

# Ethnobotanical study of curative plants used by traditional healers to treat rhinitis in the Limpopo Province, South Africa

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## Abstract

**Background:** Studies focusing on plants used medicinally to heal and manage rhinitis are very scarce in Africa and elsewhere.

**Objectives:** To document plants used by traditional healers (THs) in the treatment and management of rhinitis and related symptoms in the Limpopo Province of South Africa.

**Methods:** Data was gathered using a semi structured interviews with 105 THs in the Limpopo Province, supplemented by field expeditions for plant specimen collection and observation.

**Results:** 63 plant species from 59 genera distributed across 40 botanical families, mainly the *Asteraceae* (7 spp.) and *Euphorbiaceae* (6 spp.) were therapeutically used by THs. Overall, 77 herbal recipes (87%=mono and 12.9%=poly), mainly prepared from roots (55.5%) and leaves (19%) were recorded. Most of these recipes were processed via pounding (59.7%) and boiling (20.7%). Oral (44.1%) and nasal (33.7%) was the preferred modes of dispensing remedies by THs. *Artemisia afra*, *Clerodendrum ternatum*, *Cryptocarya transvaalensis*, *Enicostema axillare*, *Kalanchoe brachyloba*, *Lasiosiphon caffer*, *Lippia javanica*, *Schkuhria pinnata*, *Securidaca longepedunculata*, *Spirostachys africana*, *Stylochaeton natalensis* and *Zanthoxylum capense* were the most widely used and preferred species for treatment of rhinitis and/or related symptom by all questioned THs.

**Conclusion:** This study is the first to document plants used traditionally to treat rhinitis in Africa. Therefore, it provides a baseline data on the plants used to heal rhinitis in the Limpopo Province. Finding of this study can be used as a pedestal for further investigation in to effective plant-based anti-rhinitis drugs.

**Keywords:** Bapedi, Limpopo, traditional healers, rhinitis.

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## Introduction

Rhinitis is a respiratory affliction that is characterised by inflammation of the nasal mucosa<sup>1</sup>. This complaint can either be allergic and non-allergic. Overall, rhinitis is a significant cause of both the widespread morbidity and medical treatment costs in many countries worldwide. It is estimated that over 400 million people inhabiting both developed and developing countries are diagnosed with

this condition<sup>2</sup>. For instance, up to 40% of children, and approximately 20% of the adult population in the United States of America were previously reported to suffer from rhinitis<sup>3</sup>. The latter occurrence is lower compared to 29.8% noted by Morais-Almeida et al.<sup>4</sup> amongst the adult subjects residing in Portugal. Eriksson<sup>5</sup> reported 26.9% prevalence of rhinitis amid the West Swedenees population.

Incidence of rhinitis is also common in Africa, and here it varies according to the geographical location as well as age group. In Nigeria the prevalence of 29.6% amongst adults aged between 18 and 45 years was previously registered<sup>6</sup>. The occurrence of rhinitis in this age brackets was 10.4% in Cameroon<sup>7</sup>. This respiratory infection affected at least 15.3% of Egyptian population aged 11–15 year

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olds<sup>8</sup>. In South Africa, there are extremely few epidemiological studies that addressed the prevalent of rhinitis. However, available study; Zar et al.<sup>9</sup>, was conducted in two phases carried out seven years apart, amongst the 13–14 year olds adolescents in randomly selected South African schools. The outcomes of this surveys indicated that the incidence of rhinitis amongst these subjects had increased significantly between two time points. For instance, in phase I of the investigation, conducted in 1995, the prevalence was 30.4%, and by phase II in 2003, the occurrence had gone up to 38.5%. The possible reasons for this drastic increase in the incidence of rhinitis could be attributed to the increasing prevalence of contributing factors.

Although sometimes rhinitis is mistakenly viewed as a trivial disease, its symptoms may significantly affect a patient's quality of life<sup>10</sup>. Different disorders that are associated to this respiratory infection include bronchial asthma, sinusitis, otitis media, nasosinusal polyposis, respiratory infections and alterations in dental occlusion<sup>11</sup>. In addition, conditions such as headache, cognitive impairment, nasal obstruction, nasal itching, sneezing and watery rhinorrhoea are also common in rhinitis suffer<sup>12</sup>. Therefore, appropriate management of this respiratory affliction may be an important component in effective management of all the above stated coexisting or complicating respiratory ailments.

According to DeGuzman et al.<sup>13</sup>, management approaches of rhinitis by western health care professionals in Africa and elsewhere include educating patients about the various strategies to avoid risk factors such as animals and insect allergens, house dust mites, molds and

pollens, amongst other factors. Therapeutic options or pharmacological agents such as anti-H1 antihistamines, intranasal corticosteroids, topical anticholinergic, topical or oral vasoconstrictors and sodium cromoglycate are also prescribed by these professionals as part of rhinitis treatment and management<sup>14</sup>. Despite the evidence indicating prevalence of rhinitis and its management approaches employed by western health professionals; little is still known about the herbal medications implicated by the aboriginal health care providers as treatment of this affliction. However, few attempts to address this gap in knowledge have been made in countries such as Turkey<sup>15</sup> and India<sup>16</sup>. In Africa as a continent wherein over 80% of the population relies on traditional medicines and healers' health care services either as the only option or the preferred option<sup>17</sup>, ethnobotanical studies focusing on the treatment of rhinitis are lacking. The aim of the present study is therefore, to investigate the therapeutic plants implicated by traditional healers in the Limpopo Province against rhinitis.

