The status of bark in South African traditional health care

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Bark products constitute nearly one third of plant material used in South African traditional medicine. Since the large majority of South Africans make use of traditional health care, bark is fundamental to the traditional pharmacopoeia. In this review we consider the status of bark resources, as reflected by the literature, and highlight the need for multi-disciplinary research to address the lack of available information on plant species used for their bark. The supply of bark to the medicinal plant trade has been rendered non-sustainable, due to increased user populations and reduced indigenous vegetation. Whilst conservation of the South African flora is paramount, natural resources cannot meet the current, nor foreseeable, demand for bark. Alternatives such as tree propagation and cultivation, strategic management and plant part substitution are discussed. Effective implementation of these action plans is reliant on the dissemination of existing and new knowledge. Problems of resource sustainability have strongly influenced supply and demand in the traditional medicine trade. This medicinal plant trade represents a vast ‘hidden economy’ (Cunningham 1988), with an estimated annual value in 1998 of R270 million per annum (US$3 million) (Mander 1998) and has likely appreciated considerably since then. Bark is the most popular product in South Africa harvested from trees, and comprises in volume at least 27% of the market produce traded annually in KwaZulu-Natal (Mander 1998). Since the medicinal plant trade in South Africa and neighbouring countries is centred in KwaZulu-Natal (Cunningham 1988, Mander et al. 1996, Marshall 1998, Williams et al. 2000), this is further indicative of the national trade (up to R1.35 million or US$1.5 million in 1998 (Mander 1998)) in bark products.

Introduction

African traditional health care has become the subject of increasing research momentum over recent decades. Traditional health care systems throughout the continent share characteristics such as the extent to which traditional medicine is used (80% of the population in developing countries being the definitive statistic of the World Health Organisation (WHO) (Penso 1980)), importance in the delivery of primary health care, and growing recognition of this medical pluralism, where patients may choose between biomedical and traditional health care (Gesler 1984, Dauskardt 1990). Cultural parallels include spiritual principles and treatment methodologies employed by traditional healers (Iwu 1993, Srivastava et al. 1996).

Southern African systems of traditional health care differ significantly from those of other regions of the continent in the plant material used. In South Africa, the trade in traditional medicine plants is dominated by material with a long shelf life: bark, roots, bulbs, whole plants, seeds and fruits (Cunningham 1990). Storability of plant material is important, as a lengthy time period may lapse between harvesting and sale. Plants are, therefore, either killed or limited to asexual reproduction by harvesting. In contrast, leaves are the most commonly used plant part in other regions of Africa (Cunningham 1990), harvesting of which is less likely to affect plant vigour and reproductive capacity.

Problems of resource sustainability have strongly influenced supply and demand in the traditional medicine trade. This medicinal plant trade represents a vast ‘hidden economy’ (Cunningham 1988), with an estimated annual value in 1998 of R270 million per annum (US$3 million) (Mander 1998) and has likely appreciated considerably since then. Bark is the most popular product in South Africa harvested from trees, and comprises in volume at least 27% of the market produce traded annually in KwaZulu-Natal (Mander 1998). Since the medicinal plant trade in South Africa and neighbouring countries is centred in KwaZulu-Natal (Cunningham 1988, Mander et al. 1996, Marshall 1998, Williams et al. 2000), this is further indicative of the national trade (up to R1.35 million or US$1.5 million in 1998 (Mander 1998)) in bark products.
Trees comprise 65% of all medicinal plants used worldwide; 8,000 of them are globally threatened (Gates 2000). The South African flora is well known for its richness and diversity of species: the 21,377 recorded species constitute approximately 10% of the world’s plant diversity, of which 10% are threatened (Goldring 1999). Estimates of the South African traditional pharmacopoeia range between 700 (Mander 1998) and 3,000 higher plant species (Van Wyk et al. 1997). Some 130 medicinal species, at least 112 of which are harvested for their bark, come from indigenous forest, which now covers only 0.3% of South Africa (Cooper 1985, Mander et al. 1997, Cunningham 1988).

