Bush Tea (*Athrixia phylicoides* DC.) as an Alternative Herbal and Medicinal Plant in Southern Africa:Opportunity for Commercialization

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ABSTRACT

Bush tea (*Athrixia phylicoides* DC.) is a plant indigenous to South Africa and is commonly known as bushman's tea (English); Boesmanstee (Afrikaans); Icholocholo, itshelo, umthsanelo (Zulu). It is a herbaceous plant that belongs to the Asteraceae family. People of South Africa have predominantly used it throughout history as a medicinal tea, for cleansing or purifying the blood, treating boils, headaches, infested wounds, cuts and the solution may also be used as a foam bath. The foam bath brew can also be used as lotion dabbed on to the boil, skin eruption or cut. The tea is also excellent for coughs and colds and as a gargle for throat infections and loss of voice. It is also believed to have aphrodisiac properties in some parts of southern Africa. The leaves contain 5-hydroxy-6,7,8,3',4',5'-hexamethoxy lavon-3-ol as a new flavonol which is a recently discovered flavonoid. Today, herbal tea cultivation is a big business in many parts of the world. South Africa is well known for its indigenous herbal tea production such as honey bush, rooibos and bush tea. There are increasing demands for such products, especially in the light of growing health consciousness worldwide. This necessitated the establishment and revival of bush tea as a healthy herbal beverage alternative to caffeine-containing beverages. Current research suggests that there is a great need to standardize processing methods and production protocols for consistent quality.

Keywords: antioxidant contents, beverage, health benefits, herbal tea quality, tannins, total polyphenols **Abbreviations: CDCl3**; deuterated chloroform; **IBA**, indole-3-butryric acid; **TMS**, Tetramethysilane; **UV**, ultraviolet

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INTRODUCTION

Herbs are plants, which have some culinary, medicinal, or other domestic use such as dyes, insect repellents, or scents (Larkin 1983). They are pleasingly fragrant or strongly aromatic; a few are with odour or have no odour at all. Written history from the ancient civilizations explained that plants had been used as medicine for many years (Manteiga *et al*. 1997). Manteiga *et al*. (1997) cited that the first complete list, or *Materia Medica*, of all known medicinal herbs was written during the Roman Empire. Based on the archaeological reports the infusion from variety of wild plants and the traditional black tea was probably practiced for more than 500 000 years

(Gutman and Ryu 1996). Throughout history, herbs have had their place in every civilization in the world, with their usage changing very little as the centuries passed. Ancient cultures wrote of the plentiful use of herbs, which include flowers, leaves, and tree bark, are used for improving the taste of food, or to make medicines and tea (Manteiga *et al*. 1997; Dufresne and Farnworth 2001). People have knowledge of using herbs (John 2003) and this tradition continues by 80% of the world (Phelan and Rees 2003). Although there is a contradictory concept of defining the herbal tea (Cao *et al*. 1996; Manteiga *et al*. 1997; Trevisanato and In Kim 2000; Phelan and Rees 2003), the herbal teas do not contain any of the leaves of true tea plant or black tea (*Camellia sinensis* L.) (Trevisanato and In Kim 2000; Phelan and Rees 2003). According to the Chinese definition only a beverage obtained from the leaves of the black tea plant (*C*. *sinensis* L.) is considered as tea (Du-fresne and Farnworth 2001). Mostly there is misunderstanding between tea and herbal tea for example, in the derivatives of Germanic languages like English. However, in other linguistic groups such as Neo-Latin languages (e.g., French) herbal tea and tea evidently different where the first is known as infusion (tisane), while the second known as tea (thé) (Pietta 2000; Trevisanato and In Kim 2000).

A few of the more popular commonly used as herbal tea include chamomile, marjoram, peppermint, rosemary, sage, rose, lemon verbena and thyme (Pietta 2000). Other herbal
plants teas commonly used in South Africa are lavender, lemon verbena, lemon balm, fever tea and mint (van Wijk 1986).

Today, herbal tea cultivation is a thriving big business in many parts of the world and the complex industry now produces a variety of teas (Wise 2002). South Africa is well known by its indigenous herbal tea production like honey-bush tea (*Cyclopia intermedia*) and rooibos tea (*Aspalathus linearis*) (Marnewick *et al*. 2000). Like honeybush and rooibos tea, bush tea (*A*. *phylicoides*) has been used for decades as herbal tea or medicinal tea by the peoples of South Africa (van Wijk 1986). van Wyk and Gericke (2000) also reported the suitability of this plant for domestication and development as a commercial health tea. Therefore the purpose of this review is to explore the current research work done with the possible ways on how these results will aid a better break through and the strategy to support the development of bush tea as a healthy alternative to caffeine-containing beverages in South Africa.

