

CHAPTER 3

ETHNOBOTANICAL STUDY OF PLANTS USED FOR THE MANAGEMENT OF DIABETES MELLITUS IN THE NKONKOBÉ MUNICIPALITY OF SOUTH AFRICA

CHAPTER 3

Ethnobotanical study of plants used for the management of diabetes mellitus in the Nkonkobe Municipality of South Africa.

Abstract.....	36
Introduction.....	37
Methodology.....	40
Results and discussion.....	40
References.....	45

This chapter has been published in the Journal of Medicinal Plant
Research

Ethnobotanical survey of medicinal plants used for the management of diabetes mellitus in the Nkonkobe Municipality of South Africa

SO Oyedemi, G Bradley and AJ Afolayan

School of Biological Sciences, University of Fort Hare, Alice 5700, South Africa

Abstract

An ethnobotanical survey was conducted on the medicinal plants frequently used for the management of diabetes mellitus in Nkonkobe Municipality, Eastern Cape of South Africa. Information was obtained through structured questionnaire administered to traditional healers and herbalists in the region. The study revealed 15 species of plants belonging to 13 families namely; *Hyacinthaceae*, *Asphodelaceae*, *Caryophyllaceae*, *Aloaceae*, *Loganiaceae*, *Portulacaceae*, *Solanaceae*, *Asteraceae*, *Hypoxideae*, *Menispermaceae*, *Alliaceae*, *Celastraceae* and *Lamiaceae*. The infusion of the roots, leaves and barks of these plants are the most commonly used while the extracts are taken orally for long period of time usually between six and 12 months, depending on the severity of the ailments. *Strychnos henningsii* and *Leonotis leonorus* of the families *Loganiaceae* and *Lamiaceae* respectively, were repeatedly mentioned by the traditional healers as the two mostly used for the management of diabetes mellitus in the study area.

Key words: Medicinal plants, diabetes mellitus, herbal medicine.

INTRODUCTION

Diabetes mellitus is a chronic disorder that affects the metabolism of carbohydrates, fats, proteins and electrolytes in the body as a result of defect in insulin secretion, insensitivity of target organs to insulin or both. It is characterized by chronic high blood glucose that causes glycation of body protein which could lead to severe complications (Rang et al., 1991). These complications are classified into acute, sub-acute and chronic. Acute complications include hypoglycemia, diabetic ketoacidosis, hyperosmolar and hyperglycaemic non-ketotic syndrome (Kmentz and Natras, 1991) while sub acute complications are thirst, polyuria, lack of energy, visual blurriness and weight loss (Kumar and Clark, 2002). The chronic complications of diabetes mellitus include hypertension, neuropathy, nephropathy, retinopathy and diabetic foot ulcers which could result to amputation.

Diabetes insipidus is another disorder that is associated with lack of vasopressin and characterized by an abnormal increase in urine output, fluid intake, frequent urination, and excessive thirst (Perkin et al., 2003). Vasopressin is an antidiuretic hormone formed in the hypothalamus and secreted by the pituitary gland. The hormone is used primarily to control water retention through the reduction in urine output. Although, both diabetes mellitus and diabetes insipidus share some common symptoms such as frequent urination and excessive thirst, however, the diagnosis and treatments are not the same (Perkin et al., 2003). Therefore, diabetes insipidus should not be confused with diabetes mellitus, which results from insulin deficiency or resistance leading to high blood glucose.

On the basis of aetiology and clinical presentation, diabetes mellitus can be grouped into type 1 known as insulin- dependent diabetes mellitus (IDDM) and type 2 diabetes mellitus also known as non insulin- dependent diabetes mellitus (NIDDM).

Type 1 diabetes mellitus is prevalent in 10 % of diabetic patients and caused by insulin deficiency due to the lack of functional β cells (Notkins, 2002), whereas type 2 diabetes is characterized with insulin dysfunction. Type 2 diabetes includes all cases of diabetes except those that are insulin dependent and afflicting 85-95% of all diabetic individuals. It is a prevalent form of the disease and common in individuals over 40 years of age.

