doi: 10.1111/j.1472-8206.2007.00563.x

ORIGINAL ARTICLE

Medicinal plants and the treatment of diabetes in Senegal: survey with patients

Amadou Moctar Dièye[a]*, Anna Sarr[b], Saïd Norou Diop[b], Mamadou Ndiaye[a], Guata Yoro Sy[a], Mounibé Diarra[c], Ilham Rajraji/Gaffary[a], Awa Ndiaye/Sy[a], Babacar Faye[a]

[a]*Laboratoire de Pharmacologie, Faculté de Médecine, de Pharmacie et d'Odonto-Stomatologie, Université Cheikh Anta Diop de Dakar-Fann, BP 5005, Dakar-Fann, Sénégal*
[b]*Service de Médecine Interne-Diabétologie, Centre Hospitalier Abass Ndao, Dakar, Sénégal*
[c]*Laboratoire de Physique, Faculté de Médecine, de Pharmacie et d'Odonto-Stomatologie, Université Cheikh Anta Diop de Dakar-Fann, BP 5005, Dakar, Sénégal*

Keywords
diabetes,
medicinal plants,
Senegal

Received 2 July 2007;
revised 4 September 2007;
accepted 20 November 2007

*Correspondence and reprints:
ctdieye@yahoo.fr

ABSTRACT

Diabetes is the most common metabolic disorder worldwide and is a major public health problem. Its frequency increases every day in all countries. However, in developing African countries, few people have access to drugs. In addition, in Africa, traditional beliefs induce people to use medicinal plants whenever they have health problems. Thus, many people in these developing countries use plants for the treatment of diabetes. Yet, few studies are focused on the knowledge and attitudes of the users on medicinal plants in Africa in general and in Senegal in particular. Hence we undertook this survey on the use of medicinal plants for the treatment of diabetes in Senegal in order to make recommendations which could contribute to the increase of the value of herbal medicines in developing countries. We did a cross-sectional survey by direct interview at a university teaching hospital, in Dakar with a representative sample of 220 patients. Forty-one plants were used by the patients and the two most frequently cited were *Moringa oleifera* Lam (65.90%) and *Sclerocarya birrea* (A. Rich) Hochst (43.20%). Patients gave several reasons for using medicinal plants (traditional treatment: 40%, efficacy: 32%, low cost: 20%). The principal suppliers of plants were tradesmen in the market (66.8%) and traditional therapists (5%). Sixty-five per cent of patients think that medicinal plants are efficient for the treatment of diabetes and 20% have reported adverse effects which could be caused by medicinal plants. In conclusion, many people in our study think that medicinal plants are efficient for the treatment of diabetes, which requires research work by scientists in developing countries in this field in order to prove their efficacy and innocuousness.

INTRODUCTION

It is increasingly being acknowledged that diabetes and other chronic diseases are major public health problems. Medicare and managed healthcare organizations have recognized the enormous personal and societal costs of uncontrolled diabetes in terms of complications, patients' quality of life and healthcare system resources. The consequences are more dramatic in developing African countries where few people have access to drugs [1]. According to the World Health Organization (WHO), up to 90% of the population in developing countries, especially in Africa, resort to traditional medicine, including medicinal plants, to help meet their primary care needs [2]. Thus, many people in the developing countries of Africa use plants for the treatment of diabetes [3–5]. Many studies have been performed worldwide on diabetic animal models

including those in our laboratory to provide scientific justifications for the traditional use of medicinal plants [6–9]. However, so far, few good clinical trials have been carried out to prove the efficacy and the innocuousness of the plants in human beings [5]. In addition, few studies have focused on users' perception of medicinal plants [10]. Hence we undertook this survey on the use of medicinal plants for the treatment of diabetes in Senegal in order to make recommendations which could contribute to increasing the value of herbal medicines in developing countries. The specific aims were to identify the most frequently used plants for treating diabetes, to precise the reasons why patients use medicinal plants, to identify the suppliers of plants, to determine users' perception of the efficacy of medicinal plants and to determine adverse effects attributed to these plants.

MATERIALS AND METHODS

Study site

This study was performed in Marc Sankale diabetic centre located in Abass NDao hospital which is a university teaching hospital in Dakar. It is considered to be the national reference centre of diabetes in Senegal.

Materials

Questionnaire

We prepared a questionnaire with 17 items. The questions were in general closed and focused on the names of the most-used plants, the reasons for using these plants, how patients get information on medicinal plants for the treatment of diabetes, the suppliers of plants, the perception of patients on the efficacy of medicinal plants, the doses used and the possible adverse effects of plants. The questionnaire also elicited data about the socio-professional characteristics of patients.

