



## Medicinal plants used for the management of diabetes mellitus in Zaria, Kaduna state, Nigeria

[Plantas medicinales utilizadas para el manejo de la diabetes mellitus en Zaria, estado de Kaduna, Nigeria]

Umar S. Abubakar\*, Sani Abdullahi, Victoria Ayuba, Shettima Kaigama, Usman S. Halidu, Muhammad K. Ayuba

Bioresources Development Centre, Kano. National Biotechnology Development Agency (NABDA), Abuja, Nigeria.

\*E-mail: [umarfarouk2003@yahoo.com](mailto:umarfarouk2003@yahoo.com)

### Abstract

**Context:** The knowledge of traditional uses of medicinal plants in the management of diabetes mellitus in Zaria is still intact with the traditional medicine practitioners.

**Aims:** To collect, identify and document medicinal plants used traditionally for the management of diabetes mellitus in Zaria city.

**Methods:** Open-ended informal interviews and general conversation were administered to twenty-two (22) traditional medicine practitioners (TMPs) and herb sellers. The data collected included the local names of plants, parts used, method of preparations and mode of administration.

**Results:** Twenty-six (26) species of plants belonging to eighteen (18) families were identified. Herbal remedies were mostly prepared from freshly collected plants, while decoction was the main method of preparation. Leaves and stem bark formed the major parts of plants for herbal preparations.

**Conclusions:** The study has documented different traditional practices used for the management of diabetes mellitus in the study area. Further studies should be conducted to evaluate the antidiabetic activity of plant species that have not yet been studied and to identify the bioactive compounds responsible for the antidiabetic activity as claimed by the traditional healers.

**Keywords:** decoction; diabetes mellitus; medicinal plants; traditional healers.

### Resumen

**Contexto:** El conocimiento de los usos tradicionales de las plantas medicinales en el manejo de la diabetes mellitus en Zaria sigue intacto con los médicos tradicionales.

**Objetivos:** Colectar, identificar y documentar las plantas medicinales utilizadas tradicionalmente para el manejo de la diabetes mellitus en la ciudad de Zaria.

**Métodos:** Se realizaron entrevistas informales abiertas y conversaciones generales a veintidós (22) practicantes de medicina tradicional (TMPs) y vendedores de hierbas. Los datos recogidos incluyeron los nombres locales de plantas, partes utilizadas, método de preparación y modo de administración.

**Resultados:** Se identificaron veintiséis (26) especies de plantas pertenecientes a dieciocho (18) familias. Los remedios herbarios se prepararon sobre todo de las plantas recién recogidas, mientras que la decocción era el método principal de la preparación. Las hojas y la corteza del tallo formaron las partes principales de las plantas para las preparaciones herbarias.

**Conclusiones:** El estudio ha documentado diferentes prácticas tradicionales utilizadas para el manejo de la diabetes mellitus en el área de estudio. Se deben realizar estudios adicionales para evaluar la actividad antidiabética de las especies de plantas que aún no han sido estudiadas y para identificar los compuestos bioactivos responsables de la actividad antidiabética según lo reivindicado por los curanderos tradicionales.

**Palabras Clave:** curanderos tradicionales; decocción; diabetes mellitus; plantas medicinales.

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## INTRODUCTION

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Diabetes mellitus has been identified as the most common endocrine disorder that currently affects 200 million people of the world's population (Wais et al., 2012). It is projected to rise to over 366 million in the year 2030 (Wild et al., 2004). Diabetes mellitus is characterized by hyperglycemia with alteration of carbohydrates, protein and fat metabolism, resulting from defects in insulin secretion or sensitivity of insulin to body cells or both (Hovens et al., 2005). Such alterations result in elevated blood glucose concentration, which causes acute complications like hyperglycemia and hypoglycemia and long-term complications in many organs, which may lead to increase the risk of atherosclerosis, renal failure, nerve damage, coronary heart disease and blindness resulting in increasing disability (ADA, 2009).

