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South African traditional medicinal plant trade—Challenges in regulating quality, safety and efficacy

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ABSTRACT

Based on the long history of medicinal plant use, users of traditional medicines accept that they are safe for human consumption. However, the absence of regulation of the medicinal plant trade in aspects such as collection, processing and storage provides no such guarantee. Environmental pollution, misidentification and adulteration provides further grounds for concern. The potential adverse effects of South African traditional medicines are not well documented. There are only a few investigations of mutagenic properties and heavy metal contamination. In the absence of regulatory controls, the safety and quality of medicinal plants vary considerably. The current comprehension and future challenges regarding quality, safety and efficacy of South African traditional medicine are discussed.

1. Introduction

It is estimated that around 27 million South Africans depend on traditional medicine for their primary health care needs (Mander, 1998). The reliance of such a large portion of the population on traditional medicine can be attributed to a number of factors; relatively good accessibility to the plants, affordability and extensive local knowledge and expertise amongst the local communities (Mander et al., 1996).

Secondary metabolites obtained from plants are not benign molecules (Gurib-Fakim, 2006). Plants have evolved such chemical defenses in order to deter, stun, poison or kill threatening species. It would therefore be naive to assume that plant extracts are inevitably safe (Gurib-Fakim, 2006). Nonetheless, a common misconception is that medicinal plants are "pure and natural" which equates to "harmless".

Inappropriate methods of collection, processing and storage with undesirable contaminants in the products, have all contributed to the negative impact with regards to African natural plant products competing in international markets (Tadmor et al., 2002). The regulation of traditional medicinal plant use embodies three fundamental aspects: quality, safety and efficacy. Unfortunately, comprehensive safety and efficacy data on traditional medicines are lacking (Springfield et al., 2005). The shortage of safety and quality controls of South African medicinal plants is further compromised by the fact that there is currently no pharmacopoeia that documents indigenous medicinal plants of South Africa (Fennell et al., 2004a). The objective of this paper is to discuss factors which influence the safety, quality and efficacy of medicinal plants and to highlight current knowledge and future challenges of the South African medicinal plant trade.

2. Factors compromising quality, safety and efficacy of South African medicinal plants

Many South African medicinal plants are harvested from the wild. This not only threatens medicinal plant biodiversity and population stability but also leads to speculation with regard to safety as industrial encroachment has led to contamination of water sources and natural habitats. The deposition of processed and unprocessed mining and industrial waste materials (Naicker et al., 2003; Roychoudhury and Starke, 2006) have led to questions of safety for South African medicinal plants that are harvested near to these resources. According to Verster et al. (1992) large quantities of polluted water and tonnes of dry sewage sludge is being disposed on South African soils—much of this on agricultural land. Numerous reports have revealed heavy metal contamination of South African rivers and soils (Abbu et al., 2000; Binning and Baird, 2001; Okonkwo and Mothiba, 2005). As a result of polluted harvest sites or poor farming practices, medicinal plant products may

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be contaminated with pesticides, microbial contaminants, heavy metals, toxic substances and adulterants (Chan, 2003).

Due to genetic, ecological and environmental differences, plants harvested from the wild generally vary in quality and consistency of active compounds (Bopana and Saxena, 2007). Medicinal plant gatherers collect their materials throughout the year to supply the persistent demand for medicinal plants. If mature trees or plants cannot be found, then younger ones suffice, which results in availability of inconsistent plant material of the same species (Von Ahlefeldt et al., 2003). Plant age, seasonal variation and geographical deviation in harvest site are contributing factors towards variation in biological activity (Taylor and Van Staden, 2001; Shale et al., 2005; Buwa and Van Staden, 2007). Collections of *Harpephyllum caffrum* Bernh. (Anacardiaceae) bark from the same female tree at different times of the year showed the highest antibacterial activity in summer months (Buwa and Van Staden, 2007). A study by Taylor and Van Staden (2001) on the effect of age, season and growth conditions on the anti-inflammatory activity of *Eucomis autumnalis* (Mill.) Chitt. (Hyacinthaceae) plant extracts showed significant differences between plants harvested before and after the growing season with the highest anti-inflammatory activity (COX-1 inhibition) shown shortly before the onset of dormancy. The age of plant affected COX-1 inhibition, with young plants having large amounts of COX-1 inhibitory activity, particularly in leaves. However, as the plants matured, more activity was associated with the underground plant parts (bulb and root). Thus, harvesting plants from undisclosed harvest sites throughout the year may result in inconsistent quality of available plant material.

