufactured in South Africa by local pharmaceutical companies, by a number of herbalists as well as by home-based entrepreneurs, and has become a commercially viable incentive among some groups. Preparation of the rhizome for ingestion is diverse and range from infusion of chopped rhizomes for use as tea to more sophisticated home-filled capsules containing pulverized rhizomes. A number of commercial products prepared from *Hypoxis* extracts are also available over-the-counter in South Africa (Figure 3.5). One such product is Moducare® that is available in capsule form from health stores and pharmacies. Drewes & Khan (2004) informed of the development of Moducare® based initially on two phytosterol, ß-sitosterol and its glucoside originally obtained from *H. hemerocallidea* rhizomes. However, Moducare® no longer contains *Hypoxis* extracts but those of pine and soya (Drewes & Khan 2004) although the label continues to carry a picture of a *Hypoxis* flower. Drewes & Horn (1999) reported the results of their TLC analysis of Moducare® where they found β-sitosterol and sterols of a structure similar to that in *Hypoxis*. Table 3.2 lists some products, apart from those mentioned in Drewes & Khan (2004) available in South Africa that claim to contain extracts of *Hypoxis*.

Figure 3.5.—Examples of over-the-counter products prepared from *Hypoxis* rhizomes. Photograph: A. Rajh.

Table 3.2.—Some products from *Hypoxis hemerocallidea* rhizomes available in South Africa

Trade name	**Form**	**Manufactured by**	**Available at**	**Composition of *Hypoxis***
Moducare®	Capsule	Aspen Pharmacare	Health stores and Pharmacies	20 mg plant sterols and 0.2 mg sterolins per capsule. Research on sterols and sterolins for the product was based on *H. hemerocallidea*. Now pine bark is used instead of *Hypoxis*.
African potato/ *Hypoxis hemerocallidea*	Capsule	NutriGreen-NutriHerb-NutriLife	Health stores	300 mg of dry extract of *H. hemerocallidea,* per capsule
Immunizer	Capsule	Vikeleka Herbal Pharmaceuticals	Pharmacies	Undisclosed amounts of *H. hemerocallidea* and *Aloe vera*
Immuno *Active*	Capsule	Vuselela Herbal Pharmaceuticals	Pharmacies	500 mg of *H. hemerocallidea*. Also contains *Aloe ferox*
Herbal Immune Booster	Tincture	Farmos Health	Pep Store	500 mg of *Hypoxis* and 55 mg plant sterols per 20ml
Hypoxis rooperi	Tincture	Phyto-Force	Health Stores	Undisclosed
African Potato Herbal Tea	Tea	Natural Wonder Healer	Home Industry Outlets	Undisclosed
Die Afrika Aartappel	Tea	Private home based	Flea market	Undisclosed

These products are being used by the public for the treatment of arthritis and cancer, and to get a general boost in immunity to help cope with common ailments like colds and flu. The use of the *Hypoxis*-based products for self medication is mainly promoted through referral by users.

There is at present no formal control in South Africa on the products being manufactured from plants such as *Hypoxis*, and the marketing thereof. This is of concern especially in the absence of clinical evidence of the activity of *Hypoxis* and suitable dosages. The pharmaceutical companies use plants from a cultivated source, however, small home businesses are probably buying the rhizomes off vendors in the muthi market, thereby creating a demand for plants in the wild. Surplus rhizomes that are not sold within a certain period at the muthi market are discarded and replaced by new stock. The problems around harvesting wild source rhizomes are discussed under "What South Africa needs?".

Due to their anti-inflammatory activity (Pegel 1976), lipophilic extracts of *H. hemerocallidea* rhizomes are used to treat prostate problems in Europe (Hostettmann *et al*. 2000). A commercial product from *H. hemerocallidea* of note is Harzol®. The product was launched in 1974 and was used mainly in Germany to treat benign prostate hypertrophy. See Drewes & Khan (2004) for a detailed history of the development of Harzol®. Van Wyk & Gericke (2000) cite Bruneton (1995) and point out that pumpkin (*Cucurbita pepo* L., Cucurbitaceae) oil which contains high levels of phytosterols is marketed in Europe as a remedy for benign prostate hypertrophy. This would be a more suitable source instead of *Hypoxis* as cultivation of the latter requires a longer period.