In South Africa, the number of people suffering from diabetes has been rising steadily over the past two decades. Several reports have stressed the high mortality from diabetes especially among the black populations. The prevalence is predicted to hit 3.9 % of South Africans population between the age of 20 and 79 by the year 2025 (www.eatlas.idf.org). This is because; there is no promising therapy, neither insulin injection nor numerous oral hypoglycemic drugs that could cure diabetes mellitus (Sumana and Suryawanshi, 2001). In addition, these drugs are characterized by appreciable level of toxicity, high cost and unavailability to the people in the rural area. Because of this, many South African patients seek relief from traditional healers who administer plant preparations for the treatment of the disease (Morris, 2002; Farnsworth et al., 1985).

The use of plant derived products containing high concentration of dietary fibre and complex polysaccharide for the management of diabetes have been proposed (Jenkins et al., 1976). Natural products especially of plant origin have been found to be potential sources of novel molecules for the treatment of diabetes (Farnsworth, 1994; Marles and Farnsworth, 1995). Considering the rate at which the vegetation is getting depleted in this part of the world, there is need to document the precious knowledge of these plants and to search for more plants with antidiabetic potential.

The search for anti-diabetic agents has been focused on plants because of their ready availability, effectiveness, affordability and low side effects.

Ethnobotanical study has been the method often used to search for locally important plant species with low side effects especially for the discovery of crude drugs (Farnsworth, 1994). The previous ethnobotanical survey conducted by Erasto et al. (2005) revealed 14 plant species used for the management of diabetes in the Eastern Cape Province of South Africa. However, before the commencement of this study, the medicinal plants for the treatment of diabetes in Nkonkobe Municipality area of the Province had not been explored or documented. The present study therefore is a documentation of plants and plant parts used exclusively for the management of diabetes mellitus by traditional healers of the region.

STUDY AREA

Nkonkobe Municipality is an area in South Africa that is situated between 32° 47' S and 26° 50' E. The area is bounded by the sea in the east and drier Karroo in the west. The altitude is approximately 1300 m above sea level and the vegetation is veld type 7 (Masika and Afolayan, 2003). The major ethnic group is Xhosa speaking people with farming as their main occupation. The people of the region use herbal medications either alone or in combination with orthodox medicines for the treatment of several diseases. The majority of the people are rural dwellers; hence the use of plants for the treatment of common diseases, such as diabetes is very common.

MATERIALS AND METHODS

This study was carried out from May to June 2008 using a well structured questionnaire. The set questions contained the diagnosis of diabetes mellitus, the names of plants, methods of preparation, duration of treatments, adverse effects and mode of administration of the plant materials. Traditional healers and herbalists were interviewed consisting of women and men between 40 and 60 years of age. They have low educational qualifications and were all married. Vouchers of the reported antidiabetic plants were collected, and identified by Prof. DS, Grierson at the Botany Department, University of Fort Hare and deposited at the Giffen Herbarium.

RESULTS AND DISCUSSION

The study revealed 15 species of plants belonging to 11 families that are commonly used by the herbalists, traditional healers and people of Nkonkobe Municipality of South Africa for the management of diabetes mellitus (Table 2). Out of these, 13 species (86.67 %) have not been reported before in the study area for the treatment of diabetes mellitus. Members of *Asphodelaceae* and *Alliaceae* were the most commonly used while other families had one species each. The root of the plants was mostly used (33.3%) followed by the whole plants (20%), corms (20%), bark (13.3%) and leaves (13.3%). Crushing and boiling of plant materials remains the commonly used method for herbal preparation. These are taken orally for long period of time usually between six and 12 months depending on the severity of the ailment. The traditional healers and herbalists consulted in this study claimed to diagnose diabetes mellitus in their patients by observing symptoms such as loss of weight, fatigue, excessive urination and presence of sugar in urine. Two of the plant species,