ORIGIN AND DISTRIBUTION

The genus *Athrixia* belongs to the Asteraceae family, tribe Inuleae and subtribe Athrixiinae. There are 14 species, which are predominantly found in southern Africa, tropical Africa and Madagascar of which nine are endemic to southern Africa (Herman *et al*. 2000). The most common ones in South Africa are *Athrixia angustissina*, *A*. *elata*, *A*. *ger-rardii*, *A*. *hererophylla* and *A*. *phylicoides*. *A*. *phylicoides* is widely distributed in the eastern part of South Africa from the Soutpansberg Mountains in Limpopo to Queenstown, King William's Town and East London and throughout KwaZulu-Natal from the coast to the Drakensberg Mountains (Herman *et al*. 2000).

BOTANICAL INFORMATION

Bush tea (*Athrixia phylicoides* DC.) is indigenous to South Africa where it is commonly known as bushman's tea (English); Boesmanstee (Afrikaans); Icholocholo, itshelo, umthsanelo (Zulu). Botanically, it is an attractive shrub, about 50 cm to 1 m in height, branched, with thin, woolly stems. Leaves are simple, alternate, linear to broadly lanceolate, tapering to a sharp point, shortly stalked, auri-culate at the base, light grey-green, smooth on the upper surface and white-woolly below, with margins entirely or slightly revolute (Roberts 1990).

The inflorescence head is sessile or sub sessile and terminal axillary in large panicles (Herman *et al*. 2000). The flowering period in the coastal areas occurs during May to June and inland flowers appear during mid-summer (Roberts 1990). Flowers vary from pink to all shades of pink and an attractive purple colour, depending on edaphic factors and geographical area (van Wyk and Gericke 2000).

Propagation is commonly by ripening seeds, which are mostly collected at the end of summer (Roberts 1990). The fruits consist of narrow, cylindrical and thin achenes that are approximately 0.01 to 0.06 mm wide, with an average of 12 pappus per seed of about 4 mm, which helps in the dissemination of the seed as a parachute (Araya 2005). Bush tea adapts well in open grassland and in thick forest margins of South Africa, especially in Limpopo Province, Free State Province, KwaZulu-Natal and some parts of the Eastern Cape Province, and in neighbouring Swaziland. For good establishment, plants need well-drained soil with full sunlight and enough space for spreading their branches (Roberts 1990).

MEDICINAL USAGE AND CONSUMPTION AS TEA

The indigenous people of South Africa have used bush tea for many years as medicinal tea for cleansing or purifying the blood, treating boils, headaches, infested wounds, cuts and the solution may also be used as foam bath (Mabogo 1990). The foam bath brew can also be used as lotion dabbed on to the boil, skin eruption or cut (Roberts 1990).

In Venda culture, it is known as the tree which is not supposed to be consumed by bachelors (D.N.E. Mabogo pers. comm.). It is also chewed, for sore throats and coughs by the Sotho and Xhosa. In Vhembe District of Limpopo Province bush tea extracts from soaked roots and leaves are used for treating anthelmintics (G. Makhera, pers. comm.). The tea is also excellent for coughs and colds and as a gargle for throat infections and loss of voice (Mabogo 1990). Traditionally, the roots are used for aphrodisiac in some parts of South Africa (Mabogo 1990). The Sothos use strong brew preparations as a calming wash for sore feet and then bandage the washed feet synergistically with castor oil leaves (Roberts 1990; Marnewick *et al*. 2000). *A*. *phylicoides* shrub is used for coughs, sores and boils, and as an aphrodisiac (Mabogo 1990). The herbal tea is used for stomach complaints, cough and chest ailments and the shrub is also used to treat sore feet and for skin infections, boils and sores (Mabogo 1990).

Traditionally, the common way of preparing bush tea is to boil water together with leaves for 10 to 15 min, and then served. Older people do not prefer to drink bush tea with milk and sugar although younger generations add 2-3 tea spoons and fresh milk. Herbalists often dry the leaf samples under the shade and dispense the samples to diabetic patients, or for cleansing or purifying the blood, treating boils, headaches and infested wounds (G. Makhera, pers. comm.).

