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Effect of storage on the chemical composition and biological activity of several popular South African medicinal plants

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Abstract

The in vitro biological activity of nine frequently used medicinal plants in South Africa was assessed and re-assessed after various lengths of storage. The plants investigated were *Alepidea amatymbica*, *Leonotis leonurus*, *Drimia robusta*, *Vernonia colorata*, *Merwilla natalensis*, *Eucomis autumnalis*, *Bowiea volubilis*, *Helichrysum cymosum* and *Siphonochilus aethiopicus*. Water, ethanol and hexane extracts of fresh, 90-day-old and 1-year-old material were assayed for antibacterial activity against four strains of bacteria and for COX-1 inhibition activity. TLC-fingerprints of the fresh and stored extracts were produce to document chemical changes. *Alepidea amatymbica*, *Eucomis autumnalis*, *Helichrysum cymosum*, *Leonotis leonurus*, *Siphonochilus aethiopicus* and *Vernonia colorata* were investigated further as to the effect of 1 year's storage. Elevated temperature and humidity (55 °C and 100% relative humidity) were used to accelerate the ageing process of *Alepidea amatymbica*, *Leonotis leonurus* and *Vernonia colorata* plant material for further investigation. The TLC-fingerprints indicated that there was chemical breakdown during storage in certain species. The degree of changes in biological activity and chemistry due to storage were species-specific. In general, antibacterial activity was retained in most species while COX-1 inhibition activity was lost rapidly.

Keywords: Antibacterial; Anti-inflammatory; Medicinal plants; Storage; Accelerated ageing; South Africa

1. Introduction

Over the past decade, herbal medicine has become a topic of augmented global importance, having impacted on both world health and international trade. In terms of world health, traditional medicinal plants continue to play a central role in the healthcare systems of large proportions of the world's population (Akerele, 1988). This is particularly true in developing countries, where traditional systems of medicine have a long and uninterrupted history of use. Recognition and development of the medicinal and economic benefits of traditional medicinal plants is on the increase in both developing and industrialised countries, although it varies greatly from region to region (WHO-Traditional Medicine (TRM) 1998). Until recently, traditional medicines were not acknowledged by the South Africa health authorities. Now, however, the South African government recognises the importance of traditional medicine as a key provider of primary health care and is promoting the integration of traditional healing into the official health care system under the Reconstruction and Development Plan (RDP) (Pick, 1992). It is estimated that 27 million South Africans utilise traditional herbal medicines from more than 1020 plant and 150 animal species. Approximately, 450 plant species are sold in large volumes in markets (Dauskardt, 1990; Meyer et al., 1996; Williams, 1996; Mander, 1997). Nine plant species make up approximately one-fifth of the traditional medicinal plant market in KwaZulu-Natal (Mander, 1997). The amount of plant material traded in KwaZulu-Natal

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is estimated at 4500 tonnes/year (Cunningham, 1988; Meyer et al., 1996; Mander, 1997). More than 500 species are reported to be traded in Witwatersrand markets (Dauskardt, 1990; Williams, 1996). These independent studies indicate that the plants traded in these two major geographical regions are similar.

The physical conditions and infrastructure in these markets are generally poor, with most plant material displayed in the open. Under these conditions, the material is exposed to microbial and insect attack as well as the effects of light, gases and temperature. Often, these informal markets are situated close to both pedestrian and motor vehicle traffic, which places plant material in contact with various kinds of pollution. Mander (1997) found that 84% of the rural clinic patients he interviewed ($n = 100$) indicated that they would prefer more hygienically packaged indigenous medicines, with most consumers indicating that they would prefer more modernised and hygienic trading sites.