The impact of traditional health care on the South African flora is unlikely to abate soon. Current trends indicate that the expected increase in the demand for traditional medicines in South Africa is indeed occurring. Factors influencing the demand for traditional medicinal plants include population growth, slow employment rate, influx of foreigners seeking work, and limited government resources for welfare upliftment (Mander et al. 1996). More recently, the AIDS pandemic and international demands for medicinal plant products have also been identified (Mander 1998). The simultaneous effects of rising consumer demands and declining plant resources threaten the integrity of traditional health care in South Africa.

This review focuses on the use of bark in South African traditional medicine as reflected by the literature. We highlight the importance of medicinal bark products, and therefore the urgent need to address the sustainability of available resources, which in turn influences the quality of bark-derived medicines. Authentication is a key aspect to the monitoring of this situation, and we briefly discuss methods and problems of authenticating bark. Multi-disciplinary research is needed to deal with the complex issues surrounding the use of bark in South African traditional health care.

Problems with the literature

Despite the importance of bark in South African traditional medicine, ethnobotanical literature about it is scant or inaccessible. There are several accounts of traditional plant medicines in South Africa (e.g. Watt and Breyer-Brandwijk 1962, Cunningham 1988, Roberts 1990, Hutchings et al. 1996, Van Wyk et al. 1997, Van Wyk and Gericke 2000 and Williams et al. 2000 and 2001). Several publications on the South African flora have included medicinal usage (Palmer and Pitman 1961, Immelman et al. 1973, Coates Palgrave 1977, Pooley 1993, Mander et al. 1995, Scott-Shaw 1999). Ethnobotanical accounts of the South African flora, such as those of Gerstner in 1938 and 1939 (cited in George et al. 2001), Watt and Breyer-Brandwijk in 1962, and Bryant in 1966 (cited in George et al. 2001), succeeded in documenting early ethnographic information before it disappeared (George et al. 2001). However, none address barks in particular. Where barks are explicitly mentioned, the value of data is frequently reduced by vague information: omitting to detail user populations, localities, correct botanical nomenclature, sources of plant material, or methods of medicinal preparation. These were found to be the limiting factors affecting a database currently being compiled to document the use and properties of barks used in traditional medicine in KwaZulu-Natal, sourced primarily from the literature. An indication of the sparse information available, even for ten of the most popular plant species used for their bark in this province, is shown in Table 1. Despite concerns voiced for the South African flora threatened by medicinal exploitation, there is a lack of comprehensive information to empower efforts of conservation, trade monitoring and health care standardisation. This needs to be addressed — a problem with resolution in increasing South African ethnobotanical research and publications in recent years (see Cunningham 2001a) for a review of African ethnographic literature and Hedberg (1993) for a discussion of botanical methods in ethnographic research). Literature dealing with other aspects of bark research, such as anatomy and phytochemistry, are prolific, but historically fraught with confusion in terminology (for discussions, see Martin and Crist 1970, Borger 1973, Trockenbrodt 1990 and Junikka 1994). Furthermore, phytochemical and pharmacological investigations of medicinal barks have focussed on traditional American and Asian healthcare.

The effects of bark harvesting

The supply of traditional medicine products from forests in South Africa has been affected by exploitation for timber by European settlers since the eighteenth century. Afforestation and forest clearance for agriculture similarly reduced indigenous forest and savannah forests, from the effects of European settlers since the eighteenth century. Afforestation and forest clearance for agriculture similarly reduced indigenous forest and savannah forests, from. According to Mander (1998), the potential area of forests exploitable for medicinal harvesting in the province has deteriorated from 889km² to 260km². Most indigenous forest in KwaZulu-Natal remains privately owned, thereby at risk of similar irreversible exploitation due to landowners’ ignorance of management practice (Cooper 1985). The grassland, savannah and thicket biomes in the province have been reduced by 60% (Mander 1998). Reduction in harvestable vegetation which were formerly actual or potential sources of medicinal plants has increased the use of remaining areas (Cunningham 1988).