## Methods

### Study area and population

The area selected for survey was the municipalities of Capricorn, Sekhukhune and Waterberg districts, in the Limpopo Province, South Africa (Figure 1). Five villages from each municipality were selected as study sites. Generally, most of these settlements are poorly developed and lack basic infrastructures such as sanitations, roads and healthcare facilities.

The populace of the sampled districts comprised of different ethnic groups, with Bapedi who speak Sepedi language being the largest group, comprising about 50% of the entire population<sup>18</sup>.



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

## Ethnobotanical survey and data collection

The ethical approval to conduct the present study was obtained from the Ethical Review Committee of the University of Fort Hare (Ref: MAR001SSEMO1). Prior to the field survey, permission to conduct an investigation was sought from the local tribal leaders of each sampled village, and subsequently THs were requested to take part in this study. Both the local community leaders and all the THs were informed about the purpose of the survey. Traditional healers who agreed to participate in the study were asked to sign a consent form before being questioned.

Data was collected from May 2017 to October 2017 using semi structure questionnaires during face-to-face interview with 105 THs who were conveniently chosen (i.e., with the help of local leaders and THs). The questionnaire was designed to capture information on the local name of used medicinal plants by THs to treat rhinitis, used plant part/s, mode of herbal preparation, administration and dosage prescription. Interviews were conducted by researchers, independently for each traditional healer in Sepedi language.

The data obtained from questionnaire guides was supplemented by independent field walk with each traditional healer for the practical identification of used medicinal plants and direct observations on their characteristics. During field trips plants were initially pointed-out by THs via vernacular names and subsequently researchers collected the voucher specimens. The collected plant samples were prepared (i.e., numbered, pressed and dried) and deposited at the Larry Leach Herbarium (University of Limpopo) for scientific identification by a trained taxonomist.

## Data analysis

### Micro Soft Excel and Statistical Package for the Social Sciences (SPSS)

Data from ethnobotanical surveys was analysed using Microsoft Excel 2000 and SPSS programmes by means of descriptive statistics. These programmes were used to identify proportions of plant families, habits, used species and their parts, condition of medicinal plant part/s use (fresh/dried), mode of remedies preparations and administration, amongst the other information.

## Fidelity level (FL)

The FL was employed to quantify the percentages of THs claiming the use of a certain plant for rhinitis and/related symptom/s. This was determined following the method of Al-Quran<sup>19</sup>:

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

Where Np was the number of THs who independently used a particular plant species to treat rhinitis and/or related symptom, and N was the total number of THs who reported the plant as a medicine to treat any given disease (rhinitis or related symptom/s). The FL index shows the degree of homogeneity on the informant's knowledge regarding the medical application of a particular medicinal plant species against a specific ailment<sup>19</sup>, therefore it reveals the most utilised and avoided species.

## Use value (UV)

Use value provides a good measure to estimate all the possible uses of an individual plant species. An individual plant-disease-use combination mentioned by Bapedi THs for rhinitis and related symptoms was evaluated using the formula outlined below<sup>20</sup>:

$$UV = \sum \frac{U}{N}$$

Where U was the number of citations per species, and was N the total number of questioned THs. Generally, UV for a plant is high when there are corresponding broad therapeutic applications coupled with a relatively high use mentioned (UM) by participants<sup>20</sup>.

## Results

### Diversity of used plant species

In the present study a total of 63 plant species (55 indigenous and 8 exotics) from 59 genera distributed across 40 botanical families, mainly the *Asteraceae* (7 spp.), *Euphorbiaceae* (6 spp.) and *Malvaceae* (4 spp.) were used by 105 Bapedi THs to treat rhinitis and various symptoms they perceived as related to this respiratory infection (Table 1). Amongst these plant species, only 19% (n=12) comprising of *Artemisia afra*, *Clerodendrum ternatum*, *Cryptocarya transvaalensis*, *Enicostema axillare*, *Kalanchoe brachyloba*, *Lasiotisiphon caffra*, *Lippia javanica*, *Schkuhria pinnata*, *Securidaca longepedunculata*, *Spirostachys africana*, *Stylochaeton natalensis* and *Zanthoxylum capense* were most widely distributed and used by all THs (n=105) who treated rhinitis across the studied districts and municipalities.

