

## Research Article

# Plants Used by Bapedi Traditional Healers to Treat Asthma and Related Symptoms in Limpopo Province, South Africa

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To the best of our knowledge there are presently no ethnobotanical surveys focusing on the utilisation of herbal remedies for asthma in South Africa. The present study is therefore an attempt to fill this gap in knowledge. A total of 140 Bapedi traditional healers (THs) practicing in the Capricorn, Sekhukhune, and Waterberg districts of the Limpopo Province (South Africa) were queried using semistructured questionnaires, supplemented by field observations during face-to-face interview. A total of 104 medicinal plant species (92 indigenous and 12 exotics) belonging to 92 genera, distributed across 54 botanical families, mostly the Asteraceae and Fabaceae (18.5%, for each) as well as Malvaceae (12.9%), were used as antiasthmatics and related symptoms by these THs. Most of the plants were trees and herbs (37.5%, for each), with root (57%), leaf (15.8%), and bark (7.5%), respectively, being the saliently used parts for preparation of remedies. *Clerodendrum ternatum*, *Cryptocarya transvaalensis*, *Lasiosiphon caffer*, *Enicostema axillare*, *Mimusops obovata*, *Sclerocarya birrea*, and *Stylochaeton natalensis* were widely used and valued by all THs across the surveyed districts. Furthermore, these taxa also scored both the highest use value and fidelity level indexes as asthma therapies. Overall, the larger number of species documented in the present study is recorded for the first time in literature as asthma and/or related symptoms remedies. Our study finding generally contributes towards an establishment of South African database of herbal therapies used traditionally against these conditions.

## 1. Introduction

Asthma is a chronic lung disease that inflames and narrows the airways, affecting people of all ethnic groups worldwide [1]. Its symptoms include amongst others intermittent attacks of wheeze, cough, breathlessness with variable airway obstruction, chest tightness, and cough that occurs more at night and or early in the morning [2]. In 2008 at least three hundred million people worldwide were diagnosed with asthma and over 250,000 asthma-related annual deaths were reported [3].

Despite the above statistics, asthma continues to be a major world problem affecting people in various countries of the world including Australia [4], India [5], Jamaica [6], and Norway [7]. Health impact of this condition is also

common in Africa, and studies conducted in Algeria [8], Nigeria [2], Uganda [9], and Zambia [10], amongst other countries, highlighted this. Asthma impact is also prevalent in South Africa. According to the recent report by the Global Initiative for Asthma, this country has the world's fourth highest asthma death rate amongst people aged five to 34 years [11]. Furthermore, of an estimated 3.9 million South Africans diagnosed with asthma, 1.5% die of this condition annually [12].

Treatment of asthma is focused on ad hoc treatment of acute exacerbations including lifestyle factors and prevention of exacerbations [13]. There are a number of top medications such as short or long acting beta<sub>2</sub> agonist (preferably by inhalation) and inhaled steroid that an asthmatic patient can receive during exacerbations [3]. Supplementary medications

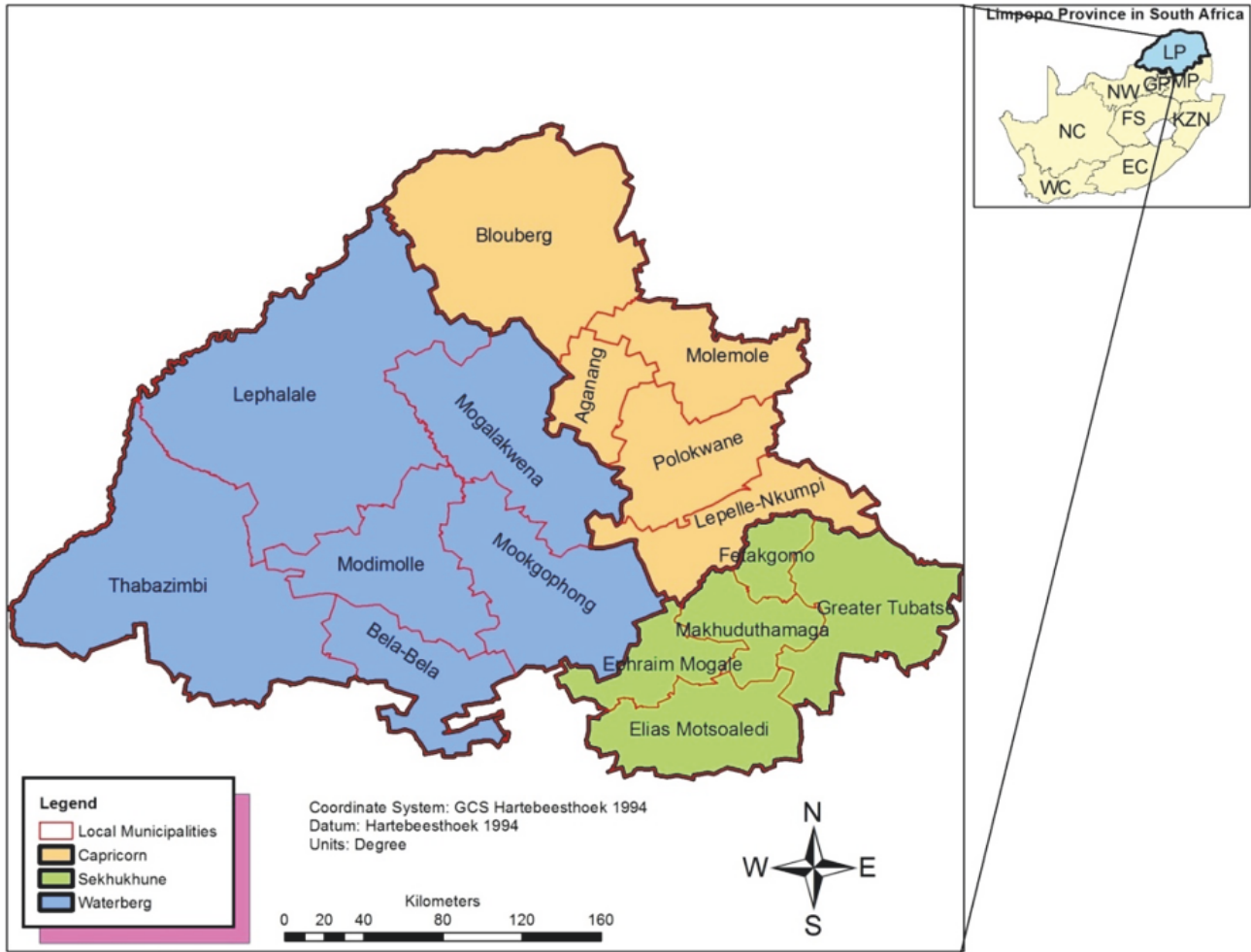


FIGURE 1: Map of Limpopo Province indicating the studied areas (districts and municipalities).

for asthma sufferers include leukotriene receptor antagonists and theophylline or slow release beta<sub>2</sub> agonist tablets [14]. However, these therapies are often limited and/or not affordable to a common man residing in most developing countries particularly in Africa [15, 16]. Consequently, asthma sufferers in these countries resort to locally available traditional healers (THs) who prescribe affordable herbal remedies.

There are extremely few ethnobotanical surveys reporting on the use of medicinal plants by indigenous people including THs as treatments of asthma and related symptoms in Africa as a continent. To the best of our knowledge the only studies that focused on this subject were conducted in Cameroon [17] and Nigeria [18]. However, general ethnobotanical studies carried out in other African countries, to name a few, Uganda [19], Kenya [20], Lesotho [21], and Botswana [22], highlighted that THs of other cultures do treat asthma and related conditions. South Africa is no exclusion and studies by Hutchings [23], Thring and Weitz [24], De Beer and Van Wyk [25], York et al. [26], and Bhat [27] also emphasised this. The present study therefore will be the first in South Africa to exclusively focus on ethnobotanical knowledge and practices of plants implicated in the treatment of these conditions.

## 2. Methodology

**2.1. Study Area and Population.** This study was carried out in the three districts (Capricorn, Sekhukhune, and Waterberg) of the Limpopo Province and associated municipalities (Figure 1).

A total of five rural villages from each municipality were chosen as study sites. In general, all these settlements are economically and socially marginalized [28]. Therefore, there is inadequate infrastructure, high unemployment, and dependency on natural resources amongst the people to support their livelihoods [28]. Furthermore, larger number of people still rely heavily on traditional methods of health care for treatment of various ailments [29]; thus THs and their services play an important role in the wellbeing of people. The Bapedi tribe who speak Sepedi language is the dominant ethnic group inhabiting the studied districts, representing more than 50% of the total population [30].

**2.2. Ethnobotanical Survey and Data Collection.** A reconnaissance study was firstly carried out in each selected village to (i) request permission from local tribal leaders to conduct

this study within their areas of governance and (ii) ask THs who were conveniently (i.e., with the help of local leaders and healers) selected to participate in the survey. Both traditional leaders and healers were enlightened about the nature of the project including aim and objectives, using their mother tongue of Sepedi. Consequently, THs who agreed to take part in this study were requested to sign a consent form.

Data was collected from May 2017 to October 2017 using a semistructured interview with 140 THs during face-to-face interviews, supplemented by field trips for participant's observation and specimen collections. The questionnaire was designed to capture information on (i) local names of the plants used by Bapedi THs to manage asthma; (ii) plant parts used; (iii) state/s of used plant part; and (iv) mode/s of preparation and administration of remedies. Overall, THs were questioned independently in their consultation rooms using Sepedi dialect.

Field excursions for medicinal plant species identification and collection were conducted with the assistance of each questioned traditional healer. During these trips THs initially identified the species via vernacular names. Subsequently, voucher specimens were collected, prepared, and deposited at the Larry Leach Herbarium (University of Limpopo), wherein a scientific name of plant species was established by a trained taxonomist.

### 2.3. Data Analysis

**2.3.1. Microsoft Excel and Statistical Package for the Social Sciences (SPSS).** The data collected in this study were analysed using Microsoft Excel 2000 and SPSS version 14.0. Descriptive statistics using frequencies and cross-tabulations were utilised in constructing tables showing the commonly used plant species by THs, local names of the plants used for asthma and related conditions, plant parts used and state/s of their usage, modes of preparation, and remedy administration.

**2.3.2. Fidelity Level (FL).** The FL as described by Al-Quran [31] were used to determine the uniformity of plant utilisation amongst the questioned THs. Analysis of FL of each plant species mentioned by Bapedi THs as a treatment of asthma and related symptom followed the formula displayed below:

$$FL (\%) = \frac{NP}{N} \times 100, \quad (1)$$

where  $Np$  was the number of THs who claim the use of a particular plant species to treat asthma or related symptom and  $N$  was the total number of THs who mentioned the use of species as a medicine to treat any given ailment/s (asthma or related symptom). Fidelity level expresses the preference a species is given over others in the management of a particular ailment [32].

**2.3.3. Use Value (UV).** Use values are calculated for an individual plant, in order to objectively give a quantitative measure of its relative importance to the informants [33]. Therefore, the extent of utilisation of each species used therapeutically by Bapedi THs for asthma and related symptoms

was determined via UV, following Phillips and Gentry [33] index:

$$UV = \sum \frac{U}{N} \quad (2)$$

From the above formulation,  $U$  was the number of curative applications of each species, where  $N$  represented the total number of THs. Generally plant with broad therapeutic uses or those that are highly accepted as cure of a particular ailment will score a high UV.

