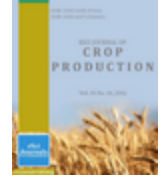




Available Online at ESci Journals  
**ESci Journal of Crop Production**

ISSN: 2305-2627 (Online), 2306-4064 (Print)  
<http://www.escijournals.net/EJCP>



---

## **BUSH TEA (*ATHRIXIA PHYLIKOIDES* DC.) SUCCESS STORIES IN SOUTH AFRICA A REVIEW**

**<sup>a</sup>Nchabeleng Lehlohonolo, <sup>b</sup>Irvine K. Mariga, <sup>a</sup>Wonder Ngezimana, <sup>a</sup>Fhatuwani N. Mudau**

<sup>a</sup> *Department of Agriculture and Animal Health, College of Agriculture and Environmental Sciences, University of South Africa, Florida, South Africa.*

<sup>b</sup> *School of Agriculture and Environmental Science, University of Limpopo, Sovenga, South Africa.*

---

### **ABSTRACT**

Wide range of new consumers in Africa could be provided new herbal teas with the recent regionalization and globalization of foods, beverages and natural products. It is evident that bush tea has a potential to be used commercially as a herbal beverage because it has been harvested for generations by rural communities as a tea, a medicine, as well as to make brooms. Surveys have shown that the consumption of bush tea is widespread and commercialization of the extracts holds economic and developmental potentials. Bush tea leaves contain 5 hydroxy-6, 7, 8, 3', 4', 5'-hexamethoxyflavon-3-ol which is possibly responsible for bioactivity in the plants. There are also reports on the potential for development of bush tea as a healthy beverage alternative to caffeine-containing tea. This review puts together research conducted on different aspects of bush tea (*Athrixia phylicoides*) in South Africa, showing what is known about its potential as a herbal beverage, its other wide uses, and what further research may be needed for commercialization.

**Keywords:** Bush tea, commercial potential, healthy beverage.

---

### **INTRODUCTION**

This review puts together research conducted on different aspects of bush tea (*Athrixia phylicoides*) in South Africa, thus showing what is known about its potential as a herbal beverage, its other wide uses, and what further research may be needed for bush tea to be commercialized. According to Van Wyk and Gericke (2000), the genus *Athrixia* comprises of 14 species found in Southern Africa, tropical Africa and Madagascar. Nine of these species are found in South Africa (Leistner, 2000) and they are not harvested from the wild. However, most research work has focused on the indigenous specie *Athrixia phylicoides* because of the potential benefits that it offers mostly derived from its traditional uses and no reports in the African countries as well as other parts of the world have been exploited with the aim of domesticating the plant.

South Africa has a rich heritage of commercialized

herbal teas such as honeybush (*Cylophia* species) and rooibos (*Aspalathus* species) tea despite the agronomic challenges that the industry is facing in South Africa. The challenges include lack of understanding judicious agronomic practices as well as yield build up over time. The lack of understanding of these challenges has a posses risk to investors due to lack of understanding operations expenses and capital expenditure.

Therefore, the current review reports the work that has been carried out in South Africa with the efforts to commercialize the bush tea as a medicinal and herbal tea.

**Characteristics, distribution and uses:** In Africa, many plant products have been used over the centuries as herbal teas, and as popular local drinks. They have also been used as refreshing beverages and for their perceived health and medicinal attributes (Juliani *et al.*, 2009). With the regionalization and globalization of foods, beverages and natural products, the introduction of new drinks such as African teas into other countries and even regions in Africa can provide new herbal teas

---

\* Corresponding Author:

Email ID: [mudaufn@unisa.ac.za](mailto:mudaufn@unisa.ac.za)

