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# Ethnobotanical survey of medicinal plants used by Bapedi healers to treat diabetes mellitus in the Limpopo Province, South Africa

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ABSTRACT

*Ethnopharmacological relevance:* Bapedi phytomedicine employ a range of plant species to treat diabetes mellitus (DM). Existing literature partially support the use of certain species for this purpose.
*Aim of the study:* To report on Bapedi medicinal plants employed to treat DM.
*Materials and methods:* A semi-structured questionnaire was employed to conduct a survey on medicinal plants used by Bapedi traditional healers in their DM management protocol. Fifty-two traditional healers from 16 municipalities, covering three districts, were interviewed during the first half of 2011.
*Results:* A total of 24 plant species belonging to 20 families, mostly from the Asteraceae (13%), Cucurbitaceae and Sapotaceae (8%), were used to treat diabetes mellitus. Plant parts mostly preferred were roots and leaves. A decoction of these is most commonly used to make extracts, which are then taken orally for a period of one week. *Mimusops zeyheri* (29%), *Helichrysum caespititium* (25%), *Plumeria obtusa* (21%), *Aloe marlothii* subsp. *marlothii*, *Hypoxis iridifolia* and *Moringa oleifera* (17% each), were repeatedly mentioned by the traditional healers as most used for the management of diabetes mellitus in the study area. *Plumeria obtusa* and *Momordica balsamina* are exclusively used to treat diabetes mellitus, and only in the Sekhukhune District.
*Conclusion:* It is concluded that Bapedi traditional healers do have a basic understanding of the causes and remedial action required in the treatment of diabetes mellitus.


## 1. Introduction

Diabetes mellitus (DM) is one of the major chronic disease which affect millions of people worldwide (Smeltzer et al., 2009). This systemic disease is caused by an imbalance between insulin supply and insulin demand (WHO, 2006). Several forms of DM are known to occur but types I and II predominate. Type I diabetes is autoimmune-mediated form of the disease and is characterised by the destruction of pancreatic beta cell islets resulting in absolute insulin deficiency. Type II diabetes is characterised by insulin resistance or the abnormal secretion of insulin (Shafrir, 1996).

The prevalence of DM for all age-groups worldwide was estimated at 2.8% in 2000 and is projected to increase to approximately 4.4% in 2030. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030 (Wild et al., 2004). In 2009 the International Diabetes Federation projected that about 285 million people worldwide will be affected by 2010, with an estimated increase to 430 million by 2030. Developing countries are thought to carry the brunt of this increase, and Africa is postulated to contribute significantly to this rise. According to Levitt (2008), 10.8 million people had diabetes in sub-Saharan Africa in 2006, and that this would rise to 18.7 million by 2025, which is an increase of 80%, exceeding the globally predicted increase of 55%. In South Africa, the Working Group of the National Diabetes Advisory Board (1997) reported that nearly half a million, or 8% of the black population suffered from DM.

Uncontrolled diabetes leaves numerous morphological changes, for example changes that affect the functioning of the urinary tract and cardiovascular system (Rheeder et al., 2002). This is exacerbated by the co-existence of cardiovascular risk factors such as hypertension, dyslipidaemia, obesity and smoking (Mundet et al., 2008). Damage is not only confined to blood vessels but can also include other organs such as the eyes, nerves and skin (Bradshaw et al., 2006). The common symptoms of DM include an excessive urge to eat (polyphagia), passing large amounts of urine within short intervals (polyuria), abnormal thirst, poor vision and weight loss. However, in some individuals it presents asymptomatic (Rotchford and Rotchford, 2002; Turner and Wass, 2002).

To manage the medical challenges posed by diabetes, numerous treatment protocols have been developed. Most cases of DM type

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I treatment involves the use of exogenous insulin, whilst type II diabetes treatment usually involves a combination of drug therapy and lifestyle intervention such as diet modification and physical exercise (Zimmet et al., 2001). In addition, the cost of administering modern antidiabetic drugs is beyond the reach of people in the low income groups and those living in rural areas (Erasto et al., 2005), such as the Limpopo Province.