## 3. Results and Discussions

**3.1. Diversity of Used Plant Species.** This is the first study of its kind in South Africa and few of those conducted in other African countries [17, 18] and elsewhere [34] that focused on the utilisation of plants to treat asthma and related symptoms. A total of 104 medicinal plant species (92 indigenous and 12 exotics) belonging to 92 genera, distributed across 54 botanical families, mostly the Asteraceae and Fabaceae ( $n=10$  spp., for each, 18.5%), Malvaceae ( $n=7$  spp., 12.9%), Anacardiaceae, and Euphorbiaceae ( $n=4$  spp., for each, 7.4%), respectively, were recorded as being used by 140 Bapedi THs to treat these conditions. This diversity of plants is higher compared to 46 noted by Sonibare and Gbile [18] in Nigeria, and 29 by Noumi [17] in Cameroon. The observed variation might be attributed to extremely larger sample size of THs and spatial coverage included in our study compared to these two studies. Some of the above-mentioned botanical families documented in our study are repeatedly noted as predominant in various ethnobotanical surveys focusing on asthma. For instance, the Asteraceae, Euphorbiaceae, and Fabaceae were also represented with higher number of species in a study conducted in India [34]. In a similar survey carried out amongst THs in South Western Nigeria, Euphorbiaceae was also dominant [18]. The widespread and higher utilisation of species from all the aforesaid botanical families is an indication that they are widely distributed in various countries of the world. Overall, their high preponderance in the present study might be due to the fact that they contain a relatively higher integer of antiasthmatic taxa locally known by Bapedi THs compared to the rest of plant families which had less than four taxa (Table 1).

**3.2. Plant Habit.** Plants documented in this study were mainly trees and herbs ( $n=39$ , for each) as well as shrubs ( $n=26$ ). This finding, however, is not surprising because these growth forms are prevailing components of local flora distributed across the studied districts and municipalities. According to Shankar et al. [35] the more common the growth form is in an area, the greater the probability of its popular use is. Therefore, Bapedi THs might prefer the aforesaid habits due to their local availability and familiarity.

**3.3. Distribution of Used Plants within the Municipalities and Districts.** The recorded 104 plant species were not used by all THs who diagnosed asthma and its symptoms

TABLE 1: Plant used to treat asthma and related symptoms in the Capricorn, Sekhukhune and Waterberg districts of Limpopo Province, South Africa.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140)			
								UM	%	UV	
Acanthaceae	<i>Blepharis diversispina</i> (Nees) C.B.Clarke	Setlwadiwa	Shrub	Root	Dry	Boiled for 3–5 minutes. Extract is taken orally. Thrice a day	Fatigue	6	4.2	100	0.04
Acanthaceae	<i>Blepharis subvolubilis</i> C.B.Clarke	Mookapitsi	Shrub	Root	Dry	Boiled for 5–6 minutes. Extract is taken orally. Thrice a day	Fatigue	1	0.7	100	0.00
Alliaceae	<i>Tulbaghia violacea</i> Harv. var. <i>violacea</i>	Moeye-ya-naga	Herb	Bulb	Fresh	Boiled for 5 minutes. Steam inhaled (nasally) under blanket. Thrice a day	Nasal congestion	2	1.4	100	0.01
Amaryllidaceae	* <i>Allium sativum</i> L.	Khonofolo	Herb	Bulb	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma Labourered breathing	1	0.7	50	0.01
Amaryllidaceae	<i>Clivia caulescens</i> R.A.Dyer	Maime	Herb	Root	Dry	Boiled for 4–10 minutes. Extract is taken orally. Thrice a day	Asthma	3	2.1	100	0.02
Anacardiaceae	<i>Harpephyllum caffrum</i> Bernh. ex Krauss	Motshidi-tshwene	Tree	Root	Dr	Boiled for 5 minutes. Extract is taken orally. Thrice a day	Asthma	1	0.7	100	0.00
Anacardiaceae	* <i>Mangifera indica</i> L	Momenko	Tree	Root	Fresh	Boiled for 5 minutes. Extract is taken orally. Thrice a day	Asthma	1	0.7	100	0.00
Anacardiaceae	* <i>Schinus molle</i> L.	Thoba/Mokwepere	Tree	Leaf	Fresh	Boiled for 5–7 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma Fatigue Labourered breathing	1	0.7	14.2	0.05
								4	2.8	57.1	
								2	1.4	28.5	

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV	
Anacardiaceae	<i>Sclerocarya birrea</i> (A.Rich.) Hochst. subsp. <i>caffra</i> (Sond.)	Morula/Mokano	Tree	Bark	Dry	Pounded and with mixed with dried powdered roots of <i>B. discolor</i> and <i>S. italica</i> , and dried bark of <i>P. africanum</i> . Powdered is poured in to the boiled water and steam is inhaled (nasally) under blanket. Thrice a day	Asthma	1	100	100	1
						Pounded and mixed with dried powdered roots of <i>A. erioloba</i> , <i>X. caffra</i> and dried bark of <i>P. africanum</i> . Taken orally with warm water	Asthma	1	100	100	1
						Pounded and taken orally with warm water. Thrice a day	Asthma	1			
						Juice is squeezed (raw), dried and pounded. Powder is poured in the hot water. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma	137			
Apiaceae	<i>Alepidea amatymbica</i> Eckl. & Zeyh. var. <i>amatymbica</i>	Lešokwane	Herb	Rhizome	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	11	7.8	100	0.07
Apocynaceae	<i>Schizoglossum nitidum</i> Schltr	Phenyokga	Herb	Root	Dry	Boiled (until water gain colour) and extract is taken orally. Thrice a day	Asthma Nasal congestion	2	1.4	66.6	0.02
Apocynaceae	<i>Strophanthus speciosus</i> (Ward & Harv.) Reber	Morarwane	Shrub	Root	Dry	Boiled for 6–12 minutes. Extract is taken orally. Thrice a day	Asthma	15	10.7	100	0.10
Araceae	* <i>Stylochaeton natalensis</i> Schott	Mokunya/Mokushete	Herb	Root	Dry	Boiled for 5 minutes. Extract is taken orally. Thrice a day	Asthma	140	100	100	1
Araceae	<i>Zantedeschia aethiopica</i> (L.) Spreng.	Mothebe	Herb	Root	Dry	Boiled for 5–6 minutes. Extract is taken orally. Thrice a day	Asthma	7	5	100	0.05

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV	
Asphodelaceae	<i>Aloe spp.</i>	Thogo/Marobadibogale	Shrub	Leaf	Fresh	Mixed with dried pounded leaf of <i>D. senecioides</i> . Boiled for 2 minutes. Extract is taken orally. Thrice a day Macerated in warm for 3–24hrs. Decoction is taken orally. Thrice a day	Asthma Fatigue	3 5	2.1 3.5	37.5 62.5	0.02 0.03
Asphodeloideae	<i>Aloe falcata</i> Baker	Sekgopha	Shrub	Leaf	Fresh	Macerated in warm water 2–5hrs. Decoction is taken orally. Thrice a day Boiled for 3–7 minutes. Extract is taken orally. Thrice a day	Fatigue Wheezing	1 2	0.7 23.5	100 6	0.00
Asteraceae	<i>Artemisia afra</i> Jacq, ex Willd. var: <i>afra</i>	Legana/Moilanshi	Herb	Leaf	Dry	Mixed with fresh leaf of <i>C. sativa</i> . Boiled for 5 minutes. Extract is taken orally. Thrice a day Pounded and mixed with dried powdered bark of <i>P. africanum</i> . Taken orally with Syrup®. Thrice a day	Asthma Asthma Asthma Asthma Nasal congestion	8 1 16 6	8 17.8 4.2	75.7 0.23 18.1	

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of uses, n = THs (140) UM %	FL	UV
						Boiled for 4–6 minutes. Extract is taken orally. Thrice a day	Asthma	10		
						Pounded and mixed with dried powdered root of <i>Z. capense</i> . Taken orally with warm water. Thrice a day	Asthma	1		
						Mixed with fresh leaf of <i>C. edulis</i> . Boiled for 5 minutes. Extract is taken orally. Thrice a day	Asthma	1	9.2	86.6
Asteraceae	<i>Callilepis lauroleola</i> DC.	Phela/Hlonya/ Makuru/Pedipekanto	Herb	Root	Dry	Pounded and mixed with dried powdered root of <i>L. javanica</i> . Boiled for 4 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma	1		0.10
						Boiled for 7–9 minutes. Extract is taken orally. Thrice a day	Fatigue	1		
						Pounded and mixed with dried powdered whole plants of <i>H. caespititium</i> , leaves of <i>L. javanica</i> and <i>T. dioica</i> , and root of <i>O. lanceolata</i> . Taken orally with warm water. Thrice a day	Fatigue	1	1.4	13.3
Asteraceae	<i>Dicoma anomala</i> subsp. gerrardii	Phelana/ Makušwaneng	Herb	Root	Dry	Boiled for 5–8 minutes. Extract is taken orally. Thrice a day Or Pounded and taken orally with warm water. Thrice a day	Asthma	3	2.1	100 0.02
Asteraceae	<i>Helichrysum caespititium</i> (DC.) Harv.	Bokgatha	Herb	Whole plant	Dry	Pounded and mixed with dried powdered roots of <i>C. lauroleola</i> and <i>O. lanceolata</i> , leaves of <i>L. javanica</i> and <i>T. dioica</i> . Taken orally with warm water. Thrice a day	Fatigue	1	0.7	100 0.00

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV
Asteraceae	<i>Helichrysum gymnocomum</i> DC.	Mpepho	Herb	Whole plant	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	2 1.4 100 0.01	100	0.01
Asteraceae	* <i>Pseudognaphalium luteoalbum</i> (L.) Hilliard & B.L.Burtt	Unknown	Herb	Leaf	Dry	Boiled for 5 minutes. Extract is taken orally. Thrice a day	Fatigue	2 1.4 100 0.01	100	0.01
Asteraceae	<i>Psiadia punctulata</i> (DC.) Vátke	Lesotlane/Monotletsane/lesodi	Shrub	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	7 5 53.8 0.05	53.8	0.05
Asteraceae	* <i>Schkuhria pinnata</i> (Lam.) Kuntze ex Thell.	Šathume/Moššane/Seralane	Herb	Whole plant	Fresh	Boiled for 5–7 minutes. Steam is inhaled under (nasally) blanket. Thrice a day	Nasal congestion	6 4.2 46.1 0.04	46.1	0.04
Asteraceae	<i>Senecio serratuloides</i> DC.	Legatuludi	Shrub	Leaf	Dry	Pounded and mixed with dried powdered root of <i>P. grandiflora</i> . Powder is poured in the boiled water. Steam inhaled (nasally) under blanket. Thrice a day	Asthma	1 0.7 100 0.00	100	0.00
Asteraceae	<i>Veronica natalensis</i> Sch.Bip. ex Walp.	Mošuhla	Herb	Leaf	Leaf	Boiled for 3–8 minutes and steam is inhaled (nasally) under blanket. Thrice a day	Nasal congestion	12 9.2 48.1 0.19	48.1	0.19
Cactaceae	* <i>Opuntia ficus-indica</i> (L.) Mill.	Motloro	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	1 0.7 100 0.00	100	0.00
Canellaceae	<i>Warburgia salutaris</i> (G.Bertol.) Chiov.	Molaka	Tree	Bark	Dry	Boiled for 4–11 minutes. Extract is taken orally. Thrice a day	Asthma Wheezing	4 2.8 36.3 0.07	36.3	0.07



TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV
Cannabaceae	<i>Cannabis sativa</i> L. var. <i>indica</i> (Lam.) Wehmer	Lebake/Patše	Herb	Leaf	Fresh Dry	Mixed with dried leaf of <i>A. afra</i> . Boiled for 5 minutes. Extract is taken orally. Thrice a day Pounded and taken orally with warm water. Thrice a day	Asthma Tight chest	8 5.7 11 7.8	42.1	0.13
Capparaceae	<i>Maeria juncea</i> Pax subsp. <i>crustata</i> (Wild) Wild	Diragadibonwe	Shrub	Root	Dry	Boiled for 5 minutes. Extract is taken orally. Thrice a day Mixed with fresh bulb of <i>D. elata</i> , dried bark of <i>C. abbreviata</i> . Boiled for 6 minutes. Extract is taken orally. Thrice a day Pounded and taken orally with warm water. Thrice a day	Asthma Fatigue Fatigue	3 2.1 1 2	50	0.02
Celastraceae	<i>Catha edulis</i> (Vahl) Forssk. ex Endl.	Lehlatse/Lewang/Molomomomate	Tree	Root	Dry	Boiled for 5 minutes. Extract is taken orally. Thrice a day	Fatigue	1	100	0.00
Convolvulaceae	<i>Ipomoea albivenia</i> (Lindl.) Sweet	Mošope	Shrub	Root	Dry	Boiled for 4–5 minutes. Extract is taken orally. Thrice a day	Asthma	1	100	0.00
Crassulaceae	<i>Kalanchoe brachyloba</i> Welw. ex Britten	Moethi/Mošimanewanaga/Mortšikana	Shrub	Leaf	Fresh	Rubbed (raw) between hands and vapour is inhaled (nasally). Thrice a day	Nasal congestion	13	100	0.09

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV
Cucurbitaceae	<i>Cucumis metuliferus</i> E.Mey. ex Naudin	Tšitšhi	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	4 2.8 100 0.02		
Cyperaceae	<i>Cyperus sexangularis</i> Nees	Mohlaha	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma Fatigue	7 5 10.7 0.46 58 41.4 89.2		
Dioscoreaceae	<i>Dioscorea sylvatica</i> Eckl. var. <i>brevipes</i> (Burrill) Davy	Kgato	Herb	Tuber	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	10 7.1 100 0.07		
Euphorbiaceae	<i>Croton gratissimus</i> Burch. var. <i>gratissimus</i>	Moolologa/Selogane	Tree	Root	Dry	Boiled for 6–10 minutes. Extract is taken orally. Thrice a day Or Pounded and taken orally with warm water. Thrice a day	Asthma Wheezing	12 8.5 48 8 5.7 32		0.17
Euphorbiaceae	<i>Euphorbia schinzii</i> Pax	Ngaka-dianya	Herb	Root	Dry	Boiled for 9 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Nasal congestion	5 3.5 20		
Euphorbiaceae	<i>Jatropha zeyheri</i> Sond.	Sephapabadiya	Herb	Root	Dry	Boiled for 5–8 minutes. Steam is inhaled (nasally) under blanket. Thrice a day Boiled for 5 minutes. Extract is taken orally. Thrice a day	Asthma	19 13.5 100 0.13		0.00
Euphorbiaceae	<i>Tragia dioica</i> Sond.	Bogopa/Mabatsane	Herb	Leaf	Dry	Pounded and mixed with dried powered whole plant of <i>H. caespitium</i> , leaf of <i>L. javanica</i> and roots of <i>O. lanceolata</i> and <i>C. laurreola</i> . Taken orally with warm water. Thrice a day	Fatigue	1 0.7 100 0.00		

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of uses, n = THs (140) UM %	FL	UV
Fabaceae	<i>Acacia erioloba</i> E.Mey.	Moghlo/Mošu	Tree	Root	Dry	Pounded and mixed with dried powdered bark of <i>P. africanum</i> and <i>S. birrea</i> , and root of <i>X. caffra</i> . Taken orally with warm water. Thrice a day	Asthma	1 0.7	100	0.00
Fabaceae	<i>Acacia sieberiana</i> DC. var. <i>woodii</i> (Burt Davy) Keay & Brenan	Mošu	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	1 0.7	100	0.00
Fabaceae	<i>Acacia senegal</i> (L.) Willd. var. <i>rostrata</i> Brenan	Mokgaripe	Tree	Root	Dry	Boiled for 6–11 minutes. Extract is taken orally. Thrice a day	Asthma	2 1.4	100	0.01
Fabaceae	<i>Albizia adianthifolia</i> (Schumacher) W.Wright var. <i>adianthifolia</i>	Mafahla-nare	Tree	Root	Dry	Boiled for 5–12 minutes. Extract is taken orally. Thrice a day Or Pounded and taken orally with warm water. Thrice a day	Fatigue	3 2.1	100	0.02
Fabaceae	<i>Cassia abbreviata</i> Oliv. subsp. <i>beareana</i> (Holmes) Brenan	Monepenepe	Tree	Bark	Dry	Boiled for 5–9 minutes. Extract is taken orally. Thrice a day	Asthma	3 2.1	100	0.02
Fabaceae	<i>Elephantorrhiza burkei</i> Benth.	Mosišane/Batswetsi	Shrub	Root	Dry	Pounded and mixed with dried powdered stem of <i>A. spinosa</i> and root of <i>P. africanum</i> . Taken orally with warm water. Thrice a day Boiled for 5–8 minutes. Extract is taken orally. Thrice a day	Fatigue Fatigue Asthma	1 2.1 2 2.1 3 2.1	50 50	0.04
Fabaceae	<i>Elephantorrhiza goetzei</i> (Harms) Harms subsp. <i>goetzei</i>	Mosišane	Shrub	Root	Dry	Mixed with fresh bulb of <i>E. autumnalis</i> . Boiled for 6 minutes. Extract is taken orally. Thrice a day	Fatigue	1 0.7	100	0.00

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of uses; n = THs (140) UM %	FL	UV	
Fabaceae	<i>Erythrina lysistemon</i> Hutch.	Sebalo/Mmale	Tree	Bark	Dry	Boiled for 5–8 minutes. Extract is taken orally. Thrice a day	Wheezing	10	7.1	100	0.07
						Pounded and mixed with dried powdered leaf of <i>A. afra</i> . Taken orally with Syrup®. Thrice a day	Asthma	1			
						Pounded and mixed with a dried powdered root of <i>B. discolor</i> and <i>S. italica</i> , and dried bark of <i>S. birrea</i> . Powdered is poured in to the boiled water and steam is inhaled (nasally) under blanket. Thrice a day	Asthma	1	2.1	21.4	0.1
Fabaceae	<i>Peltophorum africanum</i> Sond.	Mosehla	Tree	Bark	Dry	Pounded and mixed with dried powdered roots of <i>A. erioloba</i> , <i>X. caffra</i> and dried bark of <i>S. birrea</i> . Taken orally with warm water. Thrice a day	Asthma	1			
						Boiled for 5–11 minutes. Extracts taken orally. Thrice a day	Fatigue	10	7.8	78.5	
						Pounded and mixed with dried powdered stem of <i>A. spinosa</i> and a root of <i>E. burkei</i> . Taken orally with warm water. Thrice a day	Fatigue	1			
						Pounded and mixed with a dried powdered roots of <i>B. discolor</i> , dried bark of <i>S. birrea</i> and <i>P. africanum</i> . Powdered is poured in to the boiled water and steam is inhaled (nasally) under blanket. Thrice a day	Asthma	1	6.4	100	0.06
Fabaceae	<i>Senna italica</i> Mill. subsp. arachoides (Burch.) Lock	Moroteladitshoši	Herb	Root	Dry	Boiled for 4–8 minutes. Extract is taken orally. Thrice a day	Asthma	8			

TABLE I: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140)	FL	UV	
								UM	%		
Gentianaceae	<i>Enicostema axillare</i> (Lam.) A. Raynal subsp. Axillare	Makgonotsohle/ Mphedu-ya-thaba	Herb	Whole plant	Dry	Boiled for 5–14 minutes. Extract is taken orally. Thrice a day Or Pounded and taken orally with warm water. Thrice a day	Asthma	140	100	1	
Hyacinthaceae	<i>Drimys elata</i> Jacq.	Sekanama	Herb	Bulb	Fresh	Mixed with dried root of <i>M. juncea</i> , dried bark of <i>C. abbreviata</i> . Boiled for 6 minutes. Extract is taken orally. Thrice a day Boiled for 6 minutes. Extract is taken orally. Thrice a day Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day Boiled for 5 minutes. Extract is taken orally. Thrice a day	Fatigue Fatigue Wheezing Asthma	1 3 4 4	0.7 2.1 2.8 2.8	8.3 25 33.3 33.3	
Hyacinthaceae	<i>Eucomis autumnalis</i> (Mill.) Chitt.	Mathubadifala	Herb	Bulb	Fresh	Boiled for 5 minutes. Extract is taken orally. Thrice a day Mixed with dried root dried of <i>E. goetzei</i> . Boiled for 6 minutes. Extract is taken orally. Thrice a day	Nasal congestion Fatigue	8 1	5.7 0.7	88.8 11.1	0.05 0.00
Hyacinthaceae	<i>Eucomis pallidiflora</i> Baker subsp. pole-evansii (N.E.Br.) Reyneke ex J.C. Manning	Mathubadifala	Herb	Bulb	Fresh	Boiled for 5–8 minutes. Steam is inhaled (nasally) under blanket. Thrice a day Boiled for 5–10 minutes. Extract is taken orally. Thrice a day	Nasal congestion Fatigue Wheezing	11 9 1	7.8 6.4 0.7	52.2 42.8 4.7	
Hypoxidaceae	<i>Hypoxis hemerocallidea</i> Fisch., C.A. Mey. & Avé- Lall	Hlakudiboya/Titikwane/ Sekgekolwana	Herb	Tuber	Fresh	Mixed with fresh bulb of <i>S. aethiopicus</i> . Boiled for 5 minutes. Extract is taken orally. Thrice a day Boiled for 5–12 minutes. Extract is taken orally. Thrice a day	Asthma Asthma Fatigue	1 13 4	10 2.8	77.7 22.2	0.12