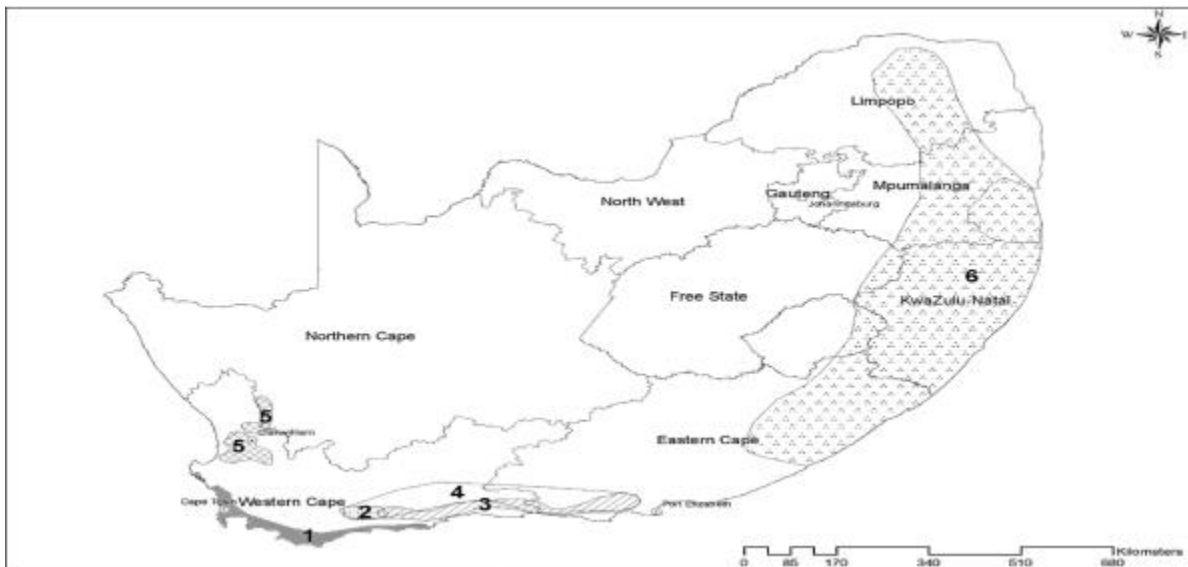
© 2012 eSci Journals Publishing. All rights reserved.

to a wide range of new consumers (Juliani *et al.*, 2009). Bush tea is a herbaceous plant of the Asteraceae family. The genus name *Athrixia* belongs to the Asteraceae family (Herman *et al.*, 2000) and it is derived from the Greek word thrix meaning hair, which refers to the leaves. The specific epithet *phylicoides* means it resembles *Phylica* (Mbambezi, 2005).

*A. phylicoides* is a popular aromatic indigenous plant to South Africa and it has been used for many decades as a health beverage and medicine by indigenous people. It is commonly known as Mohlahlaishi (Pedi), Mutshatshaila (Venda), bushman's tea (English), Boesmans tee (Afrikaans) and Umtshanelo, Icholocholo, Itshelo (Zulu), and Luphephetse (Swati). This plant can grow up to 1 m in height. White woolly stems with oval or lance-shaped leaves characterize this plant. The best flowering time for *A. phylicoides* is from March to May, but it can flower throughout the year depending on the climatic and edaphic factors (Mbambezi, 2005) and needs well-drained soils with full sunlight and enough

space for spreading their branches. Roberts (1990) reported that the bush tea plant needs well-drained soils with full sunlight and enough space for spreading their branches. *A. phylicoides* leaves have margins entirely or slightly revolute (Herman *et al.*, 2000). The leaves also have long-pointed tips, spreading or hooked backward with flowers normally purple, pink expanded portions (Herman *et al.*, 2000, Van Wyk and Gericke, 2000).

Bush tea in South Africa can be found at different locations of varying altitudes characterized by hot summers. It is commonly found in open grassland, bushveld, rocky, sloping habitats and thick forest margins of South Africa (Mbambezi, 2005). It is widely distributed in the eastern part of South Africa (Rampedi and Olivier, 2005), from the Soutpansberg Mountains in Limpopo, including Mpumalanga, to Queenstown, King William's Town and East London and throughout KwaZulu-Natal from the coast to the Drakensberg Mountains (Figure. 1) (Herman *et al.*, 2000; Rampedi and Olivier, 2005).



**Figure 1:** Production area of *Aspalathus linearis* and natural distribution of *Cyclopiya* species and *Athrixia phylicoides*. Key: (1) *Cyclopiya genistoides*; (2) *Cyclopiya sessiliflora*; (3) *Cyclopiya subternata*; (4) *Cyclopiya intermedia*; (5) *Aspalathus linearis*; (6) *Athrixia phylicoides* (Rampedi and Olivier, 2005).