The supply of tree products is not a problem intrinsic to traditional health care. Prior to the commercialisation of traditional medicine, a variety of traditional management practices secured sustainability of tree resources. Throughout Africa, trees are conserved for their shade and edible fruits, and — indirectly — medicinal products (Cunningham 1990). Protection of vegetation (natural or cultivated) at burial sites is common, and many beliefs and taboos associated with plant collection may be interpreted as conservation measures (Cunningham 1990, Van Wyk et al. 1997). For example, bark used in therapy of renal ailments is sometimes only harvested from the eastern and western sides of the tree, symbolic of the kidneys, thereby preventing ringbarking (Van...
Wyk et al. (1997). Purposeful conservation measures are traditionally implemented by community leaders and enforced by community headmen and policemen (Cunningham 1990). An illustration of this is the prohibition of hunting, cutting of saplings for construction, and the collection of fuelwood in Dwesa and Manubi forests (Transkei region, South Africa) imposed on the Gcaleka tribe by their chief to conserve such resources (Cooper and Swart 1992). According to Cunningham (2001b) habitat or resource conservation is implemented when three criteria are met: the subject is valued, human impact threatens this value, and social or political conservation controls are enforceable.

Conservation efforts in communities and areas protected by legislation are now frequently disregarded because of the lucrative demand for commercial harvesting (Cunningham 2001b). Habitat or resource conservation is implemented when three criteria are met: the subject is valued, human impact threatens this value, and social or political conservation controls are enforceable.

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Table 1: Trade and conservation of ten popular bark species in KwaZulu-Natal, South Africa

<table>
<thead>
<tr>
<th>Species</th>
<th>Biome1</th>
<th>Conservation status in KwaZulu-Natal</th>
<th>Harvesting response</th>
<th>Urban wholesale price (R)</th>
<th>Annual trade volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocotea bullata (Burch.) Baill. (LAURACEAE)</td>
<td>Forest</td>
<td>Declining and vulnerable to extinction²; protected⁴</td>
<td>Will coppice and recoppice vigorously³, but not after heavy damage⁶</td>
<td>R2.89/kg²; R20–R25/bag⁴</td>
<td>25.3 tonnes²</td>
</tr>
<tr>
<td>Warburgia salutaris (Bertol. f.) Chiov. (CANNELACEAE)</td>
<td>Forest, Grassland</td>
<td>Endangered, protected⁴</td>
<td>May show complete regrowth after ringbarking, and vigorous coppice³</td>
<td>R4.44/kg²; R120/bag⁴</td>
<td>17.2 tonnes²</td>
</tr>
<tr>
<td>Curtisia dentata (Burm. f.) Chiov. (CORNACEAE)</td>
<td>Forest</td>
<td>Vulnerable and declining³; conservation-dependant and protected⁴</td>
<td>Produces vigorous coppice³</td>
<td>R2.22/kg²; R30/bag³</td>
<td>23.9 tonnes²</td>
</tr>
<tr>
<td>Sclerocarya birea (A. Rich.) Hochst. (ANACARDIACEAE)</td>
<td>Grassland</td>
<td>Not threatened</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Acacia xanthophloea Benth. (FABACEAE – MIMOSACEAE)</td>
<td>Grassland</td>
<td>Not threatened</td>
<td>No data</td>
<td>R10/bag³</td>
<td>153 bags³</td>
</tr>
<tr>
<td>Albizia adianthifolia (Schumach.) W. Wight (FABACEAE – MIMOSACEAE)</td>
<td>Forest</td>
<td>Declining¹</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Harpephyllum caffrum Bernh. ex Krauss (ANACARDIACEAE)</td>
<td>Forest</td>
<td>Not threatened</td>
<td>Produces coppice and will recoppice</td>
<td>No data</td>
<td>424 bags³</td>
</tr>
<tr>
<td>Cassine papillosa (Hochst.) Kuntze (CELASTRACEAE)</td>
<td>Forest</td>
<td>Declining¹</td>
<td>No data</td>
<td>No data</td>
<td>146 bags³</td>
</tr>
<tr>
<td>Cassine transvaalenis (Burtt Davy) Codd (CELASTRACEAE)</td>
<td>Grassland</td>
<td>Declining¹</td>
<td>No data</td>
<td>R15/bag³</td>
<td>No data</td>
</tr>
<tr>
<td>Rapanea melanophloeo (L.) Mez (MYRSINACEAE)</td>
<td>Forest</td>
<td>Not threatened</td>
<td>No data</td>
<td>R10/bag³</td>
<td>327 bags³</td>
</tr>
</tbody>
</table>