Recently, there has been a surge in the use of plants to treat and control diabetes. This is due to the common perception that the pharmaceutical products on the market induce severe complications following long term use (Hanefeld, 1998). In response, many South African patients seek relief from traditional healers who administer plant preparations to treat the disease (Morris, 2002). Studies indicated that there were approximately 200 000 traditional healers practising in South Africa in 1995, compared to 25 000 modern doctors (Kale, 1995; Setswe, 1999). In South Africa, an estimated 80–85% of black South Africans use traditional healers' services in both rural and urban areas (UNAIDS, 2006). Rural patients are more dependent on traditional or folk medicinal healers to treat diseases. Reasons for this dependency include, amongst other, a lack of access to modern medical facilities, clinging to traditional approaches and unbearable queues in the modern health care centres such as clinics and hospitals (Hossan et al., 2010). Ethnobotanical study has often been used to search for locally important plant species with few side effects, especially for the discovery of crude drugs (Farnsworth, 2007). Using medicinal plants to control DM in traditional medicinal systems of different cultures have been reported in several studies (Marles and Farnsworth, 1995; Grover et al., 2002; Erasto et al., 2005; Dièye et al., 2008; Shanmugam et al., 2009). All these studies allude to efficacy of medicinal plants in the treatment of DM.

The Limpopo Province of South Africa is the second poorest province in the country (SSA, 1998). Because of the rural nature of the Limpopo Province and consequent high levels of unemployment and poverty, people in this area are heavily reliant on medicinal plants and use herbal medications either alone or in combination with western medicines to treat several diseases. In this province, the Bapedi speaking people constitute the largest cultural group, comprising almost 57% of the population (Lodge, 2005). However, there is no documentation on the use of plants by the Bapedi tribe for the treatment of DM, although Igumbor et al. (2003) stated that in the Limpopo Province, DM is amongst the 10 leading causes of death for all races and both sexes, for people aged 45–59 years.

**Table 1**
Districts and local municipalities included in this study.

| Capricorn district | | Sekhukhune district | | Waterberg district | |
|---|---|---|---|---|---|
| Aganang | A | Elias Motsoaledi | F | Lephalale | K |
| Blouberg | B | Fetakgomo | G | Modimolle | L |
| Lepelle-Nkumpi | C | Groblersdal | H | Mogalakwena | M |
| Molemole | D | Makhuduthamaga | I | Mookgophong | N |
| Polokwane | E | Marble Hall | J | Thabazimbi | O |

## 2. Materials and methods

### 2.1. The study area

Semi-structured questionnaires were completed by 52 traditional healers from 15 local municipalities (Fig. 1 and Table 1), covering three of five districts (Capricorn, Sekhukhune and Waterberg) that constitute the Limpopo Province. The major ethnic group in these districts are Sepedi speaking.

### 2.2. Ethnobotanical survey

A dual purpose reconnaissance survey was first carried out in each local municipality to: (i) obtain permission to conduct this study within the area of jurisdiction and (ii) also to meet with