It is evident that bush tea has a potential to be used commercially as a herbal beverage because it has been harvested for generations by rural communities for use as a tea and a medicine as well as to make brooms (Rampedi and Olivier, 2005). Surveys have further shown that the consumption of bush tea is widespread and commercialization of the extracts holds economic and developmental potential (Chellan *et al.*, 2008). It is

used for various purposes in various communities. Traditional Zulu people use it as a cough remedy and purgative and traditional Venda people also use bush tea plant for aphrodisiac purposes (Mashimbye *et al.*, 2006; Mabogo, 1990) and its extracts from soaked roots and leaves as anthelmintics (Mbambezi, 2005). Bush tea is used for cleansing or purifying the blood, treating boils, headaches, infested wounds and cuts (Roberts, 1990;

Joubert *et al.*, 2008). Bush tea is also used as a treatment for acne (Joubert *et al.*, 2008), lotion on boils or skin eruptions and loss of voice. Aside from its horticultural potential, this plant also has traditional economic uses. The Bushman used to make tea from the leaves of bush tea. Sotho and Xhosa people also chewed it to alleviate symptoms of sore throats, colds, coughs, for loss of voice and for infested throats as a gargle (Roberts, 1990; Mbambezeli, 2005).

This beautiful plant may be used as a filler plant in the open spaces in flowerbeds, though it works well as a specimen plant in the garden (Mbambezeli, 2005). The dried leaves and fine twigs of *A. phyllicoides* have traditionally been used by the Khoi and Zulu people as a herbal tea and medicinal decoction (Van Wyk and Gericke, 2000).

#### **RESEARCH DONE ON BUSH TEA (*A. phyllicoides*) in South Africa**

**Bush tea health benefits and growth:** Mudau *et al.* (2007b) reported the potential for development of bush tea as a healthy beverage alternative to caffeine-containing tea. Bush tea leaves contain 5 hydroxy-6, 7, 8, 3', 4', 5'-hexamethoxy flavon-3-ol which is possibly responsible for bioactivity in the plants (Mashimbye *et al.*, 2006). It has no phytotoxicity (McGaw *et al.*, 2007). Aqueous extracts from bush tea were reported to stimulate *in vitro* glucose uptake and metabolism in an insulin-mimetic manner, thus suggesting that the extraction could have a potential benefit to type two diabetic people as an adjunct therapy (Chellan *et al.*, 2011). The essential oil displayed anti-inflammatory activity (IC<sub>50</sub> = 25.68 µg/ml). Low safety indices were reported for both the methanol extract (SI = 2.28) and essential oil (SI = 1.77). The *in vitro* biological activities may validate the use of *A. phyllicoides* in traditional medicine (Padayachee, 2011).

A trial to determine the quality of tea harvested at various phenological stages (namely new growth, older growth and whole plants) from wild and cultivated bush tea was conducted by Maudu *et al.* (2012). This was to determine the best phenological stage to harvest bush tea of best quality for health benefits. In cultivated bush tea, harvested new growth and whole plants produced higher quality beverage owing to their higher polyphenol and tannin attributes, respectively. In wild bush tea, both new and older growth showed higher quality due to their higher total polyphenol content and

higher total antioxidants, respectively (Maudu *et al.*, 2012).

**Propagation, growth medium, growth hormones, pruning and germination in bush tea:** Germination of bush tea seeds was reported to be highest (75.5%) at 20 and 25°C, followed by 64.5% at 15°C and lowest (47%) at 30 and 10°C (Araya, 2005). Germination percentage was further reported to be higher with continuous light than with alternate light (Araya, 2005). Propagation of this tea is commonly by mature seeds, which are mostly collected at the end of summer (Roberts, 1990). Better vegetative propagation and survival of bush tea can be attained from apical cuttings with Seradix No 2 hormone (Araya, 2005). The authors demonstrated successful nursery propagation of bush tea using Seradix No 2 hormone under net shading. This method seems capable of generating planting material for field scale production of bush tea. There is still need to test rapid propagation through tissue culture using leaf discs. Pruning largely led to crop losses in bush tea plants whereas unpruned bush tea plants remained the tallest plants, with higher number of branches, bigger leaf area and a larger biomass than apically pruned, middle pruned and base pruned bush tea plants (Maudu *et al.*, 2010). Pruning at different heights also proved to have little or no effect on quality of bush tea. While only total polyphenols remained higher in unpruned tea plants, no significant differences were observed in tannin and total antioxidant content in unpruned, apically pruned and middle pruned tea plants (Maudu *et al.*, 2010). The effects of pruning on the long-term productivity of bush tea, both yield and quality, remain unexplored. There is also need to investigate when to prune and desirable pruning cycles for bush tea.