¹ Sensu Low and Rebelo (1998); ² Mander (1998); ³ Cunningham (1988); ⁴ Scott-Shaw (1999); ⁵ Hilton-Taylor (1996); ⁶ Creig (1984); ⁷ Mander et al. (1995)

* Bags refer to standard 50kg-size maize bags. While no estimates of the mass of bark material contained in one bag are provided, Cunningham (1988) estimated that one bag may represent the bark of three Ocotea bullata trees with diameters of 40–44cm at breast height.
The removal of bark may kill trees by effectively interrupting downward phloem translocation. In response, carbohydrate photosynthetic products and growth hormones diffuse from the phloem above the wound to the xylem, and enter the upward transpiration stream, causing a concentration of these compounds in the aerial parts (Kozlowski and Pallardy 1997). The efficacy of bark removal as a management practice to manipulate flowering and fruiting in economic crops is well documented in the literature (for example, partial ring-barking of fruit trees induces early fruiting, and reduces the trunk to a maximum height of 3m, but when bark is scarce, ladders are built to access bark in the crown of the tree and branches are felled (Cunningham 1988). Wastage is tremendous if the tree is killed by bark stripping on the trunk, before bark on the upper portion of the tree is utilised (Cunningham 1988). Cunningham (1991) noted that in the case of Warburgia salutaris bark is harvested even when partially regrown, until both aerial parts and roots are entirely debarked.

Non-sustainable harvesting for the traditional medicine trade in South Africa, and indeed throughout the continent, has the highest impact on popular, slow-growing and slow reproducing species with specific habitat requirements and a limited distribution (Cunningham 1990). Many tree species used for their bark qualify as such. Peters (1994) noted that management potential of bark as a non-timber forest product (NTFP) is significantly lower than products such as fruits, seeds, exudates and leaves.

Coppicing ability and the vulnerability of trees to the effects of bark removal are important attributes that vary with the physiology (Cunningham 1991), ecology and taxonomy of different species, which may facilitate effective management for continual bark harvesting. Some indigenous trees used for traditional medicine products are extremely sensitive to bark removal (for example Faurea macaughtonii Phill. (Proteaceae) and Podocarpus henkelii Stapf. ex. Dallim. & Jacks (Podocarpaceae)), while others such as Warburgia salutaris and Nuxia floribunda (Benth.) may show complete regrowth after ringbarking (Cunningham 1991). Prunus africana (Hook. f.) Kalkm. (Rosaceae), and some latex producing Ficus species, such as Ficus natalensis Hochst. (Moraceae), are able to withstand complete bark removal (Cunningham and Mbenkum 1993). Examples of post harvest management of trees to promote bark regrowth include the wrapping of the trunk of Ficus natalensis with banana leaves in Uganda (pers. comm. Dominic Byarugaba to Prendergast 1999) and a similar application with plastic for Eucommia sp. (Eucommiaceae) in China (pers. comm. Bengang Zhang to Prendergast 2000). Bark production may also occur on new shoots. Cinchona spp. (Rubiaceae), cultivated for their quinine-containing bark since the mid-nineteenth century, are felled for complete bark removal and allowed to coppice. The reactions of many plants to intervention — such as bark removal and felling — may be species-specific or widely applicable, but knowledge about them may be largely scattered in horticultural literature or among the wealth of unwritten indigenous knowledge.

Continual bark removal will cause death even where copice production is prolific, as plants are debarked when immature (Cunningham 1988); subsequent prevention of seed set adversely affects population structure. Of urgent importance, therefore, in the conservation of tree species used for bark products (and indeed for other economic purposes, such as fuelwood and timber) is knowledge of their ability to withstand harvesting pressure, and of their regeneration responses (see Table 1 for the paucity of information about ten popular bark species in Kwazulu-Natal). Such information would assist in the selection of appropriate management practices for individual trees, and natural or cultivated populations.