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV	
Hypoxidaceae	<i>Hypoxis obtusa</i> Burch. ex Ker Gawl.	Monna maledu	Herb	Tuber	Fresh	Boiled for 4–7 minutes. Extract is taken orally. Thrice a day	Fatigue	2	1.4	100	0.01
Icacinaceae	<i>Cassinopsis ilicifolia</i> (Hochst.) Kuntze	Mohufi/Mohufe	Tree	Root	Dry	Boiled for 5–7 minutes. Extract is taken orally. Thrice a day	Fatigue	2	1.4	100	0.01
Icacinaceae	<i>Pyrenacantha grandiflora</i> Baill.	Bjere	Shrub	Root	Dry	Pounded and mixed with dried powdered entire plant of <i>S. pinnata</i> . Powder is poured in the boiled water. Steam inhaled (nasally) under blanket. Thrice a day	Asthma	1	0.7	100	0.01
Kirkiaceae	<i>Kirkia wilmsii</i> Engl.	Modumela/mogaba	Tree	Bark	Fresh	Boiled for minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma Nasal congestion	2	1.4	66.6	0.02
Lamiaceae	<i>Clerodendrum glabrum</i> E.Mey. var. <i>angustifolium</i> E.Mey.	Mohllokholoko	Tree	Leaf	Fresh	Boiled for 5–8 minutes. Extract is taken orally. Thrice a day	Asthma	4	2.8	100	0.02
Lamiaceae	<i>Clerodendrum ternatum</i> Schinz	Sebokane	Herb	Whole plant	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	140	100	100	1
Lamiaceae	<i>Leonotis leonurus</i> (L.) R.Br.	Lebake	Shrub	Root or leaf	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	14	10	100	0.1
Lauraceae	<i>Cryptocarya transvaalensis</i> Burt Davy	Kgosupsa	Tree	Bark	Dry	Boiled for 5–9 minutes. Extract is taken orally. Thrice a day	Asthma	140	100	100	1
Malvaceae	<i>Abutilon galpinii</i> A.Meeuse	Mmotša	Shrub	Root	Dry	Boiled for 5–8 minutes. Extract is taken orally. Thrice a day	Asthma	5	3.5	100	0.03
Malvaceae	<i>Adansonia digitata</i>	Mogoo	Tree	Root	Dry	Boiled for 6–10 minutes. Extract is taken orally. Thrice a day	Fatigue	68	48.5	100	0.48
Malvaceae	<i>Dombeya rotundifolia</i> (Hochst.) Planch. var. <i>rotundifolia</i>	Mokgoba	Tree	Root	Dry	Pounded and extract is taken orally with warm water. Thrice a day	Fatigue	3	2.1	100	0.02

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV	
Malvaceae	<i>Gossypium herbaceum</i> L. subsp. <i>africanum</i> (Watt) Vollesen	Katluni/Leokodi/Mohlare-wa-mawisi	Shrub	Root	Dry	Pounded and extract is taken orally with warm water. Thrice a day	Asthma	70	50	100	0.5
Malvaceae	<i>Grewia hispida</i> Harv.	Mogwete/Mogolori/Lefelo	Shrub	Root	Dry	Pounded and extract is taken orally. Thrice a day	Nasal congestion	2	1.4	100	0.01
Malvaceae	<i>Grewia sulcata</i> Mast. var. <i>sulcata</i>	Mogwete/Mogoto	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	2	1.4	100	0.01
Malvaceae	<i>Sida cordifolia</i> L.	Mohutasela	Shrub	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	3	2.1	100	0.02
Mesembryanthemaceae	<i>Carpobrotus edulis</i> (L.) L. Bolus subsp. <i>edulis</i>	Moshipse	Herb	Leaf	Fresh	Chewed (orally) as raw and juice is swallowed. Thrice a day Mixed with dried root of <i>C. laurozola</i> . Boiled for 5 minutes. Extract is taken orally. Thrice a day	Asthma	3	2.8	100	0.02
Moringaceae	* <i>Moringa oleifera</i> sensu Exell & Mendon	Moringka	Tree	Leaf	Dry	Pounded and taken orally with warm water. Thrice a day	Fatigue	17	12.1	100	0.12
Myrtaceae	* <i>Eucalyptus camaldulensis</i> Dehn	Mopilikomo	Tree	Bark	Dry	Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma	1	0.7	100	0.00

TABLE I: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of uses; n = THs (140)			
								UM	%	UV	
Olacaceae	<i>Ximenia caffra</i> Sond. var. natalensis Sond.	Motšhidi-kgomo	Tree	Root	Dry	Pounded and mixed with dried powdered roots of <i>A. erioloba</i> , dried bark of <i>P. africanum</i> and <i>S. birrea</i> . Taken orally with warm water. Thrice a day Pounded and taken orally with warm water. Thrice a day	Asthma	1	5.7	100	0.05
								7			
Oleaceae	<i>Olea europaea</i> L. subsp. africana (Mill.) P.S.Green	Mohlware/Mo-olive	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day Thrice a day	Asthma	4		100	0.03
								1			
Punicaceae	* <i>Panica granatum</i> L.	Mokgarenate	Tree	Fruit scale	Fresh	Chew as raw (orally). Thrice a day	Asthma	1	0.7	100	0.00
Passifloraceae	<i>Adenia fruticosa</i> Burtt Davy subsp. fruticosa	Mopowane	Shrub	Root	Dry	Boiled for 5–13 minutes. Extract is taken orally. Thrice a day Boiled for 6 minutes. Extract is used topically as bath. Thrice a day	Asthma	9	9.2	69.2	0.09
								4	2.8	30.7	



TABLE I: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of uses:			
								n = THs (140)	FL	UV	
Passifloraceae	<i>Adenia spinosa</i> Burt Davy	Monna-apare/ Pisayabatšumi/ Mothema	Shrub	Stem	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma Fatigue	25 56	17.8 40.7	30.4 69.5	0.58
Pedaliaceae	<i>Dicerocaryum senecioides</i> (Klotzsch) Abels	Momphati	Herb	Leaf	Dry	Pounded and mixed with fresh leaf of <i>Aloe spp.</i> Boiled for 2 minutes. Extract is taken orally. Thrice a day	Asthma	3	2.1	100	0.02
Plumbaginaceae	<i>Plumbago zeylanica</i> L.	Mašimabe/ Mašegomabe	Shrub	Root	Dry	Boiled for 6–13 minutes. Extract is taken orally. Thrice a day	Asthma Nasal congestion	4 1	2.8 0.7	80 20	0.03
Poaceae	<i>Sorghum bicolor</i> (L.) Moench subsp. arundinaceum (Desv.) de Wet & Harlan	Mabele-thoro	Herb	Seed	Dry	Pounded and taken orally with Mageu® drink or soft porridge. Thrice a day	Fatigue	6	4.2	100	0.04
Poaceae	* <i>Zea mays</i> subsp. mays L.	Mabele	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	1	0.7	100	0.00
Polygalaceae	<i>Securidaca longepedunculata</i> Fresen. var. <i>longepedunculata</i>	Mphesu/ Mpitamarago	Tree	Root	Dry	Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma	2	1.4	100	0.01
Proteaceae	<i>Protea caffra</i> Meisn. subsp. <i>caffra</i>	Modumela	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma Fatigue	8 1	5.7 0.7	88.8 11.1	0.06
Ptaeroxylaceae	<i>Ptaeroxylon obliquum</i> (Thunb.) Radlk.	Mogabaletswana	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	25	17.8	100	0.17
Rhamnaceae	<i>Berchemia discolor</i> (Klotzsch) Hemsl.	Moneyee/ Mogokgoma	Tree	Root	Dry	Pounded and mixed with powdered dried bark of <i>S. birrea</i> and <i>P. affricanum</i> , and dried root of <i>S. italica</i> . Powder is poured in boiled water and steam is inhaled (nasally) under blanket. Thrice a day	Asthma	1	0.7	100	0.00

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of uses; n = THs (140) UM %	FL	UV	
Rhamnaceae	<i>Ziziphus mucronata</i> Willd. subsp. <i>mucronata</i>	Mokgalo	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	1	0.7	100	0.00
Rutaceae	* <i>Citrus limon</i> (L.) Burm.f.	Moswiri	Tree	Fruit	Fresh	Boiled for 4–5 minutes. Extract is taken orally. Thrice a day	Tight chest	2	1.4	100	0.01
Rutaceae	<i>Vepris reflexa</i> I.Verd.	Pharagobe	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Fatigue	2	1.4	100	0.01
Rutaceae	<i>Zanthoxylum capense</i> (Thumb.) Harv.	Monokwane/ Moregakgaka	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Wheezing Asthma	7 5	5 3.5	53.8 46.1	0.09
Santalaceae	<i>Osyris lanceolata</i> Hochst. & Steud.	Mphera	Tree	Root	Dry	Pounded and mixed with dried powdered root of <i>C. laurole</i> . Taken orally is with warm water. Thrice a day	Asthma	1	0.7		
Santalaceae	<i>Dodonaea viscosa</i> Jacq. var. <i>angustifolia</i> (L.f.) Benth.	Mofentshe	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma Laboured breathing	14 1	11.4 0.7	87.5 6.2	0.11
Santalaceae	<i>Osyris lanceolata</i> Hochst. & Steud.	Mphera	Tree	Root	Dry	Pounded and mixed with dried powdered root of <i>C. laurole</i> and <i>O. lanceolata</i> , whole plant of <i>H. caespitium</i> and leaves of <i>L. javanica</i> and <i>T. dioica</i> . Taken orally with warm water. Thrice a day	Fatigue	1	0.7	6.2	6.2
Sapindaceae	<i>Dodonaea viscosa</i> Jacq. var. <i>angustifolia</i> (L.f.) Benth.	Mofentshe	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Laboured breathing	1	0.7	100	0.00

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV	
Sapotaceae	<i>Englerophyllum magalimontanum</i> (Sond.) T.D.Penn.	Mohlatshwa	Tree	Root	Dry	Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma	3	2.1	100	0.02
Sapotaceae	<i>Mimusops obovata</i> Nees ex Sond.	Mmupudu	Tree	Root	Dry	Mixed with (spider's web). Pounded and taken orally with warm water. Thrice a day	Asthma	140	100	100	1
Scrophulariaceae	<i>Buddleja salviifolia</i> (L.) Lam	Moketla	Shrub	Root	Dry	Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma	3	2.1	100	0.02
Solanaceae	<i>Solanum catombelense</i> Peyr.	Mothola-o-momokhwibidu	Herb	Whole plant	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	2	1.4	100	0.01
Solanaceae	<i>Solanum panduriforme</i> E.Mey.	Mothola-o-moserolwane	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	3	2.1	100	0.02
Solanaceae	<i>Withania somnifera</i> (L.) Dunal	Mošalašupeng	Shrub	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Fatigue	6	4.2	85.7	0.04
Thymelaeaceae	<i>Lasiosiphon caffer</i> Meisn.	Nkekologe	Shrub	Root	Dry	Pounded and mixed with dried powdered root of <i>O. lanceolata</i> . Taken orally with warm water. Thrice a day	Labourered breathing	1	0.7	14.2	0.00
Velloziaceae	<i>Xerophytia retinervis</i> Baker	Thuse	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	4	2.8	100	0.02
Verbenaceae	<i>Lantana rugosa</i> Thunb.	Bokokotane/mokokotane	Shrub	Leaf	Fresh	Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma	5	3.5	100	0.03

TABLE 1: Continued.