**Table 1:** Medicinal plants used by Bapedi traditional healers to treat rhinitis and related symptoms in the Limpopo Province, South Africa

Botanical family	Species name	Vernacular name	Habit	Used plant parts	State of use	Methods of herbal preparation and administration	Aliment / treated	Frequency of use; N=THs (105)		FL	UV
								UM	%		
Anacardiaceae	<i>Sclerocarya birrea</i> (A.Rich.) Hochst. subsp. <i>caffra</i> (Sond.)	Morula/Mokano	Tree	Fruit	Fresh	Juice is squeezed (raw), dried and pounded. Powder is poured in the hot water. Steam is inhaled (nasally) under blanket. Thrice a day	Rhinitis	3	2.8	100	0.02
Apiaceae	* <i>Daucus carota</i> L.	Mokherotse	Herb	Tuber	Fresh	Mixed with fresh root of <i>M. sapientum</i> . Macerated in cold water for 5 hrs. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	1	0.9	100	0.00
Apocynaceae	<i>Acokanthera rotundata</i> (Codd) Kupicha	Moethi	Shrub	Root	Dry	Pounded and a pinch of fingers is snuffed (nasally). Thrice a day	Rhinitis	10	9.5	100	0.09
Apocynaceae	<i>Strophanthus speciosus</i> (Ward & Harv.) Reber	Morarwane	Shrub	Root	Dry	Boiled for 6–12 minutes. Extract is taken orally. Thrice a day	Fatigue	23	21.9	100	0.21
Araceae	<i>Stylochaeton natalensis</i> Schott <i>Aloe spp.</i>	Mokunya/Mokušhete	Herb	Root	Dry	Boiled for 5 minutes. Steam inhaled (nasally) under blanket. Thrice a day	Rhinitis	102	100	100	1
						Pounded and poured in boiled water. Steam is inhaled (nasally) under blanket. Thrice a day	Rhinitis	3			
Asphodelaceae	<i>Aloe marlothii</i> A.Berger subsp. <i>Marlothii</i>	Thogo/ Marobadibogale	Shrub	Leaf	Fresh	Juice is squeezed (raw) and a drop is applied topically in the eyes. Thrice a day	Painful eyes	1	0.9	100	0.00
Asphodelaceae	<i>Artemisia afra</i> Jacq. ex Willd. var. <i>afra</i>	Sekgopha-sa-go-ema	Shrub	Leaf	Fresh	Juice is squeezed (raw) and a drop is applied topically in the eyes. Thrice a day	Painful eyes	1	0.9	100	0.00
Asteraceae	<i>Athrixia phylloides</i> DC	Legana/Moilanši	Herb	Leaf	Dry	Boiled for 4–5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Rhinitis	105	100	100	1
Asteraceae	<i>Geigeria burkei</i> Harv. subsp. <i>burkei</i> var. <i>hirtella</i> merxm	Mohlalhaiša/ Mmangwako	Shrub	Leaf	Dry	Pounded and taken orally with warm water. Thrice a day	Rhinitis	1	0.9	100	0.00
Asteraceae	<i>Kleinia longiflora</i> DC.	Mmagae/ Mmalefagong	Herb	Whole plant	Dry	Pounded and mixed with warm water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	26	24.7	100	0.24
Asteraceae	* <i>Schkuhria pinnata</i> (Lam.) Kuntze ex Thell.	Mmale	Shrub	Twig	Dry	Pounded and mixed with warm water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	50	47.6	100	0.47
Asteraceae	<i>Senecio serratulooides</i> DC.	Šathume/Mošășane/ Seralane	Herb	Whole plant	Fresh	Macerated in cold water for 5–24 hrs. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	105	100	100	1
Asteraceae	<i>Vernonia natalensis</i> Sch.Bip. ex Walp.	Legatuludi	Shrub	Leaf	Dry	Pounded and taken orally with warm water. Thrice a day	Fatigue	3	2.8	100	0.02
Asteraceae	<i>Markhamia zanzibarica</i> (Bojer ex DC.) K.Schum	Mošuhla	Herb	Leaf	Dry	Pounded and taken orally with warm water. Thrice a day	Headache	1	0.9	100	0.00
Bignoniaceae	<i>Commiphora marlothii</i> Engl.	Bolebatša	Tree	Root	Dry	Pounded and mixed with warm water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	4	3.8	100	0.03
Burseraceae	<i>Warburgia salutaris</i> (G.Bertol.) Chiov.	Mphaphapha	Tree	Root	Dry	Burned for about 4 seconds. Smoke is inhaled (nasally). Thrice a day	Rhinitis	1	0.9	100	0.03