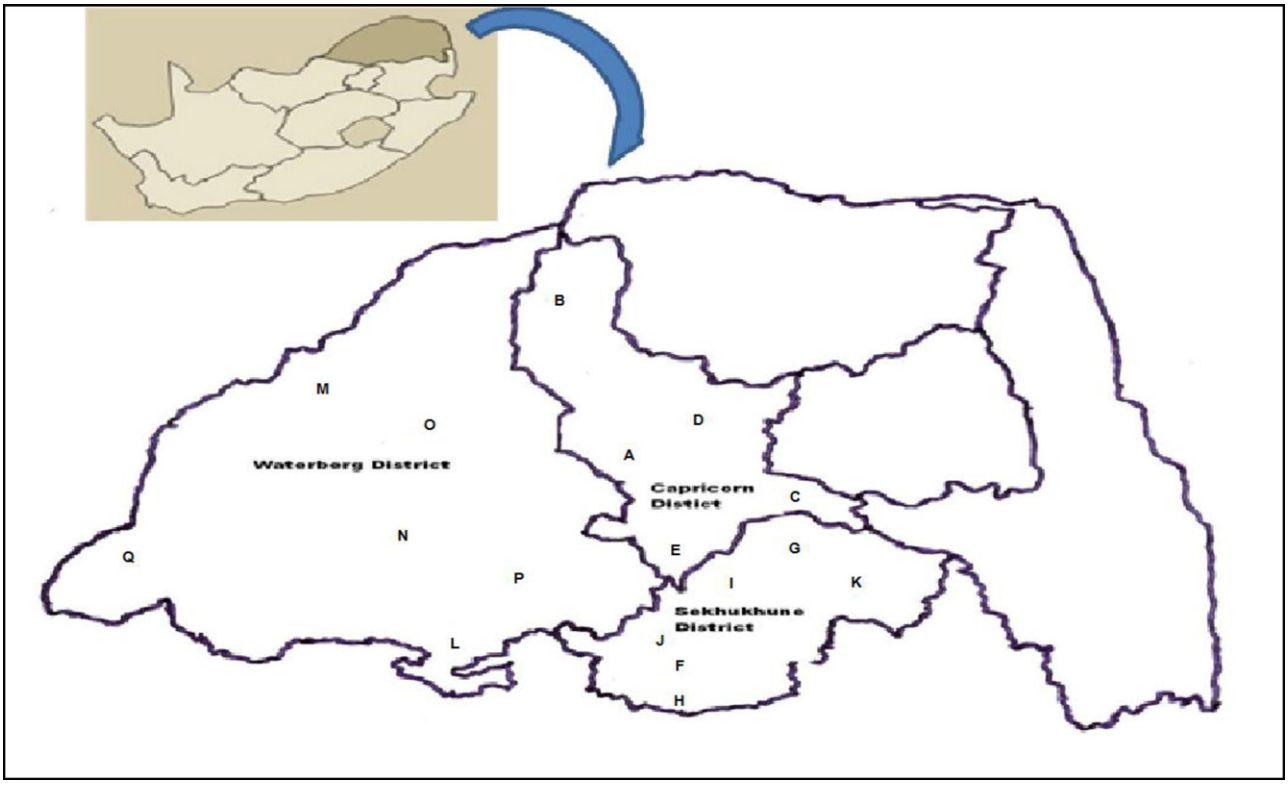


**Fig. 1.** Study area: Capricorn, Waterberg and Sekhukhune districts, Limpopo Province, South Africa. A–O designates the involved municipalities.