HARVESTING AND TRADING

Bush tea is traditionally harvested during early autumn and midwinter during flowering. The herbalists prefer this period because flowers are said to improve the sweetness and after harvesting, they dry the leaves under the shade (G. Makhera, pers. comm). There are different harvesting techniques e.g. of young shoots or by cutting other branches as low as possible from the ground with sickle or pruning shears. The approximate cutting length measures 1 m but depends on the size of the plant. Excessive cutting helps the resprouting for future harvesting and it reduces the occurrence of suffrutex or shoot dieback after harvesting. Bushes previously harvested give better materials for processing, as the stems are softer. Fire also aids a more vigorous shoot development in the following season (pers. obs.). Trading of bush tea depends on the purpose of harvesting the plant. When the plant is not harvested for brewing, the stems of bush tea are well tied in bundles for brooms and traded on a small-scale at vendor's markets in Limpopo, Mpumalanga and KwaZulu-Natal Provinces (J. Olivier, pers. comm.).

CURRENT RESEARCH FINDINGS

Many studies have revealed that *A*. *phylicoides* plants have the potential to be used commercially as a medicinal herbal beverage and this has been validated by a series of different trials. However, this review will cover only the current findings reported, without reporting the clinical trials to validate its medicinal potential reported by indigenous people in South Africa. Möller *et al*. (2006) reported that the medicinal significance of *A*. *phylicoides* could be linked to essential oil which is currently believed to take place in cells in the glandular trichomes present on the surface of the leaves. The researchers concluded that the glandular tri-chomes are peltate, multicellular structures with an apical. Subcuticular cavity where the secreted products are stored and the essential oil are released when the cuticle ruptured caused by an external pressure.

An experiment to identify the major compounds in bush tea was initiated by Mashimbye *et al*. (2006). Matured leaves were harvested in Muhuyu village (Limpopo Province, South Africa) for extraction. The green leaves were cold extracted with acetone for seven days. The extract was filtered and evaporated at 50°C under reduced pressure to yield 312 g of a green viscous liquid. Thin layer chromatography plates were visualized under UV light (240 nm) or
by spraying with visualizing reagent (anisaldehyde reagent) which was made up by mixing 250 ml ethanol, 2.4 ml concentrated sulphuric acid and 6 ml anisaldehyde. NMR spectroscopic measurements were done using a 300 MHz Bruker spectrometer, with $CDCl_3$ as solvent and TMS as an internal standard. The processed leaves of bush tea contained 5-hydroxy-6,7,8,3',4',5'-hexamethoxy flavon-3-ol considered to be a new flavonoid (Mashimbye *et al*. 2006). To support the development of bush tea as a healthy alternative to caffeine containing beverage, McGaw *et al*. (2007) reported that there was no caffeine contents in bush tea and neither screening using spectro-phometry nor confirmation using gas

chromatochraphy mass-spectrophometry analysis showed evidence of pyrrol-izidine alkaloids.

A trial to investigate the seasonal variation of total polyphenols in bush tea leaves harvested from the wild was conducted by Mudau *et al*. (2006). Leaf samples were collected from a field at Muhuyu Village (Limpopo Province) from January to December, and then air dried. Total poly-phenols were extracted with acetone, using Folin-Ciaocal-teau reagents and analyzed in a spectrophotometer. Total polyphenols showed definite seasonal variation with the lowest concentrations in March (11.8 mg/g), April (10.8 mg/g) and September (10.8 mg/g), while the highest concentrations were in June (35.5 mg/g) and July (35.9 mg/g) (Mudau *et al*. 2006). These results suggest that the ideal time for harvesting wild bush tea is during winter followed by summer season which contradicts with the way in which people traditionally perceive to be the time to harvest bush tea. Another study on seasonal nutritional requirements of bush tea was investigated (Mudau *et al*. 2005) using single applications of N, P or K, one per season (autumn, winter, spring and summer). Treatments consisted of 0, 100, 200, 300, 400, or 500 kg/ha N, P or K. Results of this study demonstrated that in all trials, regardless of season, N, P or K nutrition increased bush tea fresh and dry shoot mass, plant height, number of leaves, number of branches and leaf area, and that the optimum growth of bush tea was at 300 kg/ha N or P and 200 kg/ha of K. Results from the N trial indicated that the concentration of total polyphenols increased in response to N nutrition during all seasons, with the highest concentration being 51.1 mg/g in winter. For the P trial, total polyphenols increased in response to P nutrition regardless of season. Again, the highest concentration of total polyphenols (46.8 mg/g) was observed in winter with the optimum P level being 300 kg/ha. In the K trial, regardless of season, total concentration of polyphenols reached a maximum at 400 kg/ha with most of the total polyphenols occurring between 0 and 200 kg/ha. Therefore, for improved concentration of total polyphenols, 300 kg/ha N and P and 200 kg/ha K are recommended (Mudau *et al*. 2006, 2007a, 2007b).