Canellaceae	<i>Capparis tomentosa</i> Lam. <i>Cleome gynandra</i> L. <i>Gymnosporia maranguensis</i> (Loes.) Loes.	Molaka	Tree	Bark	Dry	Boiled for 4–11 minutes. Extract is taken orally. Thrice a day	Fatigue	1	0.9	33.3	0.02
							Headache	1	0.9	33.3	
							Pounded and mixed with dried powdered root of <i>Z. capense</i> . Taken orally with warm water. Thrice a day	Rhinitis	1	0.9	
Capparaceae	<i>Gymnosporia senegalensis</i> (Lam.) Loes.	Moopatladi	Tree	Root	Dry	Pounded and mixed with cold water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	1	0.9	100	0.00
Capparaceae	<i>Commelina africana</i> L. var. <i>Africana</i>	Lerotho	Herb	Leaf	Dry	Pounded and taken orally with warm water. Thrice a day	Rhinitis	1	0.9	100	0.00
Celastraceae	<i>Kalanchoe brachyloba</i> Welw. ex Britten	Mokgoropo	Tree	Root	Dry	Pounded and taken orally with soft porridge. Thrice a day	Headache	5	4.7	100	0.04
Celastraceae	<i>Cyperus sexangularis</i> Nees	Mphato	Tree	Root	Dry	Pounded and mixed with cold water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	4	3.8	100	0.03
Commelinaceae	<i>Euphorbia inaequilatera</i> Sond. var. <i>inaequilatera</i>	Bolebatša	Herb	Root	Dry	Boiled for 9–12 minutes. Drop of cold extract is applied topically in the eyes. Thrice a day	Painful eyes	1	0.9	100	0.00
Crassulaceae	<i>Croton menyharthii</i> Pax	Moethi/ Mošimanewanaga/ Moritšikana	Shrub	Leaf	Fresh	Rubbed (raw) between hands and vapour is inhaled (nasally). Thrice a day	Headache	105	100	100	1
Cyperaceae	<i>Euphorbia schinzii</i> Pax <i>Jatropha zeyheri</i> Sond.	Mohlahla	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Fatigue	75	72.3	100	0.72
							Pounded and mixed with powdered dried root of <i>S. italica</i> . Taken orally with soft porridge. Thrice a day	Fatigue	1		
Euphorbiaceae	<i>Spirostachys africana</i> Sond. <i>Tragia dioica</i> Sond.	Kgamaswana/ Mmatelaface	Herb	Whole plant	Dry	Burned for about 4–15 seconds. Smoke is inhaled (nasally). Thrice a day	Rhinitis	2	1.9	66.6	0.01
							Pounded and mixed with warm water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	1	0.9	
Euphorbiaceae	<i>Senna italica</i> Mill. subsp. <i>arachoides</i> (Burch.) Lock	Moologa	Tree	Root	Dry	Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Painful eyes	2	1.9	100	0.01
Euphorbiaceae	<i>Tylosema esculentum</i> (Burch.) A.Schreib. <i>Enicostema axillare</i> (Lam.) A.Raynal subsp. <i>Axillare</i>	Ngaka-dianya	Herb	Root	Dry	Boiled for 5–8 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Painful eyes	4	3.8	11.7	0.33
							Rhinitis	30	21.4	88.2	
Euphorbiaceae	<i>Clerodendrum ternatum</i> Schinz	Sephapabadiya	Herb	Root	Dry	Boiled for 5 minutes. Extract is taken orally. Thrice a day	Fatigue	1	0.9	100	0.00
Euphorbiaceae	<i>Cryptocarya transvaalensis</i> Burt Davy	Morekuri/ Motampota	Tree	Root	Dry	Burned for about 7–8 minute. Smoke inhaled (nasally). Thrice a day	Headache	105	100	100	1
Euphorbiaceae	<i>Adansonia digitata</i> L	Bogopa/Mabatšane	Herb	Leaf	Dry	Pounded and taken orally with warm water. Thrice a day.	Fatigue	1	0.9	100	0.00
Fabaceae	<i>Grewia bicolor</i> Juss. var. <i>bicolor</i>	Moroteladitšhoši	Herb	Root	Dry	Pounded and mixed with dried powdered root of <i>C. sexangularis</i> . Taken orally with warm water. Thrice a day	Fatigue	1	0.9	100	0.00
Fabaceae	<i>Grewia hispida</i> Harv.	Monoga/Noga-koto	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Headache	1	0.9	100	0.00
Gentianaceae	<i>Hibiscus meyeri</i> Harv. subsp. <i>meyeri</i>	Makgonotšohle/ Mphedu-ya-thaba	Herb	Whole plant	Dry	Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Rhinitis	105	100	100	1
Lamiaceae	<i>Ficus burkei</i> (Miq.) Miq.	Sebokane	Herb	Whole plant	Dry	Boiled for 5 minutes. Steam inhaled (nasally) under blanket. Thrice a day	Rhinitis	105	100	100	1