Leonotis leonorus and *Strychnos henningsii* were frequently mentioned by the traditional healers and herbalists for the treatment of this disease. Information from the literature revealed that both plants are used for the treatment of many other diseases besides diabetes mellitus. For example, *Leonotis leonurus* is used orally for the treatment of cough, cold, influenza, chest infections, diabetes mellitus, eczema, epilepsy, delayed menstruation; intestinal worms, constipation, scorpion stings, spider and snake bite in South Africa (Jager et al., 1996; Van Wyk et al., 2000; Ososki et al., 2002). The plant has also been used topically for the management of haemorrhoids, eczema, skin rashes and boils (Bienvenu et al., 2002). In other parts of Africa, the infusion of the leaves and stem are used as purgative and for the treatment of influenza, tuberculosis, jaundice, hypertension and muscular cramps (Noumi et al., 1999). Whereas, *Strychnos henningsii* is used for various indications in traditional medicine including rheumatism, gynaecological complaints, abdominal pain, snake bite, gastrointestinal pain, malaria and diabetes (Hutchings, 1989; Bisset, 1970); it also has significant medicinal uses in the healing of wounds and as a mouth antiseptic.

In conclusion, this study has revealed 15 medicinal plants, of which *Leonotis leonurus* and *Strychnos henningsii* were frequently mentioned by the traditional healers and herbalists of the area. This primary information may possibly offer effective and affordable management of diabetes mellitus. Further experimental investigations are in progress to validate the pharmacological uses of the plants.

Table 1: Diagnosing methods of diabetes mellitus by the herbalists using herbal drug.

Diagnosis	Respondent (%)
Loss of body weight	100
Body weakness	100
Excessive urination	100
Presence of sugar in urine	100
Excessive thirsty	53
Duration of treatment	
Short duration	40
Long duration	60
Efficacy of plant treatment on patients	
Disappearance of sugar in urine	100
Reduction in body weakness	100
Normal body weight	100
Reduction in frequency of urination	100
Traditional healers claim of no adverse effect after treatment	
Yes	100
No	0
Traditional healers claim of total cure after treatment	
Yes	80
No	20

% of respondent = $\text{Number of respondent} / \text{Total number of respondent} \times 100/1$

Table 2: Plants used for the management of diabetes mellitus in Nkonkobe Municipality, South Africa

Scientific names	Local names (Xhosa)	Family name	Parts used	Preparation and mode of administration (3 times a day after meal)
<i>Albuca setosa</i>	Ingwe beba	Hyacinthaceae	Corms	Fresh corms are crushed, boiled and ½ of a cup taken orally.
<i>Bulbine abyssinica</i>	Uyakayakana	Asphodelaceae	Whole plants	A fresh plant is crushed, boiled and 2 teaspoonfuls of the infusion is taken orally.
<i>Allium sativum</i>	Ikoronofile	Alliaceae	Whole plants	A fresh plant is crushed, boiled and ½ of a cup of infusion taken orally.
<i>Bulbine natalensis</i>	Ibhucu	Asphodelaceae	Roots	The infusion is made from boiled fresh roots and 2 spoonfuls taken orally.
<i>Aloe ferox Mill</i>	Ikhala- lasekoloni	Aloaceae	Leaves	The liquid from the leaves is boiled to powder, soaked in water and ½ of a cup taken orally.
<i>Strychnos henningsii</i>	Umnonono	Loganiaceae	Barks	The barks are crushed to powder and the infusion is ½ of a cup taken orally.
<i>Cissampelo capensis</i>	Umayisake	Menispermaceae	Roots	Fresh corms are crushed boiled and 2 spoonfuls taken orally.
<i>Anacampseros ustulata</i>	Igwele	Portulacaceae	Corms	Fresh corms are crushed, boiled and ½ of a cup taken orally.
<i>Solanum aculeastrum</i>	Umtuma	Solanaceae	Roots	The fresh crushed roots are boiled and 2 teaspoonfuls taken orally

INTELLECTUAL PROPERTY AGREEMENT STATEMENT

All the elderly and the traditional healers who contributed one information or the other during our ethnobotanical survey of medicinal plants used for the management of diabetes mellitus in the Nkonkobe Municipality were adequately financially rewarded with further verbal agreement that this research shall not be for commercial purposes but to serve as an enlightenment information to the community and the entire Eastern Cape, Province on the plants used for the management of diabetes mellitus.

COMPLIANCE STATEMENT

No part of this study in any form has been commercialized, instead is meant to be used as a tool for information dissemination on the medicinal plants used for the management of diabetes mellitus in Nkonkobe Municipality and the entire Eastern Cape Province of South Africa.