**Table 2**
Medicinal plants used by Bapedi traditional healers to treat DM.

| Name of plants | Vernacular name | Voucher | Number of citations | Part of plant | Preparation |
|---|---|---|---|---|---|
| Aizoaceae | | | | | |
| *Carpobrotus edulis* (L.) L. Bol. | Lepolomo la go naba | SS 98 | 1 | Leaf | Squeezed juice |
| Amaryllidaceae | | | | | |
| *Gethyllis namaquensis* (Schőnland) Oberm. | Naka tsa tholo | SS 83 | 1 | Bulb | Cooked for 10 min |
| Apiaceae | | | | | |
| *Centella asiatica* (L.) Urb. | Unknown | SS 91 | 3 | Root | Cooked for 10–20 min |
| Apocynaceae | | | | | |
| *Plumeria obtusa* L. | Mohlare wa maswi wa sukiri | SS 95 | 5 | Leaf | Cooked for 5–10 min |
| Araliaceae | | | | | |
| *Cussinia spicata* Thunb. | Unknown | SS 75 | 2 | Root | Cooked for 5 min |
| Asphodelaceae | | | | | |
| *Aloe marlothii* A. Berger subsp. *marlothii* | Kgopha ya go eema | SS 80 | 4 | Leaf and root | Cooked for 5 min |
| Asteraceae | | | | | |
| *Helichrysum caespititium* (DC) Harv. | Bokgatha/Mabjana/Mmeetse | SS 78 | 4 | Whole plant | Cooked for 10–20 min or pounded and taken with warm water or soft porridge |
| *Callilepis laureola* DC. | Phela | SS 52 | 3 | Root | Cooked for 5–10 min |
| *Tarchonanthus camphoratus* L. | Unknown | SS 74 | 1 | Roots | Cooked for 10 min |
| Caricaceae | | | | | |
| *Carica papaya* L. | Mophopho | SS 70 | 1 | Root | Cooked for 20 min |
| Cactaceae | | | | | |
| *Opuntia ficus-indica* Mill. | Motloro | SS 90 | 2 | Root | Cooked for 20 min |
| Cucurbitaceae | | | | | |
| *Momordica balsamina* L. | Mothwatwa | SS 99 | 3 | Root | Cooked for 5–10 min |
| *Mormordica charantia* L. | Monamelala | SS 103 | 1 | Leaf | Cooked for 20 min |
| Fabaceae | | | | | |
| *Lessertia microphylla* (Burch. ex DC.) Goldblatt & J.C. Manning | Mosapelo | SS 93 | 3 | Root | Cooked for 10 min |
| Hypoxidaceae | | | | | |
| *Hypoxis iridifolia* Baker | Monna maledu | SS 68 | 4 | Tuber | Cooked for 5–10 min |
| Kirkiaceae | | | | | |
| *Kirkia wilmsii* Engl. | Legaba/Modumela | SS 94 | 3 | Tuber | Squeezed juice |
| Lauraceae | | | | | |
| *Persea americana* Mill. | Moafokhathe | SS 92 | 1 | Root | Cooked for 10 min |
| Moraceae | | | | | |
| *Ficus carica* L. subsp. *rupestris* (Hausskn.) Browicz (Dncir) | Mofeiye | SS 89 | 2 | Root | Cooked for 10–20 min |
| *Moringaceae* | | | | | |
| *Moringa oleifera* Lam. | Makgonatšohle | SS 65 | 4 | Seed and leaf | Raw seeds or leaves cooked for 5–10 min |
| Lythraceae | | | | | |
| *Punica granatum* L. | Mokgarenate | SS 73 | 2 | Root | Cooked for 10–20 min |
| Sapotaceae | | | | | |
| *Mimusops zeyheri* Sond. | Mmupudu | SS 53 | 7 | Leaf | Cooked for 10–25 min |
| *Englerophytum magalismontanum* (Sond.) T.D. Penn. | Mohlastwa | SS 48 | 3 | Bark | Cooked for 5–20 min |
| Sterculiaceae | | | | | |
| *Hermannia quartiniana* A. Rich. | Unknown | SS 107 | 1 | Root | Cooked for 20 min |
| Tilliaceae | | | | | |
| *Triumffeta* sp. | Unknown | SS 64 | 2 | Root | Cooked for 20 min |

the traditional healers to request them to participate in the study. Information was collected from January 2011 to July 2011 using a semi-structured questionnaire and general conversation with the traditional healers. In each local municipality two traditional healers were randomly selected and the objective of the study was explained in Sepedi, the local language. Interviews were designed to gather data on the plants used to treat DM, methods of preparation, administration of medicine and diagnoses of DM. Voucher specimens of each plant have been deposited at the Larry Leach Herbarium, University of Limpopo. Voucher numbers of collections are given in Table 2.

## 3. Results and discussion

### 3.1. Taxa involved

Twenty-four species belonging to 20 families were used by the traditional healers to treat DM (Table 2). Of these species, 13%

belong to the Asteraceae, the most represented family. The prominence of the Asteraceae came as no surprise as another study (Erasto et al., 2005), also documented this family as most commonly used to treat DM in the Eastern Cape Province. In that area it too constituted 13% of the species used. In fact the prominence of the Asteraceae in traditional medicine in South Africa has been highlighted by Hutchings (1989), who found the extensive use of this family by the Zulu, Xhosa and Sotho in the treatment of 26 groups of ailments. The importance of this family could be attributed to its wide distribution range, large number of taxa and plant numbers (Thomas et al., 2009). Furthermore studies such as Alarcon-Aguilara et al. (1998) have highlighted its wide range of biologically active compounds that can amongst others be used to treat DM; Cemek et al. (2008) noted that *Matricaria chamomilla* (L.) showed some benefit in an animal model of DM.

Forty-two percent of antidiabetic plants surveyed in this study used by Bapedi traditional healers to manage and control DM is also sources of foods (Table 2). Studies such as Royle and Walsh (1992) and Whittemore et al. (2002) indicated that a healthy diet constitutes the foundation of diabetes management. High intake of fruits and vegetables has been reported to be associated with a lower incidence of chronic diseases such as cardiovascular disease (Ikram et al., 2009), cancer (Riboli and Norat, 2003) and DM (Kaisoon et al., 2011).