Lauraceae	* <i>Moringa oleifera</i> sensu Exell & Mendon	Kgosupsa	Tree	Bark	Dry	Pounded and poured in boiled water. Steam is inhaled (nasally) under blanket. Thrice a day	Rhinitis	105	100	100	1
Malvaceae	* <i>Musa sapientum</i> L	Mogoo	Tree	Root	Dry	Boiled for 6–10 minutes. Extract is taken orally. Thrice a day	Fatigue	77	73.3	100	0.73
Malvaceae	<i>Myrothamnus flabellifolius</i> Welw.	Mogwane	Tree	Root	Dry	Pounded and mixed with cold water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	2	1.9	100	0.01
Malvaceae	* <i>Nymphaea mexicana</i> Zucc.	Mogwete/Mogolori/Lefielo	Shrub	Root	Dry	Pounded and extract is taken orally with warm water. Thrice a day	Painful eyes	1	0.9	100	0.00
Malvaceae	<i>Ximenia caffra</i> Sond. var. natalensis Sond.	Motomelatšie/Mogatšatšipa/Motiatswane	Herb	Root	Dry	Pounded and mixed with cold water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	9	8.5	100	0.08
Moraceae	<i>Adenia spinosa</i> Burt Davy <i>Flueggea virosa</i> (Roxb. ex Willd.) Voigt subsp. <i>Virosa</i>	Moumo	Tree	Fruit	Dry	Burned for about 6 seconds. Smoke is inhaled (nasally). Thrice a day	Headache	1	1.9	100	0.01
						Boiled for 5 minutes. Extract is taken orally. Thrice a day	Headache	1			
Moringaceae	<i>Sorghum bicolor</i> (L.) Moench subsp. <i>arundinaceum</i> (Desv.) de Wet & Harlan	Moringka	Tree	Leaf	Dry	Pounded and taken orally with warm water. Thrice a day	Fatigue	61	58	100	0.58
Musaceae	* <i>Zea mays</i> subsp. <i>mays</i> L.	Mopanana	Tree	Root	Fresh	Mixed with tuber of <i>D. carota</i> . Macerated in cold water for 5 hrs. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	1	0.9	100	0.00
Myrothamnaceae	<i>Securidaca longepedunculata</i> Fresen. var. <i>longepedunculata</i>	Patše-ya-tšhwene/Matlapaneng	Herb	Whole plant	Dry	Pounded and extract is taken orally. Thrice a day	Headache	6	5.7	100	0.05
Nymphaeaceae	<i>Ptaeroxylon obliquum</i> (Thunb.) Radlk.	Hlapi	Herb	Whole plant	Dry	Macerated in cold water for 30 minutes to an hour. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	26	24.7	100	0.24
Olacaceae	<i>Berchemia discolor</i> (Klotzsch) Hemsl. <i>Ziziphus mucronata</i> Willd. subsp. <i>mucronata</i>	Motšhidi-kgomo	Tree	Root	Dry	Burned for about 5–11 seconds. Smoke is inhaled (nasally). Thrice a day	Headache	7	7.6	100	0.07
						Pounded and mixed with dried powdered root of <i>V. infausta</i> . Taken orally with warm water. Thrice a day	Headache	1			
Passifloraceae	<i>Vangueria infausta</i> Burch. subsp. <i>infausta</i> <i>Zanthoxylum capense</i> (Thunb.) Harv. <i>Englerophytum magalismontanum</i> (Sond.) T.D.Penn.	Monna-apare/Pisayabatšumi/Mothema	Shrub	Stem	Dry	Pounded and taken orally with warm water. Thrice a day	Fatigue	26	24.7	53	0.46
						Boiled for 5 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Painful eyes	2	1.9	4	
							Rhinitis	21	20	42.8	
Phyllanthaceae	* <i>Capsicum annuum</i> L. var. <i>glabriusculum</i> (Dunal) Heiser & Pickersgil	Mohlakaume	Shrub	Root	Dry	Pounded and mixed with cold water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	6	5.7	100	0.05
Poaceae	* <i>Nicotiana tabacum</i> L.	Mabele-thoro	Herb	Seed	Dry	Pounded and taken orally with Mageu® drink or soft porridge. Thrice a day	Fatigue	18	17.1	100	0.17
Poaceae	<i>Solanum panduriforme</i> E.Mey.	Mabele	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Headache	1	0.9	100	0.00
Polygalaceae	<i>Lasiosiphon caffer</i> Meisn. <i>Xerophyta retinervis</i> Baker <i>Lippia javanica</i> (Burm.f.) Spreng.	Mphesu/Mpitlamarago	Tree	Root	Dry	Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Headache	105	100	98.1	1.01
						Pounded and taken orally with warm water. Thrice a day	Rhinitis	1	1.4	1.8	
						Pounded and mixed with powdered root of <i>Z. capense</i> . A pinch of finger is snuffed (nasally). Thrice a day	Rhinitis	1			