The effect of gibberellins on sprouting of cuttings and quality of bush tea was determined. Results of the study by Maudu *et al.* (2011) showed favourable response of bush tea growth to increased rates of gibberellin application. For growth parameters such as plant height, number of branches, leaf area and fresh biomass, best results were recorded at 3 and 4% gibberellin application rates. Chemical attributes in the form of total polyphenols, and total antioxidants declined with increasing gibberellin application rate. However, tannin content peaked at 2% gibberellin application rate. Overall, gibberellin application improved bush tea growth and chemical attributes (Maudu *et al.*, 2011).

**Climatic, mineral nutrition and seasonal effects on bush tea:**

Total polyphenols in bush tea leaves increased quadratically regardless of the season (Mudau *et al.*, 2007a). Increase in growth and productivity of bush tea leaves was further reported to occur due to phosphorus application of 0 to 300 kg ha<sup>-1</sup> (Mudau *et al.*, 2007b). Concentration of total polyphenols in leaves of wild bush tea plants were lowest in March (11.8 mg/ g), April (10.8 mg/ g) and September (10.8 mg/g) but highest in June (35.5 mg/ g) and July (35.9 mg/ g) (Mudau *et al.*, 2006; Mudau *et al.*, 2007c). These results suggest that premium quality bush tea can be harvested in winter. Regardless of season, N, P and K nutrition increased bush tea fresh and dry shoot mass, plant height, number of leaves, number of branches and leaf area (Mudau *et al.*, 2007c). For P trials, the highest total antioxidant contents were reported to be 100 % for autumn, winter and spring and 93 % during summer (Mogotlane *et al.*, 2007), thus showing little variation due to seasonal conditions. Maximum total antioxidant content was 83 % during autumn, 100 % during winter and spring and 63 % during summer when K was applied at 0-100 kg ha<sup>-1</sup> (Mogotlane *et al.*, 2007). These responses of bush tea to macronutrients need to be refined with their combination with essential micronutrients (Mogotlane *et al.*, 2007). Addition of N fertilizer supplements resulted in significantly increased concentrations of total polyphenols in bush tea leaves in all seasons with the most prominent increase evident at application rates of 0 to 100 kg ha<sup>-1</sup> in a shaded nursery (Mogotlane *et al.*, 2007). The amount of total antioxidants in bush tea leaves was reported to be highest at 300 N & P, 100 K kg ha<sup>-1</sup> (Mogotlane *et al.*, 2007). Mogotlane *et al.* (2007) further reported the total antioxidant contents of bush tea to be decreased by the higher N fertilizers between 300-500 kg/ha N. It was concluded that the most suitable conditions for cultivating bush tea to obtain plants with optimal leaf polyphenol content were those of reduced light intensity during winter with nitrogen application below 300 kg ha<sup>-1</sup> (Mudau *et al.*, 2006).