Proper drying conditions are largely overlooked by the collectors, growers and traders (Ramakrishnappa, 2002). Inadequate drying may result in mould growth (Whitten, 1997), which can lead to deterioration of the plant product (Ramakrishnappa, 2002). Yeasts and moulds can cause opportunistic infections in humans and are more significant in HIV patients (Govender et al., 2006). A recent study on South African medicinal plants recommended for the treatments of HIV/AIDS revealed that many plants had high bacterial and fungal numbers due to low environmental sanitation and a low standard of processing during preparation (Govender et al., 2006). A study on African herbal teas showed samples containing a high microbial count, unacceptable in modern food and food supplement markets (Tadmor et al., 2002).

The effect of harvest and duration of storage on quality and efficacy remains understudied (Fennell et al., 2004a). The effect of storage on biological activity was carried out on nine frequently used medicinal plants of South Africa (Stafford et al., 2005). On the whole, antibacterial activity was retained while anti-inflammatory activity (COX-1 inhibition) was lost. Changes in the chemical composition of the plant material during storage were shown through the use of TLC-fingerprints. According to Stafford et al. (2005), phytochemical stability is species-specific and no general assumption can be made with respect to recommended shelf-life.

Whether in the fresh, desiccated or semi-processed state, the accurate identification of medicinal plant species is fundamental with respect to quality control (Springfield et al., 2005). The well-being of the consumer is compromised due to poorly trained plant vendors who misidentify plant materials (Grace et al., 2002; Fennell et al., 2004b). Medicinal plants collected from the wild may be contaminated by other species or plant parts through misidentification (WHO, 2003). Poisoning from traditional medicines is frequently a consequence of misidentification (Stewart et al., 1998). *Jatropha curcas* L. (Euphorbiaceae), a medicinal plant commonly associated with poisonings in South Africa (Munday, 1988), was the cause of 11% (50) of the total number of acute poisonings (442) admitted to Ga-Rankuwa Hospital due to accidental ingestion of the seeds—all cases were children (Mampane et al., 1987).

The bulk of the medicinal plant trade takes place at informal street markets and involves the sale of unprocessed or semi-processed products. Raw plant material undergoes very little processing (e.g. grinding or boiling) before being administered to the patient (Mander and Le Breton, 2006). The deliberate addition of biologically active material to a plant preparation (known as adulteration) is a common method of malpractice used to enhance the efficacy of the products (Yee et al., 2005). There had been no reports of deliberate adulteration of traditional African herbal remedies until recently with reports of two separate incidences in which South African traditional remedies were adulterated with western pharmaceuticals causing severe toxicity (Snyman et al., 2005).

In the preparation of traditional medicinal plants, efficacious compounds are not extracted individually from the plants. Instead the whole plant, parts thereof or crude extracts (extracted with the use of alcohol or water), are used (Drewes et al., 2006). Many traditional health practitioners believe that isolated compounds have weaker efficacy than whole plant extracts (Rodriguez-Fragoso et al., 2008). Owing to the fact that traditional medicines are complex mixtures of more than one active ingredient, possibilities of interaction between herbal and conventional drugs are increased (Ernst, 2000). Unfortunately, herbal–drug interactions and the consequences thereof is a poorly studied field. If neglected, it may have serious negative implications on today's 'herbal boom' (Ernst, 2000). For example, two South African medicinal plants often recommended for the treatment of HIV/AIDS include *Hypoxis hemerocallidea* Fisch. & C.A. Mey. (Hypoxidaceae) and *Sutherlandia* sp. (Fabaceae). However, despite the support of the Ministry of Health and NGOs, no clinical trials of efficacy exist (Mills et al., 2005a). Alarmingly, the plants have shown a negative interaction with antiretroviral medication (Mills et al., 2005b). Thus patients may be at risk from treatment failure, viral resistance or drug toxicity (Mills et al., 2005b). Although it is customary for traditional healers to make inquiries regarding the prescription drugs used by their patients, the lack of scientific evidence with regards to herbal–drug interactions does not equip the healers to make informed decisions (Mirranda Javu, South African traditional health practitioner, personal communication).

Throughout southern Africa, plant material that is dried (roots or bark), or has an extensive shelf-life (bulbs, seeds and fruits) dominates traditional medicinal markets (Fig. 1) (Cunningham, 1993). South African medicinal plants are most commonly sold at informal street markets or indoor shops. The outdoor markets are customarily positioned in the hub of the city center to allow easy access for commuters. A rudimentary cover may keep direct sunlight or rain off the trader but most of the plants are displayed in the open (Fig. 1). Therefore, plant material may come in contact with

Fig. 1. Informal street market, Pietermaritzburg, South Africa.