Ptaeroxylaceae	<i>Siphonochilus aethiopicus</i> (Schweinf.) B.L.Burt <i>Sclerocarya birrea</i> (A.Rich.) Hochst. subsp. <i>caffra</i> (Sond.)	Mogabaletswana	Tree	Root	Dry	Burned for about 5–11 minutes. Smoke is inhaled (nasally). Thrice a day	Headache	1	90.4	100	0.90
						Pounded and taken orally with warm water. Thrice a day	Headache	94			
Rhamnaceae	* <i>Daucus carota</i> L.	Moneyee/ Mogokgoma	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Painful eyes	12	11.4	100	0.11
Rhamnaceae	<i>Acokanthera rotundata</i> (Codd) Kupicha	Mokgalo	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Headache	1	0.9	100	0.00
Rubiaceae	<i>Strophanthus speciosus</i> (Ward & Harv.) Reber <i>Stylochaeton natalensis</i> Schott	Mmilo	Tree	Root	Dry	Pounded and mixed with dried powdered root of <i>X. caffra</i> . Taken orally with warm water. Thrice a day	Headache	1	0.9	100	0.09
						Pounded and taken orally with warm water. Thrice a day	Headache	9	8.5		
Rutaceae	<i>Aloe spp.</i> <i>Aloe marlothii</i> A.Berger subsp. <i>Marlothii</i> <i>Artemisia afra</i> Jacq. ex Willd. var. <i>afra</i> <i>Athrixia phyllicoides</i> DC	Monokwane/ Moregakgaka	Tree	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Headache	26	24.7	19.8	1.24
						Pounded and mixed with dried powdered bark of <i>W. salutaris</i> . Taken orally with warm water. Thrice a day	Rhinitis	1	100	80.1	
						Pounded and mixed with dried powdered root of <i>S. longepedunculata</i> . A pinch of finger is snuffed (nasally). Thrice a day	Rhinitis	1			
						Boiled for 5–8 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Rhinitis	103			
Sapotaceae	<i>Geigeria burkei</i> Harv. subsp. <i>burkei</i> var. <i>hirtella</i> merxm	Mohlatshwa	Tree	Root	Dry	Pounded and mixed with cold water. Drop of extract is applied topically in the eyes. Thrice a day	Painful eyes	26	24.7	100	0.24
Solanaceae	<i>Kleinia longiflora</i> DC.	Mophepha	Shrub	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Headache	2	1.9	100	0.01
Solanaceae	* <i>Schkuhria pinnata</i> (Lam.) Kuntze ex Thell. <i>Senecio serratuloides</i> DC.	Mofola	Shrub	Leaf	Dry	Pounded and a pinch of a finger is snuff (nasally). Thrice a day	Headache Rhinitis	2 24	1.9 22.8	7.6 92.3	0.24
Solanaceae	<i>Vernonia natalensis</i> Sch.Bip. ex Walp.	Mothola-o-moserolwane	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Headache	17	16.1	100	0.16
Thymelaeacea	<i>Markhamia zanzibarica</i> (Bojer ex DC.) K.Schum	Nkekologe	Shrub	Root	Dry	Pounded and poured in boiled water. Steam is inhaled (nasally) under blanket. Thrice a day	Rhinitis	105	100	100	1
Velloziaceae	<i>Commiphora marlothii</i> Engl.	Thuse	Herb	Root	Dry	Pounded and taken orally with warm water. Thrice a day	Headache	17	16.1	100	0.16
Verbenaceae	<i>Warburgia salutaris</i> (G.Bertol.) Chiov.	Mošunkwane/ motlaba-dipoo	Shrub	Leaf	Fresh	Boiled for 5–10 minutes. Steam is inhaled (nasally) under blanket. Thrice a day	Rhinitis	105	100	100	1
Zingiberaceae	<i>Capparis tomentosa</i> Lam.	Serokolo	Herb	Bulb	Fresh	Raw piece is rubbed between hands and vapour inhaled (nasally). Thrice a day	Rhinitis	25	23.8	100	0.23

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

## The use of plants to treat ailments

Further analysis of the finding from this study showed that of 63 plant species recorded, 20.6% (n=13); *A. afra*, *Acokanthera rotundata*, *Athrixia phyllicoides*, *C. ternatum*, *Cleome gynandra*, *Aloe marlothii*, *C. transvaalensis*, *E. axillare*, *L. javanica*, *L. caffer*, *Siphonochilus aethiopicus*, *Sclerocarya birrea*, and *S. natalensis* were used exclusively as rhinitis treatment, and 11.1% (n=7) of plants namely *Adenia spinosa* and *Warburgia salutaris* (fatigue and painful eyes), *Euphorbia inaequilatera* and *Euphorbia schinzii* (rhinitis and painful eyes), *Nicotiana tabacum* (headache), *S. longepedunculata* (headache) and *Z. capense* (headache) used by Bapedi THs for rhinitis and the mentioned perceived symptoms. The remainder of the plants (68.2%, n=43) were used wholly as remedies for the following symptoms; fatigue, headache and painful eyes in patients diagnosed with rhinitis (Table 1).

### Plant habit

Growth forms of the 63 documented plants in this study were analysed. Accordingly, herbs (39.6%, n=25) were the most common habit used for medicinal purposes, followed by trees (36.5%, n=23) and shrubs (23.8%, n=15) respectively.

### Fidelity level (FL) and use value (UV)

Of all (n=63) the medicinal plants documented in this study, *A. afra* (UM=105 and FL=100; rhinitis), *C. ternatum* (UM=105 and FL=100; rhinitis), *C. transvaalensis* (UM=105 and FL=100; rhinitis), *E. axillare* (UM=105 and FL=100; rhinitis), *K. brachyloba* (UM=105 and FL=100; headache), *L. caffer* (UM=105 and FL=100; rhinitis), *L. javanica* (UM=105 and FL=100; rhinitis), *S. pinnata* (UM=105 and FL=100; painful eyes), *S. longepedunculata* (UM=105 and FL=100; headache), *S. africana* (UM=105 and FL=100; headache), *S. natalensis* (UM=105 and FL=100; rhinitis), and *Z. capense* (UM=105 and FL=80.1; rhinitis, and UM=26 and FL=19.8; headache), respectively had the highest FL as treatments of the mentioned ailment/s.

The highest UV calculated in this study was 1.24 for *Z. capense* (headache and rhinitis therapies), and 1.01 for *S. longepedunculata* (headache and rhinitis), respectively. This was closely and equally followed by *A. afra*, *C. ternatum*, *C. transvaalensis*, *E. axillare*, *L. caffer*, *L. javanica*, *S. natalensis* (UV=1; rhinitis, for each), *K. brachyloba* and *S. africana* (UV=1; headache, for each) as well as *S. pinnata* (UV=1; painful eyes).

## Plant parts used, mode of preparations, dosages and administrations

Root (55.5%, n=35), followed by leaf (19%, n=12), whole plant (11.1%, n=7), bark and fruit (3.1%, n=2, for each), bulb, seed, tuber, twig and stem (1.5%, n=1, for each), respectively were mostly used plant parts in this study. Larger number of these plant parts was prepared by THs in their dry (85.7%, n=54) state than when they are still fresh (14.2%, n=9).