3.6 *Hypoxis* species as a source of fibre

In a batch of communication in the *Hypoxis* files at the National Herbarium, Pretoria, there are two reports on the fibres in leaves of *Hypoxis rigidula* provided by the Imperial College in London. The first report is a response to a query sent by the Department of Agriculture, Transvaal to the Imperial College about the potential of fibres in *Hypoxis* for commercial use. It is dated 30 September 1906 and gives the results of a chemical comparison of the moisture, ash and cellulose content of *H. rigidula* leaves in comparison to esparto grass (*Stipa tenacissima* L, Poaceae). The report indicates that the fibre of the *Hypoxis* species is dark brown, smooth, stiff and wiry, somewhat lustrous and curly. It mentions that the fibre is resilient, fairly strong but slightly brittle and suggested that it could be used as stuffing material in upholstery.

The second report is dated July 1918 and is in response to a request by the Trades Commisioner's Department in South Africa as to whether there would be a market for fibre from *H. rigidula* and its possible commercial value. The request emanated out of the observation that locals were using the leaves for rope making. Values are presented for the moisture, hydrolyses loss, ash and cellulose contents in the report. The report states that the fibre is fairly resistant due to small losses on hydrolysis, but its low cellulose levels make it brittle and unsuitable for rope making. It advised that due to its extreme brittleness, the fibre is not suitable for commercial purposes.

Later, Watt & Breyer-Brandwijk (1962) mention the use of *H. rigidula* and *H. hemerocallidea* (*H. rooperi*) in rope making used in the building of huts and reed enclosures, and for sewing grain baskets. At the Ecabazini Zulu Cultural Homestead in the Valley Trust centred in the midlands of KwaZulu-Natal, the Zulu use *H. rigidula* (Figure 3.6) and *H. obtusa* fibres to make rope. The process of rope making is illustrated in Figure 3.7A–D. The ropes are used to decorate huts (Figure 3.7D).

Figure 3.6.—*H. rigidula*. A, habit; B, collected for rope making at Ecabazini, Pietermaritzburg, KwaZulu-Natal.

Figure 3.7.—Process of rope making using *H. rigidula* leaves at Ecabazini Zulu Cultural Homestead. A. leaves are plaited tightly over each other. B. close-up of how rope is held between feet and plaited. C. rope rolls stacked for used in hut decorating. D. rope décor on hut roofs. Photographs: Richard Haigh.

3.7 Other uses of *Hypoxis*

Local people in the Estcourt District of KwaZulu-Natal make a black polish from rhizomes of *H. obtusa* (known to them as inkomfe) which they apply to the floor of huts. Making the polish involves boiling sliced rhizomes in water until they are soft and then pouring the discoloured water over fine soil (Fred Smith, Robert Vilakazi of Busmansriver Gifts, pers. comm.). The soil-inkomfe mixture is applied to the floor and from time to time, inkomfe water is sprinkled over the floor to maintain the firmness and shine.

Some taxa of *Hypoxis*, mainly *H. angustifolia* var. *buchananii* and *H. hemerocallidea* are used in horticulture. The genus is suitable as garden plants as the rhizomes are resilient and flower readily in the absence of fire. Inflorescences in many species are produced sequentially throughout the growing season offering colour to beds over many months. A few other species, like *H. obtusa*, *H. acuminata* and *H. sobolifera* are floriferous when grown in clumps. *H. angustifolia* var. *buchananii* and *H. sobolifera* are easily propagated by division of the rhizome. Appleton & Van Staden (1995) offered appropriate methods for propagating *H. angustifolia* var. *angustifolia* for