Botanical family	Species names	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment/s treated	Frequency of use; n = THs (140) UM %	FL	UV	
Verbenaceae	<i>Lippia javanica</i> (Burm.f.) Spreng	Mošunkwane/motlaba-dipoo	Shrub	Leaf	Dry	Pounded and mixed with dried powdered root of <i>C. lauroleola</i> . Boiled for 4 minutes and steam is inhaled (nasally) under blanket. Thrice a day	Asthma	1	71	55.5	
						Boiled for 5–13 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Asthma	9			
						Pounded and mixed with dried powdered roots of <i>C. lauroleola</i> and <i>O. lanceolata</i> , whole plant of <i>H. caespitium</i> , and leaf of <i>T. dioica</i> . Taken orally with warm water. Thrice a day	Fatigue	1	0.7	5.5	0.12
						Boiled for 5–14 minutes. Extract is taken orally. Thrice a day	Labouring breathing	2	1.4	11.1	
						Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Nasal congestion	1	0.7	5.5	
						Boiled for 5 minutes. Steam is inhaled (nasally) under blanket, but while eyes open. Thrice a day	Wheezing	4	2.8	22.2	
Vitaceae	<i>Rhoicissus tomentosa</i> (Lam.) Wild & R.B.Drumm.	Terebe-yanageng	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Asthma	4	2.8	100	0.02
Zingiberaceae	<i>Siphonochilus aethiopicus</i> (Schweinf.) B.L.Burtt	Serokolo	Herb	Bulb	Fresh	Mixed with fresh bulb of <i>H. hemerocallitida</i> . Boiled for 5 minutes. Extract is taken orally. Thrice a day	Asthma	1	0.7	100	0.00

Key: Exotic plant species: asterisk (\*), fidelity level; FL, use mention; UM and use value; UV.

across the studied municipalities and districts. Overall the most widely distributed medicinal plant species (6.7%, n=7) used in all these geographical areas were *Clerodendrum ternatum*, *Cryptocarya transvaalensis*, *Lasiosiphon caffer*, *Enicostema axillare*, *Mimusops obovata*, *Sclerocarya birrea*, and *Stylochaeton natalensis*. The widespread utilisation of these species shows that they are popular, safe, and well-known as asthma therapies in Bapedi traditional healing sectors.

An overwhelming majority (40%, n=42) of species comprising *Abutilon galpinii*, *Acacia erioloba*, *Acacia senegal*, *Acacia sieberiana*, *Albizia adianthifolia*, *Allium sativum*, *Aloe falcata*, *Berchemia discolor*, *Blepharis diversispina*, *Blepharis subvulubilis*, *Buddleja salviifolia*, *Cassinopsis ilicifolia*, *Catha edulis*, *Clivia caulescens*, *Dicerocaryum senecioides*, *Dicoma anomala*, *Dodonaea viscosa*, *Dombeya rotundifolia*, *Elephantorrhiza goetzei*, *Eucalyptus camaldulensis*, *Grewia hispida*, *Grewia sulcata*, *Harpephyllum caffrum*, *Helichrysum caespititium*, *Helichrysum gymnocomum*, *Hypoxis obtusa*, *Ipomoea albivenia*, *Jatropha zeyheri*, *Mangifera indica*, *Opuntia ficus-indica*, *Panica granatum*, *Pyrenacantha grandiflora*, *Rhoicissus tomentosa*, *Schkuhria pinnata*, *Sida cordifolia*, *Siphonochilus aethiopicus*, *Sorghum bicolor*, *Tragia dioica*, *Tulbaghia violacea*, *Zantedeschia aethiopica*, *Zea mays*, and *Ziziphus mucronata* were used in a single municipality located within one of the three studied districts (Table 2). This finding might be attributed to the natural distribution of these taxa in the studied districts or variation with respect to THs' indigenous knowledge related to their applications as antiasthmatic medicines.

The above can also be said for 19.3% (n=20) of plants, namely, *Adansonia digitata*, *Adenia fruticosa*, *Aloe* spp., *Citrus limon*, *Clerodendrum glabrum*, *Cucumis metuliferus*, *Englerophytum magalimontanum*, *Erythrina lysistemon*, *Eucomis autumnalis*, *Euphorbia schinzii*, *Lantana rugosa*, *Leonotis leonurus*, *Maerua juncea*, *Olea europaea*, *Pseudognaphalium luteo-album*, *Solanum catombelense*, *Solanum panduriforme*, *Vepris reflexa*, *Warburgia salutaris*, and *Xerophyta retinervis*, which were utilised by THs in particular municipalities located in one district. The remainder (33.7%, n=35) of the plant species recorded in the present study were also distributed in certain municipalities but in more than one district (Table 2).

**3.4. Species Utilisation and Literature Comparison.** Amongst the 104 plants recorded in the current study, vast majority (50.9%, n=53) were used by THs to exclusively manage asthma, and 25.9% (n=27) for both asthma and the following symptoms: fatigue, nasal congestion, tight chest, wheeze, laboured breathing, nasal congestion and wheezing, fatigue and wheezing, and fatigue and laboured breathing, as well as fatigue, laboured breathing, nasal congestion, and wheeze. The remaining 24.0% (n=25) of the taxa were used exclusively to heal some of these symptoms (Table 1). Overall all taxa recorded in this study are known medicinal plants in South Africa and thus form part of local traditional ethnopharmacopoeia of various cultures in this country. However, the practice of Bapedi traditional healers to select various plant species to exclusively treat asthma might be attributed to a number of factors including the availability of some plants

during certain season of the year and in selected geographical areas. Furthermore, it is perhaps a means to allow them to select more effective asthma remedy or it is traditional practice they learned from their mentors.

**3.4.1. Asthma Therapies.** Of the 53 (50.9%) asthmatic species, six (11.3%) comprising *C. ternatum*, *C. transvaalensis*, *E. axillare*, *M. obovata*, *S. birrea*, and *S. natalensis* were appreciated by all THs (n=140) who treated asthma across the study sites. To the best of our knowledge, with the exclusion of *S. birrea* which were previously highlighted by Ojewole [36] as being used for asthma in unspecified Southern Africa countries, all the aforesaid taxa are recorded for the first time in our study as remedy for this ailment. However, such species are well-known and widely used as traditional cure for other human diseases across Africa. Hossan et al. [37] observed that medicinal plants that are both highly and widely used for a particular ailment are in most case new sources of medication of such affliction. Taking into account this, we hypothesize that the wide use of the above-listed six taxa in the treatment of asthma by Bapedi THs is due to their effectiveness and thus must be investigated for their potential as new source of asthma medication. In fact utilisation of *E. axillare* by these THs is already supported by scientific studies. For instance, its extract exhibited both anti-inflammatory and antiasthmatic activities [38]. Ethanol extracts of *Clerodendrum serratum* Linn roots showed good antiasthmatic activity in experimental animal [39], thus suggesting that a closely related species *C. ternatum* (used by Bapedi) might also possess same activity.

Most (50%, n=26) of the remaining plants, *A. galpinii*, *A. erioloba*, *A. senegal*, *A. sieberiana*, *B. discolor*, *B. salviifolia*, *C. edulis*, *C. glabrum*, *C. caulescens*, *C. metuliferus*, *D. senecioides*, *Dioscorea sylvatica*, *E. magalimontanum*, *E. schinzii*, *G. sulcata*, *H. caffrum*, *I. albivenia*, *J. zeyheri*, *L. rugosa*, *P. grandiflora*, *R. tomentosa*, *S. pinnata*, *Senna italica*, *S. catombelense*, *S. panduriforme*, and *Strophanthus speciosus*, used in this study to exclusively treat asthma were also documented for the first time in this study as remedies for this condition. These species are also traditionally utilised as medicine to treat different human diseases in South Africa and other African countries. Therefore, their use in this study for asthma is an indication that they might be safe for consumption as remedies. From conservation point of view restricted knowledge of the above-mentioned species to Bapedi THs as therapies for asthma to some extent has advantage, as it decreases the impact of being extensively and recurrently harvested across the countries to manage this chronic disorder.

The utilisation of the rest (38.5%, n=20) of the species, namely, *Alepidea amatymbica*, *Cassia abbreviata*, *Carpobrotus edulis*, *D. anomala*, *E. camaldulensis*, *Gossypium herbaceum*, *H. gymnocomum*, *L. leonurus*, *M. indica*, *O. europaea*, *O. ficus-indica*, *P. granatum*, *S. cordifolia*, *S. aethiopicus*, *Securidaca longepedunculata*, *Ximenia caffra*, *X. retinervis*, *Z. aethiopica*, *Z. mucronata*, and *Z. mays*, used for asthma by Bapedi THs was previously culturally validated either in South Africa, in other African countries, or elsewhere. Nonjinge and Tarr [40] who worked with Zulu



TABLE 2: Continued.

Species name	Districts and municipalities										Sum of overall ailment treated per species								
	Capricorn			Sekhukhune				Waterberg											
	Aganang	Blouberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of ailment (FC)	Elias Mosealedi	Ephrine Mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of ailment (FC)	Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mookgophong	Thabazimbi	Sum of ailment (FC)
<i>Citrus limon</i>	-	-	TC:1	-	TC:1	2	-	-	-	-	-	0	-	-	-	-	-	-	0
<i>Chroodendron glabrum</i>	-	-	-	-	-	0	-	AS:3	-	AS:1	-	4	-	-	-	-	-	-	0
<i>Chroodendron ternatum</i>	AS:14	AS:15	AS:13	AS:11	AS:15	68	AS:13	AS:10	AS:6	AS:4	AS:4	39	AS:7	AS:5	-	AS:8	AS:7	AS:6	33
<i>Clivia caulescens</i>	-	-	-	AS:3	-	3	-	-	-	-	-	0	-	-	-	-	-	-	0
	-	AS:3	-	AS:4	AS:5	12	-	-	-	-	-	0	-	-	-	-	-	-	0
<i>Croton gratissimus</i>	-	-	-	-	-	0	-	NC:1	NC:2	NC:1	NC:1	5	-	-	-	WH:3	WH:4	-	8
	-	-	-	-	-	0	-	-	-	-	-	0	WH:1	-	-	-	-	-	8
<i>Cryptocarya transvaalensis</i>	AS:14	AS:15	AS:13	AS:11	AS:15	68	AS:13	AS:10	AS:6	AS:4	AS:4	39	AS:7	AS:5	-	AS:8	AS:7	AS:6	33
<i>Cucumis metuliferus</i>	-	-	-	-	-	0	AS:1	-	AS:2	AS:1	AS:1	4	-	-	-	-	-	-	0
	-	-	-	-	-	0	AS:1	-	AS:6	-	-	7	-	-	-	-	-	-	0
<i>Cyperus sexangularis</i>	FA:4	FA:7	-	-	FA:1	12	FA:13	FA:10	FA:6	FA:4	FA:4	39	FA:1	-	FA:3	-	FA:3	-	7
<i>Eucalyptus camaldulensis</i>	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	AS:1	-	1
<i>Dioscorea senecioides</i>	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	AS:3*	-	3
<i>Dicoma anomala</i>	-	-	-	-	-	0	-	-	-	-	-	0	-	AS:3	-	-	-	-	3
<i>Dioscorea sylvatica</i>	-	-	AS:2	-	-	2	AS:1	-	AS:2	AS:1	AS:1	4	-	AS:1	-	-	-	AS:3	4
<i>Dodonaea viscosa</i>	LE:1	-	-	-	FA:3	3	-	-	-	-	-	0	-	-	-	-	-	-	0
<i>Dombeya rotundifolia</i>	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	-	0
	-	-	-	-	-	0	AS:4	-	-	-	-	4	-	-	-	-	-	-	0
<i>Drimys elata</i>	FA:1*	-	-	-	FA:1	2	FA:2	-	-	-	-	2	-	-	-	-	-	-	0
	-	WH:4	-	-	-	4	-	-	-	-	-	0	-	-	-	-	-	-	0
<i>Elephantorrhiza burkei</i>	-	-	-	-	-	0	-	-	-	-	-	0	AS:3	-	-	-	-	-	3
	-	FA:1*	-	-	FA:1	3	-	-	-	-	-	0	-	-	-	-	-	-	0
<i>Elephantorrhiza goetzei</i>	FA:1*	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0
<i>Engelophyllum magalismonianum</i>	-	-	-	-	-	0	-	-	-	-	-	0	AS:1	-	-	AS:1	-	AS:1	3
<i>Encostema axillare</i>	AS:14	AS:15	AS:13	AS:11	AS:15	68	AS:13	AS:10	AS:6	AS:4	AS:4	39	AS:7	AS:5	-	AS:8	AS:7	AS:6	33
<i>Erythrina lysistemon</i>	WH:2	WH:3	WH:5	-	-	10	-	-	-	-	-	0	-	-	-	-	-	-	0
	FA:1*	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0
<i>Eucomis antiumidis</i>	-	-	NC:8	-	-	8	-	-	-	-	-	0	-	-	-	-	-	-	0
	-	-	-	FA:9	-	9	-	-	-	-	-	0	-	-	-	-	-	-	0
<i>Eucomis pallidiflora</i>	-	-	NC:8	-	-	8	-	-	-	-	-	0	NC:2	-	NC:1	-	-	-	3
	-	-	-	-	-	8	-	-	-	-	-	0	-	-	-	-	-	-	3

TABLE 2: Continued.