Study population

The study population included diabetic patients of both sexes, ≥20 years old, who consulted the Marc Sankale centre from 2 May to 30 June 2006 and agreed to participate in the survey. These patients had also used, at least once, medicinal plants for the treatment of diabetes.

Methods

This study was a cross-sectional survey through direct interviews of patients in the Marc Sankale centre. The questionnaire was verified before the survey was undertaken with 10 patients and staff, and we analysed the answers and made sure patients understood the questions. These 10 patients were excluded from the study. We calculated the number of patients required for a population study with Epi Info (version 6; CDC, Atlanta, GA, USA), in a centre where the number of expected diabetic patients per year is 2000, with a risk of 5%, a precision of 10% and an unknown proportion of medicinal plants users arbitrarily fixed at 50%. The number found was 211 and we rounded it to 220. Thus, for the survey, a total of 220 patients were interviewed from 2 May to 30 June 2006, by a final-year student in pharmacy, who was accompanied by doctors of the Mark Sankale centre. The results were processed by Epi Info (version 6) and given as percentage. For botanical identification of plants, we used textbooks edited by the non-governmental organization ENDA TM, in which almost all plants used medicinally in Senegal are described with their different vernacular and scientific names. We were also helped by specialists in traditional medicine, presently working in a reference centre of traditional medicine in Senegal (Keur Massar traditional hospital).

RESULTS

Socio-professional characteristics of patients and type of diabetes

More than half of the patients (54%) were illiterate, 29% had attended secondary school, 12% had some primary schooling and only 5% of patients had reached university level. They are in general housewives (24%), tradesmen (15%), retired people (3%), and the others (58%) such as taxi drivers, teachers, veterinary doctors, secretaries and hair stylists. Of the patients, 15.45% had type I diabetes and 84.55% type II diabetes; and 66.82% of our study population were women against 33.18% of men.

Medicinal plants most used by patients

Forty-one plants were cited by the patients and the two most frequently cited were *Moringa oleifera* Lam (65.90%) and *Sclerocarya birrea* (A. Rich) Hochst (43.20%) (*Table I*).

Reasons for using medicinal plants

Patients gave several reasons for using medicinal plants: The most frequent reason evoked was that medicinal plants are a traditional treatment option (40% of patients). Efficacy came in second position (32%) followed by low cost (20%) (*Table II*).

Table I Names of medicinal plants used by the patients and the percentage of users (n = 220)

Plant species	Family	Percentage of users	Part of plant used
Moringa oleifera	Moringaceae	65.90	Leaves, root
Sclerocarya birrea	Anacardiaceae	43.20	Leaves, bark
Laurus nobilis	Lauraceae	6.80	Leaves
Allium sativum	Alliaceae	6.40	Seed
Terminalia avicennioides	Combretaceae	5.50	Leaves
Garcinia cola	Lusiaceae	5.50	Seed
Anacardium occidentale	Anacardiaceae	4.50	Leaves, fruit, bark
Petroselinum crispum	Apiaceae	3.60	Leaves
Cocos nucifera	Arecaceae	3.20	Fruit
Origanum onites	Lamiaceae	3.20	Leaves
Combretum micranthum	Combretaceae	2.70	Leaves
Neocarya macrophylla	Chrysobalanaceae	2.70	Leaves, bark, fruit
Acacia nilotica	Mimosaceae	2.70	Leaves
Allium cepa	Alliaceae	2.70	Root
Cassia sieberiana	Caesalpiniaceae	2.70	Leaves, root, fruit
Aloe vera	Liliaceae	2.30	Leaves
Anogeissius lerocarpus	Combretaceae	2.30	Leaves, bark
Vigna unguiculata	Fabaceae	1.80	Seed
Tamarindus indica	Caesalpiniaceae	1.80	Leaves, root, bark, fruit
Xylopia aethiopica	Annonaceae	1.40	Seed
Cocculus pendulus	Menispermaceae	1.40	Root
Brassica oleracea	Brassicaceae	0.90	Leaves
Trichilia roka	Meliaceae	0.90	Root
Mangifera indica	Anacardiaceae	0.90	Leaves
Cassia occidentalis	Caesalpiniaceae	0.90	Leaves, root
Guiera senegalensis	Combretaceae	0.90	Leaves, root
Parkia biglobosa	Leguminosae	0.90	Leaves
Hibiscus sabdariffa	Malvaceae	0.50	Leaves, fruit
Cymbopogon citratus	Poaceae	0.50	fruit
Ficus vogelii	Moraceae	0.50	Leaves
Trigonella foenum-graecum	Fabaceae	0.50	Leaves
Lawsonia inermis	Lythraceae	0.50	leaves
Zizyphus mauritiania	Rhamnaceae	0.50	Leaves, root, bark, fruit
Khaya senegalensis	Meliaceae	0.50	Bark
Boscia senegalensis	Capparidaceae	0.50	Leaves, root
Olea europaea L.	Oleaceae	0.50	Leaves
Catharanthus roseus	Apocynaceae	0.50	Leaves
Rheum rhabarbarum	Polygonaceae	0.50	Leaves
Diospyros digyna	Ebenaceae	0.50	Leaves
Thymus vulgaris	Lamiaceae	0.50	Leaves
Oxytenanthera abyssinica	Poaceae	0.50	Leaves