Another trial to investigate the treatment combinations of N, P and K nutrition on growth and chemical composition of bush tea was conducted using a three by three factorial arrangement (Mudau *et al*. 2006). The parameters recorded were plant height, number of branches and leaves, fresh and dry stem mass, fresh and dry root mass, stem girth, fresh and dry shoot mass, leaf area and concentrations of leaf and root tissue N, P, K and total polyphenols. The results of this study demonstrated that regardless of season, treatment combinations of N300, P300 and K200 (kg/ha) increased fresh and dry shoot mass, number of leaves, leaf area as well as the concentrations of total poly-phenols in bush tea, confirming the maximum application hypothesized in single fertilizer trials (Mudau *et al*. 2005).

Experiments to determine the effects of N, P and K application on tannin concentration across seasons in bush tea grown under a 50% shaded nursery environment were initiated by Chabeli *et al*. (2006). For the N trial, both condensed and hydrolysable tannins increased when N was applied at 300 kg/ha, regardless of the season. The peak value of condensed tannins was observed during autumn and winter (4.5% in both seasons), whereas the highest concentration of hydrolysable tannins was obtained during spring and summer (0.060% and 0.050%, respectively). Condensed and hydrolysable tannins increased in response to P nutrition, regardless of the season. The highest concentration of condensed (5.0%) and hydrolysable (0.020%) tannins was during summer. For the K trial, tannins increased quadratically reaching maximum concentrations when K was applied at 200 kg/ha regardless of the season. The peak values of condensed tannins were obtained during autumn (4.9%) and winter (5.0%). The highest concentrations of hydrolysable tannins were obtained during summer (0.041%). In a separate study to determine the seasonal variation in the concentration of tannins in wild bush tea, Mudau *et al*. (2007c) found that the highest concentrations of condensed tannins were during autumn (4.82%) compared to winter (2.44%), spring (2.66%) and summer (3.04%). The hydrolysable tannins were the lowest during winter (0.10%) compared to autumn and summer (0.14%) and spring (0.13%).

Mogotlane *et al*. (2007) reported that the application of N, P and K fertilizers increased total antioxidant content with most of the increase occurring at 0-300N, 300P and 100 K kg/ha regardless of season. Araya (2005) conducted propagation studies with *A*. *phylicoides* and established that propagation using apical cutting with 2 to 3 leaves was possible with the application of 0.3% IBA (indole-3-butyric acid; Seradix® No. 2) and 0.1% IBA (Seradix® No.1), respectively. The same researcher reported a higher survival percentage of plants generated from apical cuttings relative to those from basal cuttings. In the same study, bush tea seeds achieved germination rates of up to 75% at 20 to 25°C under continuous light.

CONCLUSIONS AND FUTURE RECOMMENDATIONS

The herbal value of bush tea has always been realized in South Africa and has been documented for Limpopo and KwaZulu-Natal Provinces. Commercialization of bush tea is unlikely to be viable if the product is solely harvested from the wild. However, for commercialization of bush tea in similar vein with that of rooibos and honeybush tea, future trials should be conducted on agronomic practices, bioacti-vity and processing techniques. Only bush tea grown on a large scale will guarantee both availability of the plant with consistency in quality. These will contribute to the economy and creation of employment opportunities in rural areas especially in Limpopo and KwaZulu-Natal Provinces. The people of South Africa are health conscious and there are already many herbal teas on the market in South Africa such as honey bush and rooibos. Therefore, with careful marketing considerations, it should not be too difficult to get a sizeable niche for the "home garden" bush tea. The foregoing suggests that in terms of quality attributes and current usage, bush tea has an enormous potential to be developed as a commercial product. However, lots of developmental research work still needs to be done.

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