REFERENCES

- Biennu, E., Amabeoku, G. J., Eagles, P., Scott, G. and Springfield, E.P. (2002). Anticonvulsant activity of aqueous extract of *Leonotis leonurus* (Lamiaceae), Phytomed. 217(2): 217-223.
- Bisset, N.G (1970). The African species of *Strychnos*. The ethnobotany. Lloydia. 33:201-243.
- Erasto, P., Adebola, P.O., Grierson, D.S and Afolayan, A.J (2005). An ethnobotanical study of plants used for the treatment of diabetes in the Eastern Cape Province, South Africa. Afri. J. Biotechnol. 4: 1458-1460.
- Farnsworth, N.R., Kinghorn, A.D Soejarto, D.D and Waller, D.P (1985). Siberian Ginseng (*Eleutherococcus senticosus*) current status as an Adaptogen. In: Wagner, H Hikino, H., Farnsworth, NR (Eds), Economics and Medicinal Plant Research. 1. Academic Press, Orlando, FL. 1: 155 - 215.
- Farnsworth, N.R (1994). Ethnopharmacology and drug development (1994). Ciba found Symp. 185: 42-59.
- Hutchings, A (1989). A survey and analysis of traditional medicinal plants used by the Zulu, Xhosa and Sotho. Bothalia. 19:111-123.
- Jager, A.K., Hutchings, A. and Van Staden, J (1996). Screening of Zulu medicinal plants for prostaglandin- synthesis inhibitors. J. Ethnopharmacol. 52(2): 95-100.
- Jenkins, D.J., Leeds, A.R., Gassull, M.A., Cochet, B and Alberti, K.G.G.M (1976). Decrease in postprandial insulin and glucose concentrations by guar and pectin. Ann Intl Medline. 86: 20-23.

- Knentz, A.J and Natras, M (1991). Diabetic ketoacidosis, non ketotic hyperosmolar coma and lactic acidosis. In: handbook of diabetes Pickup, JC and Williams, G (2nd editions). Blackwell Science. 479 - 494.
- Kumar, P and Clark, M (2002). Diabetes mellitus and other disorders of metabolism. In: Clinical Medicine. WB Saunders, London.
- Marles, R.J and Farnsworth, N.R (1995). Antidiabetic plants and their active constituents. *Phytomed.* 2: 137-189.
- Masika, P.J and Afolayan, A.J (2003). An ethnobotanical study of plants used for the treatment used for the treatment of livestock diseases in the Eastern Cape Province, South Africa. *Pharmaceut Biol.* 41: 16-21.
- Morris, K (2002). South Africa tests traditional medicines. *Lancet Infectious Diseases.* 2: 319.
- Notkins, A.L (2002). Immunologic and genetic factors in type 1 diabetes. *J. Biol Chem.* 277: 43545-43548.
- Noumi, E., Houngue, F. and Lontsi, D (1999). Traditional medicines in primary health care: plants used for the treatment of hypertension in Bafia Cameroon. *Fitoterapia.* 70: 134-139.
- Ososki, A.L., Lohr, P., Reiff, M., Balick, M.J., Kronenberg, J., Fugh-Berman, A and O'Connor, B (2002). Ethnobotanical literature survey of medicinal plants in the Dominican Republic used for women's health conditions, J. *Ethnopharmacol.* 79: 285 – 298.
- Perkins, R.M., Yuan, C.M and Welch, P.G (2003). Dipsogenic diabetes insipidus: report of a novel treatment strategy and literature review. *Clinical Exp. Nephrol.* 10 (1): 63 – 67. doi:10.1007/s10157-005-0397-0. PMID 16544179.

- Rang, H.P., Dale, M.M and Ritters, J.M (1991). The endocrine pancreas and the control of blood glucose: In Barbara Simmons, Susan Beasley. Eds. Pharmacology, U.K Longman group Ltd. 403-410.
- Sumana, G and Suryawanshi, S.A (2001). Effect of vinca rosea extracts in treatment of alloxan diabetes in male albino rats. Indian J Exp Biol. 39: 748-758.
- Van Wyk, B., Van Oudtshoorn, B. and Gericke, N (2000). Medicinal plants of South Africa. Briza publications. Cape Town.