### 3.2. Use of species according to districts and municipalities

Of the 24 plant species used in the preparation of different extracts, 23 are used in the Capricorn district, 10 in the Waterberg district and seven in the Sekhukhune district. The most widespread is *Moringa oleifera*, which is used in all three districts. *Plumeria obtusa* (Capricorn and Sekhukhune), *Cussonia spicata* (Capricorn and Waterberg), *Helichrysum caespititium* (Capricorn and Sekhukhune) and *Mimusops zeyheri* (Capricorn and Waterberg) were used in two of the three districts, whilst all other species were used only in single districts. The degree of use could be linked to their distribution, abundance and/or intra cultural differences; an aspect that warrants further investigation.

### 3.3. Inventory of selected medicinal species

The most frequently used plant species for diabetes by Bapedi traditional healers were *Mimusops zeyheri* (29%), *Helichrysum caespititium* (25%), *Plumeria obtusa* (21%), *Aloe marlothii* subsp. *marlothii*, *Hypoxis iridifolia* (syn *Hypoxis obtusa*) and *Moringa oleifera* (17% each, respectively). A number of these species have been validated through scientific research or through their extensive use by various cultures.

Amusan (2009) reported that Swazi traditional healers also use *Mimusops zeyheri* to treat DM. Validation of *Moringa oleifera* is supplied by Jaiswal et al. (2009) who conclusively showed that this species can effectively be used for the treatment of DM. It is therefore reasonable to argue that the findings from this study support the efficacy of *Moringa oleifera*, as used by Bapedi traditional healers.

Although no literature could be found linking *Helichrysum caespititium* to DM, the genus is known to be used to treat DM. For example in Turkey, leaves of *Helichrysum* species are used to treat this ailment (Albayrak et al., 2010), whilst *Helichrysum gymnocomum* DC leaves are used by the Xhosa of the Eastern Cape to treat DM (Oyedemi et al., 2009). Aiyegoro and Okoh (2010) affirmed the antioxidant potential of leaves of *Helichrysum longifolium* DC, stating that plants with antioxidant activities have free radical scavenging activity, with free radicals known as major contributors to several clinical disorders such as DM.

**Table 3**
Criteria used by Bapedi healers to diagnose DM.

| Signs and symptoms | No of traditional healers[a] |
|---|---|
| Low sex drive in males | 25 |
| Loss of body weight | 10 |
| Short tempered | 19 |
| Swollen legs | 14 |
| Lack of sexual desire in females | 4 |
| Excessive eating | 2 |
| Fatigued during warm days | 1 |

[a] Note that this is not a frequency table, as some traditional healers indicated more than one diagnostic criterion.

No information could be found to link *Plumeria obtusa* to the treatment of DM. However, the Apocynaceae is known to contain genera and species that do have linkages to DM. These include *Catharanthus roseus* (L.) G. Don (Chin, 2006) and *Plumeria rubra* L. where a decoction of the flowers is traditionally used in Mexico to treat DM (Godofredo, 2010).

Although not one of the most frequently used species, *Carpobrotus edulis* (L.) L. Bolus has been noted by Malan and Notten (2006) to be used in the Eastern Cape Province to treat DM. Similarly, Deutschländer et al. (2009) noted the use of *Momordica balsamina* as an anti-diabetic, but stated that tests do not support this use. It has some hypoglycaemic action when tested in rabbits, however, there is no definite assurance of insulin-like properties (BioNatural *Momordica balsamina*, 2006).

### 3.4. Diagnoses

Studies such as Erasto et al. (2005), Oyedemi et al. (2009) and Singh (2011) indicated that diagnosis and treatment of DM is mainly influenced by the type of symptoms experienced by the patient. This is because traditional healers diagnose and treat illnesses according to symptomatic presentation as they do not have access to laboratory results to guide diagnosis and treatment.

Before starting the treatment Bapedi healers closely observed the condition of the patients and asked patients about prevailing symptoms (Table 3). Low sex drive in males was the most commonly cited diagnostic criteria, followed by a loss of body weight. The loss of sex drive in males and sex desire in females could possibly be linked to fatigue. According to Erasto et al. (2005), symptoms such as loss of body weight and fatigue were noted by all interviewed Xhosa healers of the Eastern Cape of South Africa. Thus plant species used, dosage preparation and duration of treatment are all aimed at reducing fatigue, increasing body weight, lowering sugar in the urine and reducing the frequency of urination. Xhosa healers claimed an 80% success rate (Erasto et al., 2005).