Alternatives to harvesting from the wild

The demand for forest products cannot be met by the conservation of natural resources alone, and alternatives to harvesting them are needed. Sustainable supply of grassland, savannah and thicket tree species (e.g. Acacia spp., Albizia adianthifolia (Schumch.) W. Wight, Cussonia spicata Thunb.) may be achieved through intensive management, as relatively large populations will remain on grazing land of commercial livestock farms in the future (Mander 1998). However, cultivation of forest species is necessary in order to alleviate harvesting pressure and sustain biodiversity in the remaining forest fragments in this country (Mander 1998). The need to cultivate popular indigenous plants was identified by Gerstner nearly 60 years ago (Mander et al. 1996), and highlighted thereafter by a number of workers (see, for example, Cunningham 1988, 1990, Williams 1996, and Jäger and Van Staden 2000). Since then, commercial cultivation of indigenous trees has been largely neglected due to a lack of farmers’ understanding of marketing and cultivation economics, although cultivation trials have shown good potential for meeting consumer demands, and lessening the effects of the trade on biodiversity (Mander et al. 1996).

The use of cultivated plants in traditional medicine not only alleviates pressure on natural populations, but facilitates standardisation and increased safety, as inconsistencies in the quality and composition (due to genotypic and phenotypic variation) are reduced, probabilities of misidentification
and adulteration are lowered, and yields raised by management practice (WHO, IUCN and WWF 1993). In accordance with guidelines laid out by WHO, IUCN and WWF (1993), cultivation allows simultaneous ex situ conservation of medicinal plant species and in situ conservation of natural populations in their natural habitats. Mander et al. (1996) reported that Mondi, a South African timber company, mass-produced popular medicinal trees. Warburgia salutaris and Caitha edulis (Vahl) Forsk. ex Endl. are propagated in Catha edulis reported that Mondi, a South African timber company, mass-produced popular medicinal trees. Warburgia salutaris and Caitha edulis (Vahl) Forsk. ex Endl. are propagated in KwaZulu-Natal by the Medicinal Flora Co-Operative, which endeavours to propagate certain South African medicinal plants for existing markets (Anon 2000). (Contentious issues surrounding the role of horticultural propagation in ex situ medicinal plant conservation are discussed by Crouch (2000)). An important consideration, however, is phytochemical variation within plant populations, between cultivated and naturally occurring specimens, and chemotypes within taxa. Dahlgren and Van Wyk (1988), for example, noted that the sweet scent emitted by Greyia sutherlandii Hook. ex Harv. (Greyiaceae) at certain times of the year was not detectable in cultivated specimens. Standardisation of herbal medicines in terms of plant material, properties and usage has been dealt with thoroughly in the literature (see George et al. 2001, McChesney 2001, Fabricant and Farnsworth 2001).

It is unlikely that even commercial forests of indigenous trees would be able to meet the short-term demand for bark products in KwaZulu-Natal, but cultivation would ensure supply in the long-term (Mander 1998). Slow growing trees such as Ocotea bullata (L.) Steud. and Ocotea diffusa (L.) Steud. may intensify the problem of unsustainable tree resources, as timber and fuelwood. Shackleton (2000) noted that knowledge of management of coppice dynamics of indigenous trees might help to increase regrowth rates and/or the number of coppice shoots for fuelwood. Thus, sustained availability of both fuelwood and medicinal bark may be simultaneously achieved.

Another solution to the problem of meeting demands for medicinal plant material without compromising natural populations is the practice of plant part substitution. Non-sustainable products such as bark, bulbs and roots may be replaced with aerial parts such as leaves and twigs, as harvesting of these parts inflict less damage (Zschocke et al. 2000b). It is well known that phytochemical constituents are sometimes alike in different organs of a plant species, and therefore show similar biological activity. For example, phytochemical constituents of the bark and leaves of Ocotea bullata (Burch.) Baill. are very similar, and exhibit similar biological activity in vitro (Zschocke et al. 2000a), as is the case for Warburgia salutaris bark and leaves (Zschocke et al. 2000b). In KwaZulu-Natal, some healers are managing cultivation of Ocotea bullata (L.) Steud. by coppice production, thereby inducing high leaf yields that are used instead of bark (pers. comm. Steve McKean to Grace 2001). In many cases, however, certain plant parts are chosen and used for very particular reasons — not always phytochemical — and may not be substitutable.