Species name	Districts and municipalities										Sum of overall ailment treated per species									
	Capricorn			Sekhukhune				Waterberg												
	Aganang	Bloberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of ailment (FC)	Elias Mosealedi	Ephrine Mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of ailment (FC)	Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mogokgophong	Thabazimbi	Sum of ailment (FC)	
<i>Euphorbia schinzii</i>	-	-	-	-	-	0	-	-	-	WHE1	-	1	-	-	-	-	-	-	0	1
<i>Gossypium herbaceum</i>	-	-	-	-	AS13	0	AS13	-	-	AS6	-	19	-	-	-	-	-	-	0	19
<i>Grewia hispida</i>	-	AS8	AS7	AS11	AS13	39	-	AS4	AS6	-	-	10	-	-	-	AS8	AS7	AS6	21	70
<i>Grewia sulcata</i>	-	-	NC2	-	-	2	-	-	-	-	AS2	0	-	-	-	-	-	-	0	2
<i>Harpachyllum caffrum</i>	-	-	-	-	-	0	-	-	-	AS1	-	2	-	-	-	-	-	-	0	2
<i>Helichrysum cespitosum</i>	-	-	-	-	-	0	-	FA1*	-	-	-	1	-	-	-	-	-	-	0	1
<i>Helichrysum gymnocarum</i>	-	-	AS2	-	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
<i>Hypoxis</i>	-	-	-	AS1	AS12	13	-	AS1*	-	-	-	1	-	-	-	-	-	-	0	14
<i>Hemero-calliden</i>	-	-	-	-	-	0	-	FA4	-	-	-	4	-	-	-	-	-	-	0	4
<i>Hypoxis obtusa</i>	FA2	-	-	-	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
<i>Ipomoea albensia</i>	-	-	-	-	-	0	-	-	-	-	AS1	1	-	-	-	-	-	-	0	1
<i>Jatropha zeyheri</i>	AS1	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
<i>Kalanchoe brachyloba</i>	-	-	NC8	-	-	8	-	NC1	NC1	NC2	NC1	5	-	-	-	-	-	-	0	13
<i>Kirkia wilmsii</i>	-	-	-	-	-	0	-	-	-	-	-	0	-	-	AS2	-	-	-	2	2
<i>Lantana rugosa</i>	-	-	NC1	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
<i>Lastescapion caffr</i>	AS14	AS15	AS13	AS11	AS15	68	AS13	AS10	AS6	AS6	AS4	39	AS7	AS5	AS8	AS8	AS7	AS6	5	5
<i>Leonotis leonurus</i>	TC5	TC12	-	-	-	17	-	-	AS2	AS6	AS1	0	-	-	-	-	-	-	33	140
<i>Lippia javanica</i>	-	-	-	-	-	0	AS3	AS2	AS2	AS6	AS1	14	-	-	-	-	-	-	0	17
<i>Mercuria juncea</i>	FA1*	FA2	-	-	-	3	-	FA1*	-	-	-	0	-	-	-	-	-	AS1*3	10	10
<i>Moringifera indica</i>	-	-	NC1	-	-	2	-	-	-	-	-	0	-	-	-	-	-	-	0	2
<i>Mimosaops obovata</i>	-	-	AS3	-	-	1	-	-	-	-	-	0	WHE1	-	-	WHE3	-	-	4	4
<i>Moringa oleifera</i>	FA1*	FA2	-	-	-	3	-	-	-	-	-	0	-	-	-	-	-	-	0	3
<i>Moringifera indica</i>	-	-	-	-	-	3	-	-	-	-	-	0	-	-	-	-	-	-	0	3
<i>Mimosaops obovata</i>	AS14	AS15	AS13	AS11	AS15	68	AS13	AS10	AS6	AS6	AS4	39	AS7	AS5	AS8	AS8	AS7	AS6	1	1
<i>Moringa oleifera</i>	FA1	FA7	FA1	-	-	9	-	FA3	FA1	-	FA4	8	-	-	-	-	-	-	33	140



TABLE 2: Continued.

Species name	Districts and municipalities										Sum of overall ailment treated per species									
	Caprictorn			Sekhukhune				Waterberg												
	Aganang	Bloberg	Lepelle-Nkumpi	Molemole	Polokwane	Sum of ailment (FC)	Elias Moseotaledi	Ephrine Mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of ailment (FC)	Bela-Bela	Lephalale	Modimolle	Mogalakwena	Mogogophong	Thubuzimbi	Sum of ailment (FC)	
<i>Olea europaea</i>	-	-	-	-	-	0	-	-	AS1	-	AS4	5	-	-	-	-	-	-	0	5
<i>Opuntia ficus-indica</i>	-	AS1	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
	-	-	AS:4	AS:6	-	10	-	-	-	-	AS:4	4	-	-	-	-	-	-	0	14
<i>Osyris lanceolata</i>	-	-	-	-	-	0	-	FA:1*	-	-	-	1	-	-	-	-	-	-	0	1
	LB:1**	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
<i>Panicum granatum</i>	-	-	-	-	-	0	-	-	AS1	-	-	1	-	-	-	-	-	-	0	1
<i>Peltophorum africanum</i>	AS1**	-	AS:1*	-	-	2	-	AS:1*	-	-	-	1	-	-	-	-	-	-	0	3
	-	FA:1**	-	FA:3	FA:1	5	-	-	-	FA:6	-	6	-	-	-	-	-	-	0	11
<i>Plumbago zeylanica</i>	-	-	-	-	-	0	-	-	-	-	-	0	AS:4	-	-	-	-	-	4	4
	-	-	-	-	-	0	NC:1	-	-	-	-	1	-	-	-	-	-	-	0	1
<i>Protea caffra</i>	-	-	AS1	-	AS:3	4	-	-	-	-	-	0	AS:1	-	-	-	AS:3	-	4	8
<i>Pseudogaphalium luteo-album</i>	-	-	-	-	-	0	FA:1	-	-	-	-	1	-	-	-	-	-	-	0	1
	-	-	-	-	-	0	FA:1	-	-	-	FA:1	2	-	-	-	-	-	-	0	2
<i>Psidium punctulata</i>	-	-	AS:3	-	-	3	-	-	-	-	-	0	AS:1	-	-	AS:3	-	-	4	7
	-	-	NC:6	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	0	6
<i>Pterocyanon obliquum</i>	-	-	-	-	AS:15	15	-	AS:10	-	-	-	10	-	-	-	-	-	-	0	25
<i>Pyrenacantha grandiflora</i>	-	-	-	-	-	0	AS:1**	-	-	-	-	1	-	-	-	-	-	-	0	1
<i>Rhoicissus tomentosa</i>	-	-	-	-	-	0	-	-	-	-	AS:4	4	-	-	-	-	-	-	0	4
	-	-	AS:1	-	-	1	FA:3	-	-	-	FA:1	4	-	-	-	-	-	-	0	1
<i>Schinus molle</i>	-	-	-	-	-	1	-	-	-	-	-	2	-	LB:1	-	-	-	-	0	2
<i>Schizoglossum nitidum</i>	-	-	-	-	-	0	-	AS:2	-	-	-	0	-	-	-	-	-	-	0	2
	-	-	NC:1	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	0	1
<i>Schukeria pinata</i>	-	-	-	-	-	0	AS:1**	-	-	-	-	1	-	-	-	-	-	-	0	1
<i>Sciencarya birrea</i>	AS:1:13	AS:15	AS:13	AS:11	AS:15	68	AS:13	AS:1:9	AS:6	AS:6	AS:4	39	AS:7	AS:5	-	AS:8	AS:7	AS:6	33	140

TABLE 2: Continued.

Species name	Districts and municipalities										Sum of overall ailment treated per species								
	Capricorn			Sekhukhune				Waterberg											
	Aganang	Bloberg	Leppelle-Nkumpi	Molemole	Polokwane	Sum of ailment (FC)	Elias Motosoledi	Ephrine Mogale	Fetakgomo	Makhudumathamaga	Tubatse	Sum of ailment (FC)	Bela-Bela	Lephalale	Modimolle	Mogalakwena	Moekgophong	Thabazimbi	Sum of ailment (FC)
<i>Securidaca longepedunculata</i>	-	-	-	-	-	0	-	-	-	-	-	0	AS:1	-	AS:1	-	-	-	2
<i>Senecio serratioides</i>	-	-	AS:4	-	-	4	-	-	-	-	-	0	-	-	-	-	-	-	4
<i>Senecio italica</i>	-	-	-	-	-	0	-	FA:1	-	FA:3	-	4	-	-	-	-	-	-	4
<i>Sida cordifolia</i>	-	AS:1	-	-	-	1	-	WH:4	-	-	-	4	-	-	-	-	-	-	4
<i>Siphonochilus aethiopicus</i>	-	-	-	-	AS:3	3	-	AS:1*	-	-	-	0	AS:7	-	-	-	-	-	7
<i>Solanum catumbelense</i>	-	-	-	-	-	0	-	AS:1*	-	-	-	1	-	-	-	-	-	-	1
<i>Solanum pendulariforme</i>	-	-	-	-	-	0	-	-	-	-	-	0	AS:1	AS:1	-	-	-	-	2
<i>Sorghum bicolor</i>	-	-	-	-	-	0	-	-	-	FA:6	-	6	-	-	-	-	-	-	6
<i>Strophanthus speciosus</i>	AS:10	-	-	-	AS:1	11	AS:2	-	-	-	-	2	AS:2	-	-	-	-	-	15
<i>Sylochaeton natalensis</i>	AS:14	AS:15	AS:13	AS:11	AS:15	68	AS:13	AS:10	AS:6	AS:6	AS:4	39	AS:7	AS:5	-	AS:8	AS:7	AS:6	140
<i>Tagetes dioica</i>	-	-	-	-	-	0	-	FA:1*	-	-	-	1	-	-	-	-	-	-	1
<i>Tulbaghia violacea</i>	-	-	-	-	-	0	-	NC:2	-	-	-	2	-	-	-	-	-	-	2
<i>Vepris reflexa</i>	-	-	-	-	-	0	FA:1	FA:1	-	-	-	2	-	-	-	-	-	-	2
<i>Vernonia natalensis</i>	-	AS:3	-	-	AS:11	14	-	-	-	-	-	0	-	-	-	-	-	-	14
<i>Warburgia sudanensis</i>	-	-	NC:8	-	-	8	-	NC:1	NC:1	NC:2	NC:1	5	-	-	-	-	AS:4	-	13
<i>Withania somnifera</i>	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	-	-	4
<i>Xerophyta retinervis</i>	-	-	-	-	-	0	-	-	-	FA:6	-	6	WH:7	-	-	-	-	-	7
<i>Ximenesia coffea</i>	AS:1*	-	-	-	-	1	-	-	AS:3	AS:1	-	4	-	-	-	-	-	-	1
<i>Zantedeschia aethiopica</i>	-	-	AS:6	-	-	7	-	AS:1	-	-	-	1	-	-	-	-	-	-	8
<i>Zanthoxylum capense</i>	-	-	AS:7	-	AS:1*	7	-	-	-	-	-	0	AS:1	-	-	-	AS:4	-	7
<i>Zea mays</i>	-	-	WH:1	-	-	1	-	-	-	WH:6	-	6	-	-	-	-	-	-	7
<i>Ziziphium mucronata</i>	-	-	-	-	-	0	-	-	-	-	-	0	-	-	-	-	AS:1	-	1

Key: Fatigue; FA, laboured breathing; LB, nasal congestion; NC, wheezing; WH. Plain numeric indicate number of healer/s who use a species to treat an ailment whilst numeric with a quotation mark indicate number of healer/s who use a species in combination to treat an ailment/s.