Overall, 77 recipes prepared from the recorded plant parts were documented as described by Bapedi THs (Table 1). About 87% (n=67) of these recipes was made from a single plant part, and just 12.9% (n=10) was prepared from mixtures of diverse plant parts. The most common methods of preparation of the 77 documented recipes described by Bapedi THs were pounding (59.7%, n=46), boiling (20.7%, n=16), burning (7.7%, n=6), macerating (5.1%, n=4), squeezing and rubbing (2.5%, n=2, for each), squeezing and pounding (1.2%, n=1), respectively. Most of the prepared recipes/remedies in this study were dispensed orally (44.1%, n=34), nasally (33.7%, n=26) and topically (22%, n=17), respectively. Oral medication was prescribed as liquid or powder (Table 1). Pounded therapies were mainly taken with warm water as a vehicle. However, in few instance these therapies were mixed with additives such as Mageu® drink or soft porridge. According to THs these additives enhance the effectiveness of prescriptions. Nasal remedies were primarily taken as steam under a blanket.

Dosage strength of all herbal preparation documented in the present study was determined. In general, consistencies amongst THs with regards to this were only noted for boiled liquid medicine taken orally. For instance, a metal cup (500ml) was prescribed by all Bapedi THs three times a day (morning, midday and evening). However, dosage regimes of the rest of the herbal recipes made by these THs was not standardised, and depended on an individual healers' experience.

## Discussion

To the best of our knowledge, the present study is the first in South Africa and Africa as a continent to investigate plants used traditionally by THs or lay people to treat rhinitis and related symptoms, thus there is a dearth of comparative data against which to evaluate our findings. As a matter of fact, there is generally a scanty of information regarding the use of herbal remedies to treat these



conditions worldwide. However, few attempts to address this gap in knowledge have been made in countries such as Turkey<sup>15</sup> and India<sup>16</sup>. Comparison of medicinal plants documented in these two studies with ours is divergent, probably due to the fact that diverse cultures of the world possess their own specific knowledge of plant use and tradition<sup>21</sup>. We documented 63 plant species belonging to 40 botanical families, mainly the *Asteraceae*, *Euphorbiaceae* and *Malvaceae* used by Bapedi THs to treat rhinitis and related symptoms. Kanakavalli et al.<sup>16</sup> reported the dominant of *Fabaceae*, and Sayin et al.<sup>15</sup> found that all the botanical families in their study were each equally represented by a single species. The dominance of *Asteraceae*, *Malvaceae* and *Euphorbiaceae* in our study could be attributed to their wider distribution across the studied sites, which in turn afforded local THs with higher diversity of plants to explore healing potential, and subsequently experiment against various human ailments including rhinitis. The remaining families recorded in this study were represented with less than three species used to heal rhinitis and related symptoms, thus correspondingly suggesting that their members are less popular amongst the interviewed Bapedi THs as treatment of these diseases. Overall higher number of taxa and associated botanical families documented in this study shows that Bapedi THs are knowledgeable about diversity of plants useful for rhinitis and related conditions. Also such high diversity to some extent is a good indicator that the studied areas harbour diverse habitats which supports a rich curative floristic wealth useful for these illnesses.

The widespread utilisations of species such as *A. afra*, *C. ternatum*, *C. transvaalensis*, *E. axillare*, *K. brachyloba*, *L. caffer*, *L. javanica*, *S. pinnata*, *S. longepedunculata*, *S. africana*, *S. natalensis* and *Z. capense* in this study emphasize their importance as remedies in Bapedi traditional healing sector, and also demonstrate that there are vital ethnobotanical contact points among THs in the studied districts. However, the extent of utilisation of the remaining species in this study is also understandable given that native knowledge is not uniformly distributed amongst culturally homogeneous group living in the same and different biophysical territory<sup>22</sup>, and that healers have different knowledge regarding herbal medicine used for human ailments.

To the best of our knowledge all the species (*A. afra*, *A. rotundata*, *A. phylloides*, *C. ternatum*, *C. gynandra*, *Commiphora*

*marlothii*, *C. transvaalensis*, *E. axillare*, *L. javanica*, *L. caffer*, *S. aethiopicus*, *S. birrea*, and *S. natalensis*) used exclusively as cure for rhinitis are recorded for the first time in the present study as remedies for rhinitis, probably due to lack of African ethnobotanical studies focusing on this affliction. Overall, *A. afra*, *C. ternatum*, *C. transvaalensis*, *E. axillare*, *L. caffer*, *L. javanica* and *S. natalensis* was important species used by all THs (n=105) who treated this respiratory infection. Although not exclusively used for rhinitis, traditional utilisation of some of these species particularly *A. afra*<sup>23</sup> and *L. javanica*<sup>24</sup> against various respiratory infections in general are supported by scientific studies; hence they are mostly utilized by Bapedi THs. To yield more critical insights into the potential of most of the above-widely used taxa in this study, as future treatment of rhinitis, and to better understand rationales as to why Bapedi THs prefer them, an investigation in to their effectiveness and safety specifically in the treatment of rhinitis should be investigated.