Table II Reasons for using medicinal plants by the patients (n = 220)

Reasons	Percentages
Traditional treatment	40
Efficacy	32
Low cost	20
Innocuousness	5
Information on television	1
Others (to test plants, to use plants as good food)	2 %

Table III The suppliers of medicinal plants

Suppliers	Percentages
Tradesmen in the markets	66.8
Traditional therapists	5
Structures of traditional medicine	3.2
Others (seller in house, sent from village, bought on the road, gathering)	25

Suppliers of medicinal plants

The principal suppliers of plants were tradesmen in the markets (66.8%), traditional therapists (5%) and structures of traditional medicine (3.2%) (*Table III*).

Perception of patients on the efficacy of medicinal plants

Sixty-five per cent of patients considered medicinal plants to be efficient for the treatment of diabetes, whereas the rest considered otherwise. Patients who thought that medicinal plants were efficient based their opinion on the decrease of glycaemia (79.02%), the decrease or suppression of classic signs of diabetes (17.48%) and the fact to get back into shape (3.5%). However, many patients thought that diet was the best treatment for diabetes (44%). Drugs came in second (33%), followed by medicinal plants (22%) and physical exercise (1%). Seventy-four per cent of patients who used medicinal plants combined them with drugs and 94.1% of them were on a diet.

Information sources on the existence of medicinal plants

Most of the patients were informed of the medicinal plants by their neighbours (85.5%) followed by the media (10%) and traditional therapists (4.5%). Eighty per cent of users were influenced by other diabetic patients and the rest used plants without any influence (5%) or under the influence of traditional therapists or a member of the family (15%).

Used doses and adverse effects of plants

More than half of the patients (55.5%) said that they have information on the doses to use and the rest had no information. The principal modes of preparation of the plants were decoction (39%), maceration (27%), powdering (17%) and infusion (10%). Forty-four patients (20%) reported adverse effects which could be, in their opinion, caused by medicinal plants. These adverse effects were in general gastric disorders; two cases had symptoms of hypoglycaemia (fatigue, orthostatic hypotension, vertigo) and one had hyperglycaemic coma.

DISCUSSION

The most important findings of our study can be listed as follows: (i) Senegalese diabetics believed in general in the efficacy of medicinal plants; (ii) about 50% of the patients are not informed on the medicinal plant doses to use; and (iii) they combine medicinal plants with drugs and/or diet. In this survey, we used direct interviews and we presume that the answers provided are true: the participants cooperated well and are well known to the medical staff; we did not have any problems communicating with them; and patients are unlikely to tell lies like in surveys on incomes, sexual life or study level.

We did not evaluate the frequency of the use of medicinal plants by Senegalese diabetics in the general population but we think that this frequency is similar to what is observed in Guinea, which is a west African country like Senegal and where Balde et al. found a frequency of 33% [11].

The patients of our study have in general socio-professional problems and this can be explained by the fact that the diabetic centre doubles up as a public health centre with cheaper services. In general, in developing countries, only poor people go to public health structures and rich people to the private sector. This situation does not mean that patients do not get good health care in public structures. However, there are environmental problems in public structures and people can lose a lot of time in the antidiabetic centre of Abass Ndao hospital because it is the only well-known official centre for the treatment of diabetes in Senegal. Our results show that there are more women than men in our sample. The sex ratio is 2 and does not reflect the situation in Senegal where the number of women is much higher, with a sex ratio of 1.08. This figure can be explained by the fact that women in Senegal are more exposed to diabetes in towns like Dakar compared with men, because they are more unemployed which means that they do less physical exercises than men. They are in general housewives. Moreover, in the Mark Sankale centre, other studies reported more women than men in the type II diabetic population, with a sex ratio of 2.5 or 3.3 [12,13]. In addition, women in Senegal believe more in alternative medicine than men, despite the absence of explanation of this phenomenon.