Whilst sustainable harvesting may be possible, deviation from such management practice to increase yields and income is a real threat in any system. For example, Cunningham and Mbenkum (1993) reported over-harvesting of Prunus africana bark in Cameroon for European export (bark extract is a patented ingredient in pharmaceuticals to treat prostatic hyperplasia). Bark is sourced exclusively from natural populations, and while the species is particularly resilient to bark removal, excessive harvesting pressure has impacted strongly on existing populations. Pressures on the need for sustainable resources to secure both biodiversity and the livelihoods that depend on these resources are debated by Van Staden (1999).

**Products, therapy and trade**

Bark medicines are used in treatments for a diversity of ailments, spanning all levels of healthcare, from first aid to preventative and rehabilitative therapy, and for magical or religious purposes. Trends in usage and preparations are not apparent in the literature. The popularity of barks, attributable to their medicinal efficacy, may be justified by typically high concentrations of active constituents (Van Wyk et al. 1997). Bark may have been favoured historically, as it is readily accessible and availability unaffected by seasons,
whereas the leaves, flowers and fruits of trees may not be. Bark products are sold either as partially processed chunks (10–30cm x 3–10cm), or processed into chopped and ground products (<1mm) (Mander 1998), that are sometimes sold in mixtures of various plant ingredients. A crudely fashioned mortar and pestle, usually made from thick iron piping, is used to grind the material (Mander 1998). The healer or trader subsequently prepares raw products, usually alone and less commonly with other ingredients, for further preparation and self-administration by the patient. Methods of preparation generally aim to facilitate extraction of active principles — the ‘power of force’ — from the plant material (Kokwaro 1995). Accordingly, bark is commonly powdered and extracted prior to use. Liquid preparations such as decoctions and infusions, administered orally or by enema, are used most frequently for internal complaints. For the treatment of external ailments, such as injuries and dermatological ailments, powdered bark or ointments are used. More specialised methods of administration include the application of powdered bark to incisions made by the traditional healer, and the burning of bark to treat spiritual and psychological complaints.

Impacts on the quality of bark medicines

Cunningham (1990) noted that the species-specific demand for traditional plant medicines means that alternatives are not easily provided due to the plants’ particular characteristics, their symbolism, or the form in which they are taken. However, preparation and self-administration by the patient evolving as the supply and demand dynamic changes (Mander 1998). Formerly common products are now included only in more expensive ‘special’ mixes. For example, the bark of Curtisia dentata (Burm. f.) C. A. Sm. (Cornaceae) is found only in ‘special ikhabulo’, whereas it was once included in ‘ordinary’ mixes (Cunningham 1988). Alternative products are available at lower prices, for example the bark of the exotic Calamus L. sp. (Palmae) is used instead of Warburgia salutaris (Cunningham 1988). Although costs may influence the use of an alternative species, market prices are generally inelastic and wholesale prices remain significantly lower than retail prices (Mander 1998). Therefore cost alone cannot be considered a predictor for substitution; availability of rare material from wholesalers is also likely to influence substitution or adulteration of bark products.

Similar species or ‘mock-ups’ are substituted for scarce ingredients in the case of mythical plants; the bark of Ocotea bullata is replaced with that of Cryptocarya latifolia Sond. and C. myrtifolia Stapf. (Lauraceae), as they share a similar odour, and Mondia whitei (Hook. f.) Skeels (Periplocaceae) roots are substituted with the exotic Cinnamomum zeylanicum (Burch.) Baill. (Lauraceae) (Cunningham 1988). Perhaps the most obvious example of changes in traditional medicines is the availability of patent remedies and pharmaceutical medicines at traditional medicine stores, where plant remedies for common complaints are no longer readily available (Cunningham 1988). Although examples of the change in composition of bark products have not been documented recently, traditional medical practitioners increasingly make use of generic bark products, and adulteration of bark products by the untrained is a growing problem (pers. comm. Elliot Ndlovu to Grace 2001).