Cool weather conditions were reported to maximize tannin contents of bush tea (Mudau *et al.*, 2007a). Roberts (1990) also reported vigorous shoots in bush tea leaves when plants were exposed to lower (24°C) temperatures during winter and higher (38°C) during summer. Rakuambo (2007) reported bush tea general growth to be higher during autumn and winter than in summer and spring. A greater number of shoots, roots

and stems were further recorded in plants grown in sand than in pine park growth media 90 days after planting, however, with no significant difference 180 days after planting (Rakuambo, 2007). The amount of total antioxidant content remained the same in 8 locations of the Limpopo and Mpumalanga provinces of South Africa at 35 µmol/ g with a positive correlation observed between total polyphenol content and altitude (Nchabeleng *et al.*, 2012) However, rainfall, temperature, soil macro elements and soil pH did not have any effects on total polyphenol, total tannin and total antioxidant contents respectively (Nchabeleng *et al.*, 2012). Maximum polyphenol content (7.7 mg/100 g) was recorded in bush tea samples from Haenertsburg, whereas the lowest content (3.6 mg/100 g) was recorded in Levubu. The highest polyphenol content was reached at the higher altitude of 1410 m in Haenertsburg. Tannin content was the lowest (0.05 mg/100 g) in Khalavha at altitude of 892 m (Nchabeleng *et al.*, 2012).

**Bush tea utilization:** A study by Hlahla *et al.* (2010) revealed that fermentation temperature and time had no significant influence on the anti-oxidant content, with an increase in fermentation temperature resulting in an increase in polyphenol contents and a decrease in tannin contents. Hlahla *et al.* (2010) further reported that increased fermentation time, resulted in an increase in both polyphenol and tannin contents respectively. However, this study did not include sensory quality parameters. Negukhula *et al.*, (2011) tested the effects of soaking conditions on total polyphenolic content and antioxidant activity of black tea and black tea combined with bush tea on a 50:50 basis. Their results showed that in black tea, total polyphenols, antioxidant activity and tannin content decreased with decrease in temperature and increase in time. Combining the two teas resulted in a significant decrease in total poly phenols, antioxidant activity and tannin content. They recommended that both black tea and the 50:50 blend of the two teas should be brewed for three minutes at 90°C to obtain the highest total polyphenols and antioxidant activity. There is still need to test other ratios of black tea: bush tea to explore possibilities for enhancement of the quality of the end product. Health quality of bush tea or its variants needs to be compared to that of the other herbal teas already on the South African market.

**Shade effects on tea:** Shade tree selection and management are potentially important tools for

integrated pest management but are dependent upon site conditions (soil/climate), component selection (species/varieties/provenances), belowground and aboveground characteristics of the trees and crops and management practices. Increased shade may increase the incidence of some commercially important pests and diseases (such as *Phytophthora palmivora* and *Mycena citricolor*) and decrease the incidence of others (such as *Colletotrichum gloeosporioides* and *Cercospora coffeicola*) (Beer *et al.*, 1997). Tea grown under artificial shade produced black tea with higher theaflavin and reduced thearubigin concentrations and with a better flavour index and tasters' evaluation than did tea grown without shade. This postulates that the removal of shade from tea gardens leads to a loss in quality (Owuor *et al.*, 1988). The reduction in yield from increasing shade was as great in rows near to the shade trees as in rows most distant from them. Tea quality was also adversely affected (McCulloch, 1965).

An investigation on the metabolome changes in green tea and shade cultured green tea was initiated by Kang *et al.* (2010). The antioxidant activity of green tea samples were significantly correlated with their total phenol and total flavonoid contents. Results from this study delineate the possibility to get high umami and less astringent green teas in shade culture (Kang *et al.*, 2010). Shading defines the character of the tea by reducing the photosynthesis process and so increasing the chlorophyll content. The leaves become dark green and the tannin content is reduced, that is why you will experience a sweeter flavour, instead of the astringent taste common among green teas. Your beverage will also have a higher amount of theanine (Juneja *et al.*, 1999). Generally, shade-grown teas will have higher levels of caffeine than other teas. This phenomenon has to do with a shift in chlorophyll and other chemicals that occurs when netting is used to shade the leaves from sun in the days or weeks prior to harvest (Goodwin, 2012).