Moringa oleifera and *S. birrea* are the two main plants used by patients. This information seems to be very important if we want to investigate the efficacy and innocuousness of medicinal plants. Interestingly, these plants can decrease blood glucose levels: *S. birrea* for normoglycaemic rats [14] and *M. oleifera* for diabetic rat models [15]. Because of the fact that 65% of patients assume medicinal plants to be efficient in the treatment of diabetes, scientists must focus their efforts on these plants and extend studies to all African countries and, further, worldwide.

Many patients explained their decision to use medicinal plants because, for them, traditional treatment meant efficient treatment without side effects. We must be aware of this consideration because, medicinal plants could lead to toxicity and death [16,17] and their efficacy is not guaranteed in general [5]. The only way to prove the efficacy and innocuousness of medicinal plants is to perform experimental assays in animal models and clinical trials in human beings. Another reason why our patients use medicinal plants is their efficacy but there are few studies to prove it [5]. In addition, people combine these plants with drugs while following a diet, which explains the difficulty of knowing the true contribution of plants to the control of glycaemia. The third reason is the low cost of medicinal plants. We agree to this argument because most of the people in this study are poor and, it is not easy for them to buy drugs regularly in pharmacies. Thus, health authorities must improve the access of populations to social security. In Senegal for example, less than 20% of the population (13.3%) has access to social security [18].

The suppliers of medicinal plants are in general tradesmen in the markets. Most of these people have no relevant educational qualification and are illiterate and hence pose a grave danger to the population. Yet, health authorities do nothing to protect the population. The sector of medicinal plants needs to be better organized as it is the responsibility of the Health Ministry.

Concerning patients' conception of the efficacy of medicinal plants, many (65%) think that they are efficient for the treatment of diabetes. This high percentage

shows that African beliefs in traditional medicine is a reality that scientists cannot ignore. On the contrary, the latter must be involved in this field as suggested by the WHO which estimates that up to 90% of people in developing countries have, at least once, used traditional medicine [2]. African researchers need to investigate this domain for two reasons. First, use of medicinal plants allows African people to access efficient treatment at a lower cost than drugs; second, to prevent the use of non-efficacious and, more importantly, plants that can induce side effects by the population. Thirty-five per cent of patients think that medicinal plants are not efficient because of their lack of confidence in traditional medicine (40%) and efficacy (36%). Whether medicinal plants are efficient against diabetes or not cannot be deduced from this study because patients combined these plants with drugs and diet. It will be interesting to conduct a survey of patients taking only medicinal plants but, because of ethical considerations, the feasibility of this kind of study is not obvious.

Most of the patients were informed on the existence of medicinal plants by their neighbours. This means that if we want to undertake preventive actions against the use of medicinal plants, these actions should be oriented first on patients' neighbours. Traditional therapists and media play an important role and they must be included in programmes. Our study also showed that 80% of patients were influenced by other diabetic patients in using medicinal plants and that is why, diabetic associations, a common phenomenon throughout the world, should also be involved in preventive actions.

Many patients (44.5%) reported that they had no indication on the doses to use. This situation can be explained by the fact that suppliers of medicinal plants have no qualification in herbal medicine. This is indeed very dangerous because, even if medicinal plants are efficient, the use of inappropriate doses could turn these plants into inefficient or toxic substances. National authorities must take urgent measures to reverse this dangerous trend. These same measures are necessary even for people who have information on the doses to use, because most of the tradesmen who give these doses have no serious training on the use of medicinal plants. Some patients (20%) experienced adverse effects, such as hypoglycaemia and hyperglycaemic coma, which could be caused by medicinal plants. A study carried out in Jordan showed side effects in 36.5% of patients using herbal medicine to treat diabetes [19]. This information does not prove that medicinal plants are responsible for this but this is an alert which must urge scientists to investigate the side effects of medicinal plants in general, and antidiabetic plants, in particular.

CONCLUSIONS

Many diabetic patients in our study think that medicinal plants are efficient for the treatment of diabetes. Hence, scientists in developing countries must work in this field in order to demonstrate the efficacy and innocuousness of herbal medicines. However, instead of working alone, they must collaborate with traditional therapists and national health authorities. We are convinced this is the best way to secure the use of medicinal plants and to improve the access of populations in developing countries to drugs.