Yet another factor affecting patient safety, as plant resources become scarce, is the quality of plant medicines. Barks used in traditional medicines may vary in quality and efficacy with age of harvested material (immature bark may not contain the same concentrations of secondary metabolites), shelf life, rates of degradation and time since harvest. Determination of bark shelf life is made difficult because the rhytido (usually a large portion of bark used) is already dead prior to harvesting, and the time since death on the tree cannot be determined. Mander et al. (1997) found that traditional healers continue to employ certain plant parts, despite reduced maturity and size of material, as the use of other plant parts of the same species is in many cases unacceptable.

The motivation to market medicinal plants is frequently not to provide an essential service, but financial gain (Manana and Eloff 2001). Whilst highly trained practitioners of traditional medicine are reliable sources of therapy and medicines, traders are seldom qualified (Cunningham 1988), and there is an increasing abundance of healers without qualification or training at all (Cunningham 1988, Bye and Dutton 1991, Ngubane 1992). Consumers are reliant upon the person from whom medicine is purchased to correctly identify plant medicines, but under current circumstances where the seller may not be dependable, patient safety is jeopardised.

Stewart and Steenkamp (2000) noted that misidentification, faulty preparation and inappropriate dosage (particularly in paediatric cases) are the most frequent causes of poisonings related to the use of traditional plant medicines. The margin of error in identifying plant material is increased with other characteristics of traditional medicine. Synonymy in vernacular names is characteristic of many traditional plant medicines. For example, Sideroxylon inermis L., Minusops caffra E. Mey. ex A.DC. and Minusops obovata Sond. (Sapotaceae) share the Zulu name amasethole, but their barks, although morphologically alike, are used for different purposes (Cunningham 1988, Hutchings et al. 1996).

Authentication of bark products used in traditional health care

Because medicinal bark products are sold in pieces and in powdered form, identification is extremely difficult. Yet bark can be very useful for tree identification in the field, as it is usually typical at least at the genus level, and sometimes the species level (Acacia xanthophloea Benth. is easily identifiable by the exceptional yellow-green, powdery bark). Bark morphology, odour, flavour, characteristics of a slash wound made in the bark, and exudates, may provide reliable information in field identification of trees to the generic or specific level (see Beard 1944, Wood 1952, Whitmore 1961, Tait and Cunningham 1988, Prance and Prance 1993, Cunningham 2001b). However, field characters are of limited value for identification and authentication of excised bark products due to their usually ephemeral nature, and because they are sometimes obvious to experts only. Tait and Cunningham’s (1988) report for the identification of
common medicinal plant products represents the single available key for South African medicinal barks, using morphological characters such as odour, flavour, colour, texture, and presence or absence of oxalate crystals.

Bark anatomy is widely dismissed as too variable to be reliable for taxonomic purposes. However, in some cases anatomical studies have yielded useful trends to augment taxonomy. Whitmore (1981) identified seven distinct bark types in 103 species of Malaysian Dipterocarpaceae, and reported that subjective field characters were converted to objective features with analyses of bark tissues. Similarly, bark surface patterns were correlated with internal structure, and two bark types identified, in 12 southern African species of the genus Eugenia (Myrtaceae) (Van Wyk 1985).