### 3.5. Plant part used

Roots and leaves were the most preferred plant parts for medicinal preparation. Stem bark, seeds and whole plants were less frequently used for herbal preparation. The wide use of roots and leaves to prepare medicine is based on the perception that more healing power is stored in these parts. Existing literature supports the fact that almost any part of a plant can be used to treat an ailment; it was therefore not surprising to observe that various plant parts were used by Bapedi traditional healers to prepare extracts for the treatment of DM. However, there was a distinct preference for plant parts located underground, such as roots, tubers and bulbs. It is reasonable to consider that the limited use of seeds stem from their seasonal availability, whilst the limited use of stem bark is due to the large number of herbaceous species being employed to treat DM.

### 3.6. Preparation and administration

This study found that 81.25% of preparations were single extracts, involving only one species. Multiextracts (18.75%), involving more than one species, were only recorded from three municipalities (Aganang, Lepelle-Nkumpi and Polokwane) of the Capricorn District. The exclusiveness of multiextracts to the Capricorn district warrants further attention.

All medicinal preparations were taken orally for a period of a week. The preferred vehicle for administration was warm water. This is in contrast to Xhosa traditional healers who prescribe medicine for periods of between six and 12 months (Oyedemi et al., 2009). Currently it is not known why this large time discrepancy exists. The Xhosa also employ water as an administrative vehicle, to be taken orally (Oyedemi et al., 2009).

The cell sap of the tubers of *Carpobrotus edulis* and *Kirkia wilmsii* were pounded whilst in a cloth, thereby soaking the cloth with cell sap. This cloth is then wringed to release the sap, which is then collected and taken orally. It is believed that this method is more efficient than cooking. Preparations were always taken after meals. The reason being put forward by Bapedi traditional healers is that it lowers the sugar in the consumed meal. Bapedi traditional healers believe that DM is caused by high sugar and oil levels in the food consumed. This is partially supported by clinical diagnostic criteria that DM is characterised by chronic high blood glucose levels (Rang et al., 1991).

### 3.7. Conservation

#### 3.7.1. Conservation via alternatives

The use of a number of alternative species to treat DM is in itself a conservation measure. This study found that of the 24 species used to treat DM, five (*Carica papaya* for *Punica granutum* and *Aloe marlothii* subsp. *marlothii*, *Helichrysum caespititium*, *Momordica balsamina* and *Persia americana* for *Hypoxis iridifolia*) were alternatives. Most notable is the use of either a number of species for *Hypoxis iridifolia*, or *Hypoxis iridifolia* for a number of species. If viewed from the former point, then the use of a number of alternatives for one species should be commended and seen as an excellent conservation strategy by Bapedi traditional healers. If, however, viewed from the latter point, then serious attention needs to be paid to the conservation of this species. Although many publications give the distribution of *Hypoxis iridifolia* as widespread in the Limpopo Province of South Africa, the conservation of this species must be a concern for the future as the harvesting generally involves the removal of the whole plant. Furthermore Moeng (2010) found that *Hypoxis iridifolia* was one of the eight most heavily traded species in the Limpopo Province, being traded by nearly all traders across the province, and proposed its cultivation for future sustainable use and poverty alleviation.

#### 3.7.2. Conservation via food

A number of species used by Bapedi traditional healers to treat DM are also food species. These include amongst other *Carica papaya*, *Mimusops zeyheri*, *Opuntia ficus-indica* and *Momordica balsimina*, to name but a few. In Africa a culture exists where food plants are not only conserved, but actively grown in home gardens. Thus the dual use of these species might provide salvation from over harvesting and excessive trading; traits that are common in southern Africa.

## 4. Conclusion

The utilisation of traditional medicine can make a significant contribution to the treatment of chronic diseases, such as DM in South Africa. This study illustrated that Bapedi healers have a rudimentary understanding of DM and the medicine prescribed would seem to have some hypoglycemic action. As a result of lifestyle changes in the black population, DM is set to become more prevalent in this group. Effective management strategies require clinical knowledge of DM as well as patient counselling on the effect of lifestyle modifications. With the traditional healers' willingness to learn, the implementation of such programmes should not be difficult.

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