REFERENCES

1 Vandrerbroek I., Calewaert J.B., De Jonckheere S., Sanco L.P., Van Damme L.V., Puyvelde N.D.K. Use of medicinal plants and pharmaceuticals by indigenous communities in the Bolivian Andes and Amazon. Bull. WHO (2004) **82** 243–250.
2 World Health Organization. Traditional medicine – growing needs and potential. WHO Policy Perspectives Med. (2002) **2** 1–6.
3 Eddouks M., Maghrani M., Lemhardri A., Oualidi M.J., Jouhad H. Ethnobotanical survey of medicinal plants used for the treatment of diabetes mellitus, hypertension, and cardiac disease in the south-est. region on Morocco (Tafilalet). J. Ethnopharmacol. (2002) **82** 97–103.
4 Zayya A., Legssyer A., Mekhfi H., Dassouli A., Serhrouchni M., Benjelloun W. Phytotherapy of hypertension and diabetes in oriental Morocco. J. Ethnopharmacol. (1997) **58** 45–54.
5 Dham S., Shah V., Hirsch S., Banerji M.A. The role of complementary and alternative medicine in diabetes. Curr. Diabetes Rep. (2006) **6** 251–258.
6 Arul B., Kothai R., Christina A.J. Hypoglycemic and anti-hyperglycemic effect of Semecarpus anacardium Linn in normal and streptozotocin-induced diabetic rats. Methods Find. Exp. Clin. Pharmacol. (2004) **26** 759–762.
7 Orhan D.D., Aslan M., Sendogdu N., Ergun F., Yesilada E. Evaluation of the hypoglycaemic effect and antioxidant activity of three *Viscum album* subspecies (European mistletoe) in streptozotocin-diabetic rats. J. Ethnopharmacol. (2005) **98** 95–102.
8 Sy G.Y., Cissé A., Nongonierma R.B., Sarr M., Mbodji N.A., Faye B. Hypoglycaemic and antidiabetic activity of acetonic extract of *Vernonia colorata* leaves in normoglycaemic and alloxan-induced diabetic rats. J. Ethnopharmacol. (2005) **98** 171–175.
9 Dimo T., Nquequin F.T., Kamtchouing P., Dongo E., Tan P.V. Glucose lowering efficacy of the aqueous stem bark extract of Trema orientalis (Linn) Blume in normal and streptozotocin diabetic rats. Pharmazie (2006) **61** 233–236.

10 Moss M., CmcDowell J.R.S. Rural Vincentians' (Caribbean) beliefs about the usage of non-prescribable medicines for treating Type 2 diabetes. Diabet. Med. (2005) **22** 1492–1496.
11 Baldé N.M., Youla A., Baldé M.D. et al. Herbal medicine and treatment of diabetes in Africa: an exemple from Guinea. Diabetes Metab. (2006) **32** 171–175.
12 Sidibé E.H., Badiane M.K., Gueye A. Aspects de la bithérapie antihyperglycémiante orale chez 76 patients diabétiques non insulinodépendants à Dakar. Cahiers Santé (2002) **12** 319–322.
13 Sidibé E.H., Ndoye-Diop A., Ndour-Mbaye N.M. Diabète de type 2 et hypertension artérielle à Dakar. Rev. Fr. Endocrinol. Clin. Nutr. Métab. (1999) **40** 526–527.
14 Ojewole J.A. Hypoglycemic effect of *Sclerocarya birrea* [(A.Rich.)Hochst.][Anacardiaceae] stem-bark aqueous extract in rats. Phytomedicine (2003) **10** 675–681.
15 Kar A., Choudhary B.K., Bandyopathyay N.G. Comparative evaluation of hypoglycaemic activity of some Indian medicinal plants in alloxan diabetic rats. J. Ethnopharmacol. (2003) **84** 105–108.
16 Stewart M.J., Steenkamp V., Zuckerman M. The toxicology of African herbal remedies. Ther. Drug Monit. (1998) **20** 510–516.
17 Deciga-Campos M., Rivero-Cruz I., Arriaga-Alba M. et al. Acute toxicity and mutagenic activity of Mexican plants used in traditional medicine. J. Ethnopharmacol. (2007) **110** 334–42.
18 Fall C. Etendre l'assurance santé au Sénégal: possibilités à travers les régimes statutaires et les organisations mutualistes, Bull. Bureau Int. Travail (2003) **9** 40.
19 Otoom S.A., Al-Safi S.A., Kerem Z.K., Alkofahi A. The use of medicinal herbs by diabetic Jordanian patients. J. Herb. Pharmacother. (2006) **6** 31–41.