Bark anatomy has traditionally offered the primary means for identification and authentication of bark products. Today, most plant drugs included in pharmacopoeia are identifiable by chemical standards (Trease and Evans 1983), but microscopy remains an important tool in the authentication or identification of plant materials, especially for powdered drug mixtures (Jackson and Snowdon 1990). Successful identification or authentication is reliant on recognition of microscopical diagnostic cell types and ergastic components (Trease and Evans 1983). According to Trease and Evans (1983), plant drug characterisation should aim to determine tissue and cell size, cell shape and relative positions, and the chemical nature of cell walls and cell contents. Diagnostic characters of unprocessed and powdered bark samples are determinable by morphological and anatomical analysis with various chemical and physical tests, such as histological staining, ash analyses, and fluorescence behaviour, are commonly employed in investigations of bark pharmacognosy (Jolly 1966, Sanyal and Datta 1981, 1986). Srivastava (1964) cautioned that chemical analyses of cell wall components and ergastic contents should be used only within the context of thorough anatomical studies of processed and unprocessed bark samples.

Chemotaxonomic characters, many of which are definitive for a taxon, may be of greater significance than morphological characters for plant identification (Trease and Evans 1983), and chemical analyses (notably chromatography) are now accepted as standard techniques for the identification of plant materials (Jackson and Snowdon 1990). In addition to morphological and anatomical characters, chemical data are important indicators of plant relationships at a different level of structural organisation (Rogers et al. 2000). Reliable chemical characters are those that are exclusive to specialist groups; ubiquitous primary compounds and those typical of higher taxonomic levels have little value in separating taxa (for a review of bark phychochemistry, see Srivastava 1964).

The use of Thin Layer Chromatography (TLC) to demonstrate the most characteristic constituents of a plant extract or preparation is favoured for its simplicity, rapidity, and affordability (Gibbons and Gray 1998). The resultant chromatogram may be interpreted via qualitative (visual) assessment, or semi-quantitative analysis of constituents shown (Rios et al. 1985, Wagner and Bladt 1995). However, because plant extracts are usually complex mixtures of different compounds, other chromatographic techniques may be necessary in the characterisation of herbal drugs (Gibbons and Gray 1998, Jork et al. 1990). Qualitative assessment is perhaps more useful in the case of bark extracts, due to the variability of tissue and possibility of discrepancies in quantitative data (Srivastava 1964).

Diagnostic phytochemical TLC fingerprints have been found to correspond with existing taxonomic trends, or indicate alternative relationships, in plant genera such as Combretum (Combretaceae) (Carr and Rogers 1987) and Maytenus (Celastraceae) (Rogers et al. 2000). Drewes et al. (1998) reported chemical similarities, identified by preparative chromatography and spectroscopy, in the barks of Loxostylis alata Spreng. f. Reichb. and Smoidingium argutum E. Meyer ex Sonder, two members of the Anacardiaceae.

Quality control of herbal medicines is an important topic wherever they are used (Manana and Eloff 2001). Standardisation and authentication of traditional South African plant medicines are not well documented, although the South African Traditional Medicines Research Group (SATMERG) is compiling monographs for a pharmacopoeia of herbal medicines for this country. Some South African plant species used in traditional medicine were investigated for diagnostic anatomical characters and wound healing effects by Adams et al. (2001). Manana and Eloff (2001) reported that phytochemical fingerprints of material sold in markets in Pretoria compared closely to fingerprints of reference material, an encouraging result in the context of this discussion.

With problems of adulteration and substitution, there is a growing need for low-cost, repeatable and reliable techniques to identify bark specimens used in traditional South African medicine. Due to the practical difficulties of working with bark tissue, the use of phytochemical fingerprints in the first instance certainly meets these requirements. However, the variability of bark tissue calls for additional consideration; Srivastava (1964) stressed the need for assessment of seasonal variations in ergastic contents. The value of anatomical and morphological bark characters, to augment chemical methods of identification and address variability, should be upheld.

**Points of action**

Given the extent to which traditional health care is used in South Africa, the importance of medicinal bark products is apparent. Under difficult circumstances, where neither health care nor the indigenous flora of our country should be compromised, the need for sustainable bark resources is urgent. Debates of ex situ and in situ conservation need to be clarified, and species-specific management practices established to ensure that these efforts succeed. To secure the quality and efficacy of bark medicines, phytochemical references must be established, against which medicinal bark products may be authenticated, and the variability of bark products investigated. The diminished resources in South Africa, and slow recovery rate of indigenous forests in particular, require that bark research receive a share of the expanding ethno-botanical field in this country.

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References


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