THs of KwaZulu-Natal Province noted *A. amatymbica* as a valued medicine for asthma. In other studies conducted in Zimbabwe [41, 42], this species was amongst the ten most used asthma remedies. However, in the present study, *A. amatymbica* was only used by 7.8% (n=11) of all 58.3% (n=140) THs who treated asthma, which might be attributed to its rare status across the country [43]. In view of this and the fact that asthma is a chronic disorder requiring a readily available medicine for its management, most THs in this study might have less preferred and considered *A. amatymbica* therapies as unsustainable.

The knowledge of *D. anomala* use by Bapedi THs to treat asthma is supported by finding of Van der Merwe [44] who worked with Zulu THs. In fact most of the previously ethnobotanically validated asthmatic species used in the current study corroborate with those used by Zulu, compared to with other cultures.

Use of *L. leonurus* as recorded in this study was previously noted by Hutchings et al. [23] who questioned Zulu THs and Nzue [45] who worked with Rastafarians of Western Cape Province of South Africa. Similar finding was reported amongst Swati THs residing in Swaziland [46]. The observed similarities regarding the application of *L. leonurus* amongst South African and Swazi healers might be due to a cross-border transfer/exchange of knowledge. This posit is ascribed to the fact that most of Swaziland is locked within South Africa, which might had allowed easy transfers of knowledge amongst THs across geographical borders.

Similarly to Bapedi THs, Zulu also use *S. aethiopicus* as asthma medicine [23]. Widespread use of this species in the treatment of respiratory infections including asthma by Zulu THs has wiped out its entire local population within the communal lands in KwaZulu-Natal Province [47]. However, in the present study extent of use of *S. aethiopicus* specifically for asthma might currently not have profound impact on reduction of its natural population based on the fact that it is only used by 0.7% (n=1) and also in combination with other species, which both put less harvesting pressure on the population.

The utilisation of *X. retinervis* [48] and *Z. mucronata* [49] by Bapedi THs in the treatment of asthma was previously highlighted by the mentioned authors amongst the unspecified South African ethnic groups. Extracts of *X. retinervis* [50] and *Z. mucronata* [51] were active against pathogens causing respiratory infections, which may possibly indicate that they might be helpful in the management of asthma or related symptoms.

With the exclusion of *Z. aethiopicus* which is also used as medicine for asthma by the Xhosa people of South Africa [52], the remaining species, namely, *E. camaldulensis*, *M. indica*, *O. ficus-indica*, *P. granatum*, *S. longepedunculata*, *X. caffra*, and *Z. mays*, used exclusively by Bapedi for this condition, are recorded for the first time in South Africa as asthma therapies. However, their use in the treatment and management of this condition is common in other African countries or elsewhere. For instance, Nigerian THs also use *E. camaldulensis* [53], *M. indica* [54], and *S. longepedunculata* [55] to treat asthma. Comparably to our findings, Naoumi [17] reported the use of *M. indica* and *Z. mays* as medicines

for this ailment by THs in Cameroon. Utilisation of *X. caffra* as asthma therapy is also common in Swaziland [56]. These findings support the general notion that Africans share the same indigenous knowledge [57].

To the best of our knowledge ethnobotanical records regarding uses of *G. herbaceum*, *O. europaea*, *O. ficus-indica*, and *P. granatum* in the management of asthma are nonexistent in Africa, thus noted in this study for the first time. However, the taxa *G. herbaceum* [58], *O. europaea* [59], *O. ficus-indica* [60], and *P. granatum* [61] are all used in other continents of the world comparably to Bapedi THs, subsequently, indicating that these species might be helpful as asthma remedies. Some of the aforementioned taxa, notably *E. camaldulensis*, *M. indica*, *O. ficus-indica*, *P. granatum*, and *Z. mays*, are exotic in South Africa, thus suggesting two things: (i) that the original knowledge of their application for asthma by Bapedi was obtained via interactions with outside THs and/or (ii) was given by ancestors via dreams. The last posit is based on the fact that most of interviewed THs claimed that their ancestors show them new uses of medicinal plants via dreams while asleep. In general, fruits of *M. indica*, *O. europaea*, *O. ficus-indica*, *P. granatum*, *X. caffra*, and *Z. mays* were stated by THs as also being harvested for household consumption. Therefore an investigation into the potential of fruits from these species as asthma therapies will be interesting, and if effective it should be manufactured as beverages that assist in the asthma management. Ethanol extracts (100 mg/kg, p.o.) of *P. granatum* [61] and aqueous extract of *O. europaea* [62] fruits have already demonstrated a significant antiasthmatic activity at experimental model [61].

**3.4.2. Asthma and Related Symptoms Therapies.** As noted earlier, 25.9% (n=27) of species were multiused by THs to treat asthma and the following symptoms: fatigue, nasal congestion, tight chest, wheeze, laboured breathing, nasal congestion and wheezing, fatigue and wheezing, and fatigue and laboured breathing, as well as fatigue, laboured breathing, nasal congestion, and wheeze (Table 1). Amongst these plants, 37% (n=10) comprising *Aloe* spp., *A. fruticosa*, *Adenia spinosa*, *Callilepis laureola*, *Cyperus sexangularis*, *Elephantorrhiza burkei*, *Hypoxis hemerocallidea*, *M. juncea*, *Peltophorum africanum*, and *Protea caffra* were stated by THs as cure for asthma and fatigue. Of these taxa only use of *H. hemerocallidea* for asthma [63] and fatigue [64], as well as *P. africanum* for the latter condition [65], was previously reported in ethnobotanical literature. Use of *H. hemerocallidea* to cure fatigue by Bapedi THs was expected mainly due to its popularity as effective energy-booster. For instance, in almost every pharmaceutical chemist in Limpopo Province, there are various scientifically authenticated herbal formulations (e.g., Hypo-Plus®) made from *H. hemerocallidea* [66], which are being advertised on local radios and newspapers as effective energy and immune boosters. Thus, Bapedi THs might have had a talk about this and decided to include *H. hemerocallidea* as part of their fatigue treatment in asthma sufferers. On the other hand, use of this species as antiasthma by Bapedi THs might be due to its efficacy in the management of asthma and related conditions, attributed to its antiinflammatory activity [67]. The use *A. fruticosa*, *A. spinosa*, *C. laureola*,

*C. abbreviata*, *C. sexangularis*, *E. burkei*, *M. juncea*, *P. caffra* (asthma and fatigue), and *P. africanum* (asthma) as therapies for the mentioned ailments as disclosed by Bapedi THs was not found in literature, thus reported in the present study for the first time.

Species used as medicine for asthma and nasal congestion made up 18.5% (n=5) and included *K. wilmsii*, *P. punctulata*, *P. zeylanica*, *S. nitidum*, and *V. natalensis*. Amongst these species only *P. zeylanica* [68] and *P. punctulata* [69] were previously recorded in literature as asthma treatment but no records of its applications for nasal congestion exist. Restricted uses of *K. wilmsii* to Bapedi THs as medicine for these illnesses might be due to the fact that it is localised in the Capricorn and Sekhukhune districts (Limpopo Province) both mainly inhabited by the Bapedi culture. This might be true since the known general medicinal usage of *K. wilmsii* is presently restricted to this culture.

Only 7.4% (n=2) of species *C. sativa* and *L. caffer* were used to heal asthma and tight chest in this study. Utilisation of *C. sativa* as asthma medication was previously noted by Van Wyk and Gericke [70] amongst the unspecified South African ethnic groups. Its use for tight chest is recorded in our study for the first time in African ethnobotanical literature. However, *C. sativa* is commonly used for this condition by THs in Pakistan [71]. Its restricted uses for tight chest to Bapedi THs across Africa might somewhat be attributed to the fact that it is a legally declared drug; thus any person who is found in its possession without a permit is prosecuted. In fear of this most THs might retaliate to divulge its uses to researchers. No ethnobotanical record of *L. caffer* as treatment of asthma and tight chest was found in literature. However, this species was used by all interviewed Bapedi THs (n=140) as cure for asthma, which might be a reflection of its bioactivity against this condition.

Asthma and wheeze were also treated with two (7.4%) species, namely, *W. salutaris* and *Z. capense*. Amongst these trees only use of *W. salutaris* as antiasthma was previously reported in literature [23, 71]. The remainder of documented uses of both the aforesaid trees is reported for the first time in this study. However, lack of literature based information regarding their use for wheeze is understandable, based on the fact that this condition is one of the key symptoms of asthma. Consequently, THs of other cultures might have realised that a successful asthma treatment or management with *W. salutaris* and *Z. capense* automatically addresses all symptoms. It is also possible that use of these species by Bapedi for wheeze has specific impact on reducing constriction in the airways, and thus contributing towards reduction of wheeze sound.

Species used in the present study for asthma and laboured breathing were only (3.7%, n=1) *A. sativum*. The stated uses of this species are recorded in our study for the first time in South Africa but are common in other countries. For instance, its use as asthma medicine was previously reported in Egypt [72] and Nigeria [73]. However, as far as our literature search went, application of *A. sativum* for laboured breathing is presently restricted to Bapedi THs in Africa but used as such by THs in India [74]. Limited use of this species amongst indigenous people of South Africa might be due to

the fact that it is mostly found in the markets. Thus in view of chronic nature of asthma and lack of income to frequently purchase its material, native people might have opted for an alternative species available in free access communal lands. Few (n=2) of Bapedi THs who use *A. sativum* in the present study harvest it from home gardens.

Asthma, nasal congestion, and wheezing were treated with two (7.4%, n=2) aromatic species *A. afra* and *C. gratissimus*. Utilisation of both species for wheezing is currently restricted to the Bapedi THs. However, our finding regarding use of *A. afra* in the treatment of asthma and nasal congestion coincides with that reported by Mukinda [75] amongst Xhosa THs of the Western Cape Province (South Africa). Similarly, application of *C. gratissimus* for asthma as noted in the present study was previously highlighted by Morobe et al. [76] in South Africa. No previous record of *C. gratissimus* as nasal congestion remedy was found in literature; thus it is reported for the first time in the present survey.

A total of two (7.4%) species *D. elata* and *S. serratuloides* were multiused by Bapedi THs to cure asthma, fatigue, and wheezing. Only use of *D. elata* as medicine for the first condition was previously highlighted in ethnobotanical literature [77]. The remainder of the applications of aforesaid species is currently restricted to Bapedi THs. Anti-inflammatory properties of *S. serratuloides* were reported by Fawole et al. [78], therefore suggesting that its use for asthma and related condition in the present study might be effective.