Amongst the 11.1% of plants namely *A. spinosa* and *W. salutaris* (fatigue and painful eyes), *E. inaequilatera* and *E. schinzii* (rhinitis and painful eyes), *N. tabacum* (headache) and *Z. capense* (rhinitis and headache) used by Bapedi THs for rhinitis and the mentioned perceived symptoms, only use of *N. tabacum*<sup>25</sup> as well as *S. longepedunculata*<sup>26</sup> to treat headache was reported in literature. Thus uses of both these species for rhinitis are recorded in our study for the first time. Similarly, medicinal use of the remaining plants *A. spinosa*, *E. inaequilatera*, *E. schinzii*, *W. salutaris* and *Z. capense* for rhinitis and the aforesaid ailment/s are so far restricted to Bapedi THs.

Similarly, larger number of species recorded in this study as being used by THs to heal fatigue, headache and painful eyes (table 1), in patients diagnosed with rhinitis are recorded for the first time as medicines for these conditions. However, some of the medical application/s of *Adansonia digitata*<sup>27</sup>, *Capsicum annum*<sup>28</sup>, *C. gynandra*<sup>29</sup>, *Daucus carota*<sup>30</sup>, *Myrothamnus flabellifolius*<sup>31</sup>, *Moringa oleifera*<sup>32</sup>, *Ptaeroxylon obliquum*<sup>33</sup>, *S. africana*<sup>34</sup>, *S. pinnata*<sup>35</sup>, *Vernonia natalensis*<sup>36</sup>, *Ximenia caffra*<sup>37</sup>, *Zea mays*<sup>38</sup> and *Ziziphus mucronata*<sup>39</sup> by Bapedi THs are in partial agreements with previous studies conducted in other areas of South Africa, African countries and elsewhere, which reported applications of these species for fatigue, headache or painful eyes. in rhinitis suffers with various medicinal plants by Bapedi THs

is an indication that they do take this respiratory infection serious, and thus investigation of the efficacy of these plants should be conducted. Effective herbal treatments of these symptoms are equally imperative in achieving the best outcomes of diagnosed patients. This is because it might assist in eliminating both occurrences and associated health impact of such symptoms that might affect quality.

Our study revealed that THs mainly prefer herbaceous and tree species for the preparation of herbal medicine to heal and manage rhinitis and related symptoms. Their distinct preferences of herbaceous species could be attributed to the fact that they are abundant at close proximity and are easy to harvest with less effort, both compared to trees and shrubs. On the other hand, utilisation of these two growth forms might be due to their ease of identification in the wild, high adaptability as well as capacity to proliferate in various seasons, thus available throughout the year. In general, the above recorded habits might be a reflection of the curative plant community structure across the studied areas.

Plant species which scored the highest FL as treatments of rhinitis and related symptoms in this study indicate greater agreement among the THs regarding their phyto-therapeutic use/s which might be attributed to efficacy, hence their strong selectivity over the others. Thus, such species should be prioritised for phytochemistry and pharmacological properties studies. Similar attention must be given to species such as *Z. capense* (headache and rhinitis therapies), *S. longepedunculata* (headache and rhinitis), *A. afra*, *C. ternatum*, *C. transvaalensis*, *E. axillare*, *L. caffer*, *L. javanica*, *S. natalensis* (rhinitis), *K. brachyloba* and *S. africana* (headache, for each) and *S. pinnata* (painful eyes) with the highest UV index. However, the high UVs of these species also indicates the need to promote their sustainable utilisations and harvesting.

Roots and leaves were mostly used plant parts in this study. On contrary, Kanakavalli et al.<sup>16</sup> reported leaf, rhizome and whole plant as equally favoured medicinal plant parts for preparation of rhinitis remedies. The observed discrepancies might be due to the larger number (n=63) of plant recorded in our study compared to just nine species noted by this authors. Larger number of plant parts in our study was prepared by THs in their dry) state than when they are still fresh, thus suggesting that few species

are grown in home gardens or available in close vicinity for instance use as medicines. Not surprising, about 87% of herbal recipes was made from a single plant part, perhaps due to the ease of preparation compared to poly-recipes. Overall, diverse procedures of herbal preparing medicines recorded in this study might be attributed to THs' preferences or is a reflection of an old tradition amid these THs observed from various mentors. Different route of administering remedies such as burning and inhalation, rubbing between hands for inhalation of vapour and snuffing might be effective for treatment and management of rhinitis, mainly due to the fact that prescriptions go directly to the nasal membranes, thus might act on various components of the nasal inflammatory process reducing inflammatory cell numbers.

### Conclusion

Our study is the first to document plants used traditionally to treat rhinitis and related symptoms in South Africa and Africa at large. Therefore, it is not surprising that all species used by interviewed Bapedi THs are recorded in this survey for the first time as rhinitis cure. On the other hand, high usage of some of the plant species implicated by these THs in the treatments of symptoms they perceived as allied to rhinitis across the studied district and municipalities, confirm the authenticity of data gathered and importance of such species. Overall, the medicated claims of the species inventoried in the study need to be evaluated through phytochemical and pharmacological investigations. Scanty of ethnobotanical information focusing on treatment of rhinitis and related symptoms in South Africa and Africa as a continent call for an urgent need to record such valuable data before it becomes inaccessible or vanishes together with its holders.

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### Conflict of interest

None declared.

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