#### CONCLUSION

Surveys have shown that the consumption of bush tea is widespread and commercialization of the extracts holds economic and developmental potential (Chellan *et al.*, 2008). However, for bush tea to be commercially viable, its uses and properties must either outcompete or complement teas (*Camellia sinensis*, rooibos tea from *Aspalathus linearis* and honeybush tea from *Cyclopia intermedia*) already on the market. It is widely used as a traditional remedy, but despite its substantial use,

literature on its chemical composition and biological activities is limited. However, further research is required to improve and refine preparation methods and to ensure compliance with quality standards. In this regard research on possibilities of blending bush tea with the other local herbal teas is necessary and sensory parameters must be included in the evaluations. The availability of sufficient plant material for the industry must also be ensured; hence the need for long-term field studies to explore commercial management of bush tea is required. A research has indicated that South African indigenous plants have untapped market potential for the beverage industry which, if developed sustainably, could contribute to economic growth of the rural parts of South Africa. Thus research of bush tea grown in marginal environment such as shading effect of bush tea on ecophysiological conditions, growth and quality of bush tea is being investigated.

#### REFERENCES

- Araya, HT. 2005. Seed germination and vegetative propagation of bush tea (*Athrixia phylicoides*). MSc dissertation. University of Pretoria, Pretoria, South Africa.
- Beer, J; R. Muschler; D. Kass, & E. Somarriba. 1997. Shade management in coffee and cacao plantations. *Biomedical and Life Sciences* 38, 139- 164.
- Chellan, N. 2011. The antidiabetix and antioxidant properties of *Athrixia. phylicoides* acqueous extract: an in- vitro and ex-vivo assessment. MSc Thesis. University of Stellenbosch, Stellenbosch, South Africa.
- Chellan, N; D. De Beer; C. Muller; E. Joubert, & J. Louw. 2008. A toxicological assessment of *Athrixia phylicoides* aqueous extract following sub-chronic ingestion in a rat model. *Human and Experimental Toxicology* 2, 819- 825.
- Goodwin, L. 2012. Factors influencing caffeine levels in tea. [www.About.com](http://www.About.com) (Accessed on 25 March 2013).
- Herman, PP; J. Retief; E. Koekemoer, & WG. Welman. 2000. *Seed Plants of Southern Africa*: O. A. Leister Editions. National Botanical Institute, Pretoria, South Africa.
- Hlahla, LN; FN. Mudau, & IK. Mariga. 2010. Effect of fermentation temperature and time on chemical composition of bush tea (*Athrixia phylicoides* DC.). *Journal of Medicinal Plants Research* 4, 824-829.
- Joubert, E; WCA. Gelderblom; A. Louw, & D. De Beer.