Another 7.4% (n=2) of species (*Schinus molle* and *O. lanceolata*) were multiused by Bapedi THs for asthma, fatigue, and laboured breathing. With the exclusion of using an exotic *S. molle* as asthma medication which was culturally validated in Peru [79], application of the rest of species is reported for the first time in this study across South Africa and Africa as a continent.

Overall an aromatic herb *L. javanica* was the only (3.7%, n=1) species widely used by Bapedi THs. For instance, it was multiused as medicine to heal asthma, fatigue, laboured breathing, nasal congestion, and wheeze. Use of *L. javanica* to treat asthma [80], fatigue, and nasal congestion [26] as well as laboured breathing [81] is common amongst other South African cultures. However, its use for wheeze is presently restricted to the Bapedi THs. In general, wide usage of *L. javanica* for asthma and perceived related symptoms by these THs might be ascribed to its wide local abundance across the Limpopo Province, and its popularity as treatment of respiratory infections [51].

**3.4.3. Therapies for Asthma Symptoms.** The rest (24.0%, n=25) of the species recorded in this study as part of asthma management were exclusively used by THs to treat various conditions they perceived as being associated with this inflammatory condition (Table 1). Amongst these plants 88% (n=22) were used to treat a single ailment, namely, fatigue (*A. digitata*, *A. adianthifolia*, *A. falcata*, *B. diversispina*, *B. subvolubilis*, *C. edulis*, *C. ilicifolia*, *D. rotundifolia*, *E. goetzei*, *H. caespitium*, *H. obtusa*, *M. oleifera*, *P. luteo-album*, *S. bicolor*, *T. dioica*, and *V. reflexa*), laboured breathing (*D. viscosa*), nasal congestion (*G. hispida*, *K. brachyloba*, and *T.*

*violacea*), tight chest (*C. limon*), and wheezing (*E. lysistemon*). The remainder (12%, n=3) of the species, namely, *E. autumnalis* (fatigue, nasal congestion), *E. pallidiflora* (fatigue, nasal congestion, and wheeze), and *W. somnifera* (fatigue and laboured breathing) were multiused. Overall, applications of an overwhelming majority of the above-listed species by THs are recorded for the first time in this study. For instance, with the exclusion of *A. digitata* [82], *C. edulis* [83], *M. oleifera* [84], and *W. somnifera* [85, 86], which their utilisation as mentioned by Bapedi was previously highlighted in African literature, use/s of the remaining species are currently restricted to Bapedi THs. Overall, a larger number of the above-mentioned new medicinal use of commonly known species by Bapedi THs would let one believe that they are still experimenting or further exploring other potential uses of local flora with the hope of discovering new effective plants that could contribute towards the wellbeing of asthmatic patients.

**3.5. Fidelity Level (FL) and Use Value (UV).** Fidelity levels of the recorded plant species differed widely for specific disease/s. The maximum fidelity level of 100% was reported for 71.1% (n=74) of species, with the majority having extremely lower use-mention (UM) against a particular ailment (Table 1). Indeed Ong and Kim [87], stated that high FL can only imply that a particular plant is most preferred if there is considerable number of use-mentions from participants. Therefore, we have correlated FL and UM in order to establish the accurate FL of each species. In this regard, species with 100% FL coupled with use mentioned of less than 15 times were not considered. Accordingly, *S. birrea* (UM = 140 and FL = 100; asthma), *S. natalensis* (UM = 140 and FL = 100; asthma), *E. axillare* (UM = 140 and FL = 100; asthma), *C. ternatum* (UM = 140 and FL = 100; asthma), *C. transvaalensis* (UM = 140 and FL = 100; asthma), *M. obovata* (UM = 140 and FL = 100; asthma), *L. caffer* (UM = 140 and FL = 100; asthma, and UM = 17 and FL = 10.8; tight chest), *C. sexangularis* (UM = 58 and FL = 89.2; fatigue), *A. digitata* (UM = 68 and FL = 100; fatigue), *G. herbaceum* (UM = 70 and FL = 100; asthma), *A. afra* (UM = 25 and FL = 75.7%; asthma), *A. spinosa* (UM = 25 and FL = 30.4; asthma and UM = 57 and FL = 69.5; fatigue), *P. obliquum* (UM = 25 and FL = 100), *E. schinzii* (UM = 19 and FL = 100; asthma), *M. oleifera* (UM = 17 and FL = 100; fatigue), and *S. speciosus* (UM = 15 and FL = 100; asthma), respectively, scored the highest FL amongst the plants used by Bapedi THs for asthma and related symptoms, thus suggesting their potential as therapies against the noted corresponding specific conditions. *Adenia spinosa* and *L. caffer* which were used to treat two conditions could be of great importance in the management of various ailments.

Relatively high UVs was observed for *L. caffer* (UV = 1.2; asthma and tight chest), *M. obovata* (UV = 1; asthma), *C. ternatum* (UV = 1; asthma), *C. transvaalensis* (UV = 1; asthma), *E. axillare* (UV = 1; asthma), *S. natalensis* (UV = 1; asthma), and *S. birrea* (UV = 1; asthma). As noted earlier all these species exhibited maximum (100%) FL as antiasthmatics therapies; thus their highest UV for similar treatment further accentuates their prospective in the management of asthma.

**3.6. Plant Parts Used, Mode of Preparations, Dosages, and Administrations.** The majority of the herbal medicines used by Bapedi THs as asthma and related symptoms therapies were mainly prepared from root (57%, n=61), leaf (15.8%, n=17), bark (7.5%, n=8), bulb and whole plant (5.6%, n=6, for each), fruit and tuber (2.8%, n=3 for each), seed, stem, and rhizome (0.9%, n=1, for each), respectively. Three species, *L. leonurus* (root and leaf), *S. birrea* (bark and fruit), and *P. africanum* (bark and root), were harvested for their two different parts. Contrary to the results of the present study, Sonibare and Gbile [18] found that THs in Nigeria prefer stem bark to make asthma remedies. Extensive use of root in this study was based on the perception that it carries more healing power as opposed to other plant parts, a finding which was previously reported by Semenya [88], who worked with Bapedi THs. Indeed it has been scientifically demonstrated that plant root contains many bioactive principles [88]. However, extensive exploitation of roots by these THs should proceed with caution as it might endanger the species. Higher usage of leaves by Bapedi THs might be linked to their ease of collection and transportation, both compared with other parts.

The above-mentioned plant parts (n=107) used for herbal preparation were mostly processed by Bapedi THs in their dried states (78.5%, n=84) than when they are fresh (21.4%, n=23). This finding might be attributed to the fact that these THs preserve most of their medicine in dried form for future uses. *Sclerocarya birrea* was processed in both dried and fresh states. Overall, a total of 153 recipes were used by Bapedi THs to treat asthma. Of these formulae, monotherapies (75.1%, n = 115) based on a single plant preparation were dominant. A similar finding was noted by Noumi [17] in Cameroon. On the contrary Sonibare and Gbile [18] found that more of herbal medicine prescribed by THs in Nigeria are made from more than one species (multitherapies) in Nigeria. High use of monotherapies by Bapedi THs is perhaps an indication of the effectiveness of used plant species. This is attributed to the fact that these healers are known to combine species for the increased efficacy [88]. Use of single therapies by Bapedi THs might also be due to simplifying the preparation and because of the nature of asthma. For instance asthma attack is in most cases sudden and thus requires immediate medical attention. In light of this an overwhelming majority of THs in this study might prefer preparing medicine from a single species (which is both straightforward and less time consuming) in case of exigency. Only 24.8% (n=38) of the herbal preparations used by interviewed Bapedi THs were multitherapies (Table 1). Healers who utilised this recipe disclosed that it enhances the effectiveness of medicine, which could be due to synergistic effects of several plant compounds that are active singly. However, this postulation warrants further investigations.

Remedies were prepared via boiling, macerating, pounding, squeezing, and rubbing and raw (prescribed as harvested). Harvested parts from certain plant were prepared using more than one method or a same technique was used differently amid THs (Table 1). Boiling (48.3%, n=74), pounding (45%, n=69), pounding and boiling (2.6%, n=4), chewing and macerating (1.3%, n=2, for each), rubbing (0.6%, n=1), and squeezing and pounding (0.6%, n=1), respectively, were

the principal methods of herbal preparation in the present study. Most of these methods are consistently reported in various ethnobotanical surveys conducted in Africa [17, 18] and elsewhere [89] focusing on asthma. High usage of boiling plant parts by Bapedi THs might be due to the simplicity of preparation. Bapedi THs prefer pounded remedies because they have a far longer shelf life for the preparation [90]. Depending on an individual healer's preference, a minimum of two to a maximum of 14 minutes was used to boil various plant parts. Plant parts were pounded with grinding stones and metal equipment. Preparation times of these parts via maceration technique by Bapedi THs took from three to 24 hours (depending on an individual healer), which could explain its limited preference in this study. On the other hand, limited utilisation of squeezing and rubbing (n=1, for each) amongst Bapedi THs might be attributed to the seasonal availability of fresh fruits and leaves, respectively (Table 1).

The present study further assessed the different modes of application of the prepared remedies. Accordingly, of the 153 recorded recipes used for asthma and related symptoms, 80.9% (n=123) were administered orally, 19% (n=29) nasally, and 0.6% (n=1) topically. Naoumi [17] also found that most of the asthma medicines in his study are administered orally with very few which were taken topically. Distinct preferences of oral as route of herbal administration by Bapedi THs might be attributed to its convenience, for instance, it is straightforward and thus requires no special training. In addition its dosages can easily be premeasured.

Dosage strength of herbal remedy recorded in this study was also determined (Table 1). Overall there was a high consistency with regard to the boiled medicines taken orally. For example, a metal cup (500 ml) full of liquid preparations was prescribed by all THs three times a day (morning, mid-day, and evening). However, dosage inconsistency amongst interviewed Bapedi THs was noted for some preparations. This included boiled medicines administered nasally under a blanket, the dosage strength of which depended on an individual healer. Similarly, depending on individual healer two to five table spoons of pounded plant parts were mainly prescribed with a metal cup (500 ml) full of warm water. Some THs prescribed pounded plant parts with this cup but full of Mageu® drink or soft porridge. Lack of precision and standardization in the measurement of herbal medicine amongst Bapedi THs is one weakness of their traditional healthcare system.

#### 4. Conclusions

The present study is the first to explore plants used traditionally to treat asthma and related conditions in South Africa. Overall the most widely distributed and highly used medicinal plants by all interviewed Bapedi THs (n=140) who treated asthma were *C. ternatum*, *C. transvaalensis*, *L. caffer*, *E. axillare*, *M. obovata*, *S. birrea*, and *S. natalensis*. The traditional applications of some species used by these THs to treat asthma and related conditions are comparable to that noted in literature amongst the various cultures in South Africa, other African countries, and elsewhere; thus demonstrating that there is a cultural link between diverse ethnic groups

of the world, and exchange of traditional healing knowledge pertinent to these afflictions. Our study also recorded a larger number of new records of known medicinal plants used in traditional healing by various cultures across South Africa and Africa at large, a finding which contributes towards establishments of an African database of antiasthma plants and a new solid lead towards search for bioactive compounds against asthma.

#### Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

#### Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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