commercial use and to get plants to flower in just eight to ten weeks of transplanting. *H. stellipilis* is unusual in its bicoloured leaves; the upper surface is dark green and the lower surface white due to the density of hairs, raising the potential of this species as an ornamental. Another species of potential value as a pot plant is the dainty single-flowered, *H. parvula*, both white- and yellow-flowered forms may be grown together to create an attractive mass display in containers. The white-flowered *H. membranacea* and *H. nivea* also multiply rapidly like *H. angustifolia* and would be excellent as garden or pot plants. Plants of *Hypoxis* require little care; usually only the dried out shaggy looking leaves and old fruiting heads need to be removed at the end of the growing season. With the features highlighted above, it is clear that more species of *Hypoxis* are worthy of cultivation as garden plants.

3.8 What South Africa needs?

It is inevitable that the exhaustive harvesting of *Hypoxis* plants from the wild will eventually lead to depletion of the resource. Depletion of target species is likely to promote collection of related species. Lack of availability of species in the wild may also influence indigenous practices involving plants in the long term.

Conservation authorities and the Government in South Africa will need to work more rapidly to form partnerships with indigenous communities and develop a plan for achieving sustainable harvesting by a target year. The setting up of such partnerships is challenging as it requires buy-in from collectors, conveyors and vendors of geophytes, like *Hypoxis*. Several community based projects are underway to cultivate medicinal gardens, but their effect is currently minimal in light of the rate at which plants are being removed from the wild in South Africa. There is also the belief among local people that cultivated plants are less potent to those growing naturally and this needs to be considered. In *Science in Africa* (www.scienceinafrica.co.za), Hughes (2002) outlines the basic requirements for small scale sustainable cultivation and techniques for rural communities. He recommends that the approach be based on Afro-ethnic wisdom rather than on a westernised corporate pursuit. Such an approach is completely valid since South Africa, and Africa needs to develop custom made programmes equitable to all stakeholders. A national campaign may be appropriate to bring to an end unsustainable harvesting of our natural resources, but it needs to be initiated at government level immediately.

Through the Department of Botany, University of KwaZulu-Natal, Pietermaritzburg, a number

of studies were undertaken on cultivation requirements of *H. hemerocallidea*. These studies include work by Hammerton & Van Staden (1988) on methods for breaking seed dormancy in the species and nutrient and soil requirements for cultivating *H. hemerocallidea* plants with high hypoxoside content by McAlister & Van Staden (1995). The results from these studies are important to increasing yield of plants and hypoxoside content when plants are cultivated for commercial use.

There is evidence that rooperol is active in inhibiting cancer cells (Albrecht *et al*. 1995). What is needed now is support from the Health Department for clinical trials using the prodrug (hypoxoside) on volunteers. It is understandable that the process of clinical trials is complex but the challenge is for immunologists and policy makers to take testing further so that the activity of rooperol as an anti-cancer, anti-HIV and anti-inflammatory becomes accurately known.

Lastly, the diversity in habit, leaves and flowering stalks in *Hypoxis* allows for selection and cultivation of suitable species for the horticultural trade. Since the genus is easy to maintain in gardens and as pot plants, the South African horticultural trade needs to investigate and create a market for these geophytes.

3.9 Conclusions

This Chapter gives an overview of the ethnobotany of Hypoxidaceae with special emphasis on the potential of *Hypoxis* in medicine and horticulture. The robust species in the genus contain the diglucoside, hypoxoside, a bioactive compound which in its hydrolysed form (rooperol) has been shown to slow down the growth of cancer cells. *Hypoxis* therefore holds considerable promise as an anti-tumour drug. The demand for particular species used mainly by the Zulus and now by maverick businessmen is rapidly reducing plant populations in South Africa and is likely to put pressure on related species. National efforts are therefore necessary to promote sustainable harvesting of geophytes for use in traditional remedies from the wild. *Hypoxis* shows great potential as a garden plant and more species should be introduced into horticulture.