The lack of storage facilities and trading infrastructure frequently results in the spoiling of plant materials (Mander, 1997), resulting in wastage and/or a decrease in product quality. These findings have indicated that healers and consumers question the current state of indigenous medicine in South Africa, as they are concerned about the quality of the products purchased in the markets. This paper aims to address the concerns of traditional plant users in South Africa with respect to the effects of storage on medicinal plant quality. Additional factors such as exposure to UV light and microbial contamination fall outside the scope of this paper and the reader is advised to consult Griggs et al. (2001) and Kneifel et al. (2002).

2. Materials and methods

2.1. Plant collection, storage and accelerated ageing

Plants collected were chosen according to their popularity as a traditional medicine according to Mander (1997) (Table 1). Bark preparation were excluded, as bark is essentially non-living and thus is not of determinable age and cannot be classed as ‘fresh’. The plants investigated were *Alepidea amatymbica* Eckl. and Zeyh., *Leonotis leonurus* (L.) R. Br., *Drimia robusta* Bak., *Vernonia colorata* (Willd.) Drake, *Merwilla natalensis* (Planch.) F. Septa, *Eucomis autumnalis* (Mill.) Chitt. subsp. *autumnalis*, *Bowiea volubilis* Harv. ex Hook. f., *Helichrysum cymosum* (L.) D. Don and *Siphonochilus aethiopicus* (Schweinf.) B.L. Burtt. Plant material was collected from two locations in KwaZulu-Natal, South Africa and identified by the Herbarium, School of Botany and Zoology, University of KwaZulu-Natal (formerly, the University of Natal), Pietermaritzburg, where voucher specimens (Collection numbers *Staff 001–009 NU*) were deposited. Immediately after harvesting, the plant material was cleaned and a portion used for preparing fresh extracts. The remainder of the plant material was oven-dried at 50 °C for 24 h. This was stored at room temperature (20 °C) in brown paper bags until extraction. Five-year-old material of *Leonotis leonurus*, which had been collected from the same plant and stored in the same manner mention above was also assessed.

To accelerate the ageing process, the plant material was dried and ground to a fine powder in a miniature mill, and 25 g then placed into a weighing boat. The plant material was

Table 1
Plant species used in this investigation and their known in vitro medicinal properties

Family/species	Plant material used	In vitro activity	References
Apiaceae			
Alepidea amatymbica	Herb root	Anti-microbial, anti-hypertensive and diuretic activity	Hutchings et al. (1996), Somova et al. (2001)
Hyacinthaceae			
Boweia volubilis	Bulb	Cardiac glycosides, mild anti-inflammatory	Watt and Breyer-Brandwijk (1962), Jäger et al. (1996), Hutchings et al. (1996)
Drimia robusta	Bulb	Cardiac glycosides, mild anti-inflammatory	Watt and Breyer-Brandwijk (1962), Luyt et al. (1999a,b)
Eucomis autumnalis	Bulb	Anti-inflammatory and antispasmodic	Jäger et al. (1996), Taylor (1999), Taylor and van Staden (2001, 2002), Zschocke et al. (2000)
Merwilla natalensis	Bulb	Antiseptic and anti-inflammatory	Watt and Breyer-Brandwijk (1962), Jäger et al. (1996), Van Wyk et al. (1997), Sparg et al. (2002)
Asteraceae			
Helichrysum cymosum	Whole plants	Pain relieving, anti-infective, anti-microbial and anti-inflammatory	Watt and Breyer-Brandwijk (1962), Van Wyk et al. (1997)
Vernonia colorata	Leaves	Anti-bacterial	Kelmanson et al. (2000), Reid et al. (2001), Rabe et al. (2002)
Lamiaceae			
Leonotis leonurus	Leaves	Anti-inflammatory	Watt and Breyer-Brandwijk (1962), Jäger et al. (1996), Van Wyk et al. (1997), Kelmanson et al., 2000
Zingiberaceae			
Siphonochilus aethiopicus	Rhizome	Decongestant, anti-septic and diuretic	Watt and Breyer-Brandwijk (1962), Zschocke et al. (2000), Light et al. (2002)