2008. *Aspalathus linearis*, *Cyclopia* spp and *Athrixia phylicoides* - A review. *Journal of Ethnopharmacology* 119, 367-412.
- Juliani, HR; Y. Koelliker; M. Bucuk; C. Welch; B. Tepper; E. Jefthas, & JE. Simon. 2009. Quality and consumer studies in the USA of African herbal teas for the natural product industry development in Sub-Saharan Africa. *African Nat. Plant Prod: New Discoveries and Challenges in Chemistry and Quality* 23, 403-420.
- Juneja, LR; C. Djong-Chi; T. Okubo; Y. Nagato, & H. Yokogoshi. 1999. L-theanine—a unique amino acid of green tea and its relaxation effect in humans. *Trends in Food Science and Technology* 10, 199-204.
- Kang, MK; NC. Jung; K. Jiyong; KK. Jeong; GY. Lang; JL. Sang; YS. Hong, & HL. Choong. 2010. Metabolomics analysis reveals compositional differences of shade grown tea (*Camellia sinensis* L.). *Journal of Agriculture and Food Chemistry* 58, 418-426.
- Leistner, OA. 2000. Seeds plants of southern Africa: families and genera. *Strelitzia*, 10. *National Botanical Institute*, Pretoria, pp 125.
- Mabogo, DNE. 1990. The Ethnobotany of Vhavenda. MSc Thesis: University of Pretoria. Pretoria, South Africa.
- Mashimbye, MJ; FN. Mudau; T. Van Ree, & P. Soundy. 2006. A new flavonol from *Athrixia phylicoides* (Bush tea). *South African Journal of Chemistry* 59, 1-2.
- Maudu, ME; FN. Mudau, & IK. Mariga. 2012. Quality profiles of cultivated and wild bush tea (*Athrixia phylicoides* D.C.) at various phenological stages. *International Journal of Biology, Agriculture and Botany* 14, 552-556.
- Maudu, ME; FN. Mudau, & IK. Mariga. 2011. The effects of gibberellins on sprouting of cuttings and quality of bush tea. *Asian Journal of Biotechnology* 10, 8741-8745.
- Maudu, M; FN. Mudau, & IK. Mariga. 2010. The effect of pruning on growth and chemical composition of cultivated bush tea (*Athrixia phylicoides* D.C.). *Journal of Medicinal Plant Research* 4, 2353-2358.
- Mbambezeli, G. 2005. Distribution and habitat of *Athrixia phylicoides*. Internet: <http://www.plantzafrica.com>. (Accessed on 25 March 2013).
- McGaw, LJ; V. Steenkamp, & JN. Ellof. 2007. Evaluation of *Athrixia* bush tea for cytotoxicity, antioxidant activity, caffeine content and presence of pyrrolizidine. *Journal of Ethnopharmacology* 11, 16-22.
- McCullosh, JS; HC. Pereir; O. Kerfoot, & NA. Goodchild. 1965. Effects of shade trees on tea yields. *Agriculture Meteorology* 2, 385-399.
- Mogotlane, ID; FN. Mudau; PW. Mashela, & P. Soundy. 2007. Seasonal responses of total antioxidant contents in cultivated bush tea (*Athrixia phylicoides* L.) leaves to fertilizer rates. *Medicinal and Aromatic Plant Science and Biotechnology* 1, 77-79.
- Mudau, FN ; ES. Du Toit, & P. Soundy. 2007a. Seasonal variation of tannin content in wild bush tea. *Medicinal and Aromatic Plant Science and Biotechnology* 1, 74-76.
- Mudau, FN; HT. Araya; ES. Du Toit; P. Soundy & J. Olivier. 2007b. Bush tea (*Athrixia phylicoides* DC) as an alternative herbal and medicinal plant in South Africa: Opportunity for commercialization of bush tea. *Medicinal and Aromatic Plant Science and Biotechnology* 1, 70- 73.
- Mudau, FN; P. Soundy, & ES. Du Toit. 2007c. Effects of nitrogen, phosphorus and potassium on total polyphenol content of bush tea (*Athrixia phylicoides* L.) leaves in shaded nursery environment. *Horticultural Science* 42, 1-5.
- Mudau, FN; J. Olivier; P. Soundy, & ES. Du Toit. 2006. Variation in polyphenolic content of *Athrixia phylicoides* L. (bush tea) leaves with season and nitrogen application. *South African Journal of Botany* 71, 398-402.
- Nchabeleng, L; FN. Mudau, & IK. Mariga. 2012. Effects of chemical composition of wild bush tea (*Athrixia phylicoides* DC.) growing at locations differing in altitude, climate and edaphic factors. *Journal of Medicinal Plant Research* 6, 1662-1666.
- Negukhula, S; FN. Mudau; IK. Mariga, & KB. Liphadzi. 2011. Effects of soaking conditions on total phenolic and antioxidant activity of black tea and black tea combined (50:50) with bush tea. *International Journal of Horticulture* 68, 91-95.
- Owuor, PO; CO. Othieno; GE. Howard; JM. Robinson, & RD. Cooke. 1988. Studies on the use of shade in tea plantations in Kenya: Effects on chemical

- composition and quality of made tea. *Journal of Science, Food and Agriculture* 46, 67-70.
- Padayachee, K. 2011. The phytochemistry and biological activities of *Athrixia phylicoides*. MSc Dissertation. University of Witwatersrand, Johannesburg, South Africa.
- Rakuambo, JZ. 2007. Indigenous knowledge of bush tea (*Athrixia phylicoides*) and effect of fertigation and growing medium on plant growth. MSc Dissertation. University of Pretoria, Pretoria, South Africa.
- Rampedi, IT & J. Olivier. 2005. The use and potential commercial development of *Athrixia phylicoides*. *Acta Academia* 37, 165-183.
- Roberts, M.1990. Indigenous healing plants. First Edition. Southern book publishers: Halfway house.
- Van Wyk, B-E & N. Gericke. (2000) People's plants. A guide to useful plants of South Africa (1<sup>st</sup> edition), Briza Publication, Pretoria: South Africa.