Diabetes mellitus can be classified on the basis of clinical presentation of the disorder, and this can be grouped into three major types; Type I diabetes, Type II diabetes and gestational diabetes mellitus (Velho and Froguel, 2002). Diabetes mellitus is associated with reduced quality of life and increased risk factors for mortality and morbidity (Upendra-Rao et al., 2000).

The search for natural products to cure diseases has received considerable attentions in which medicinal plants have been the most important source (Okwu, 2001). They are believed to be an essential source of new chemical substances with potential therapeutic effects (Kuhn and Winston, 2000), and due to the crucial role that plant-derived compounds have played in drug discovery, and development for the treatment of several diseases, the isolation of new bioactive compounds from medicinal plants based on ethnomedicinal data appears to be a very promising approach (Newman, 2008).

Traditional medicine products are playing greater roles in the lives of the people across the world in the face of the global upsurge of drug resistance, toxicity, adverse effects and increasing costs of synthetic products (Mbi and Bilikha, 1998).

In Nigeria, several thousands of plants have been claimed to possess medicinal properties and are employed in the treatment of many ailments (Iweala and Oludare, 2011). Many of these indigenous medicinal plants are used as spices and food plants and for medicinal purposes (Nwaogu et al., 2007). Presently, medicinal plants continue to play a significant role in the management of diabetes mellitus, especially in developing countries where many people do not have access to modern antidiabetic drugs (Acharya and Shrivastava, 2008). However, the knowledge of medicinal uses of plants in the management of diabetes mellitus is still intact with the traditional medicine practitioners, and this knowledge is either lost or passed to their children by the word of mouth. Therefore, there is need to collect and document this knowledge before such rich heritages are lost. Thus, the present work was aimed to collect and document medicinal plants used for the treatment diabetes mellitus in Zaria local government area, Kaduna state, Nigeria.

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## MATERIAL AND METHODS

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### Study area

Zaria is the second biggest city in Kaduna State, Nigeria. It is one of the seven original Hausa city-states and also the capital of the Hausa Kingdom of Zazzau emirate. According to the 2006 Nigerian census, Zaria has a population of 406, 990 people, total land area of about 563 km<sup>2</sup> and located on 11.09°N and 7.72°E coordinates. It is the home of many educational institutions like the prestigious Ahmadu Bello University, Barewa College, College of Aviation Technology, Nigerian Military School among others (Fig. 1) (Maiwada and Renne, 2007).

### Ethnobotanical survey

The main data sources consisted of a series of informal interviews and general conversation administered on the traditional medicine practitioners and herb sellers. The interviews were done in Hausa language. The data collected included the local names of plants, parts of the plants used and method of preparations. Diabetes mellitus is gene-

rally known as “Ciwon Siga” in Hausa language, and that was the term used in this study. The plants were collected in their flowering and fruiting seasons. The voucher specimens were identified and authenticated by a Taxonomist, Mr. Tijjani A. Gawuna of Ethnobotany Unit of Bioresources Development Centre, Kano, and the scientific names were confirmed in “Hausa names for plants and trees” written by Roger Blench, Mallam Dendo 8, Guest Road Cambridge CB1 2AL, United Kingdom. The specimens were later deposited in the herbarium for preservation.

A traditional medicine practitioner was a person who was recognized by the community in which he lives as competent to provide health care by using plant, animal, mineral substances and certain other methods. On the other hand, a herb seller was a person who sells herbs and can also identify them but have little knowledge of their medicinal values.

### Statistical analysis

Descriptive statistics such as percentages, pie chart, informant consensus factor (ICF) and Fidelity level (FL) were used in the analysis of the data.

ICF was calculated using the formula as follows:

$$ICF = \frac{N_{ur} - N_t}{N_{ur} - 1} \tag{1}$$

Where Nur = number of use citation and Nt = number of species used.

The fidelity value (FL) was calculated using the formula as follows:

$$FL = \frac{I_p}{I_u} \tag{2}$$

Where Ip = number of respondents who reported the utilization of medicinal plants for a specific main ailment, and Iu = total number of respondents who mentioned the same plant for any ailment.

## RESULTS

### Respondents identity

A total number of twenty-two (22) respondents were interviewed, with 25% within the age range of 25-35 years, 55% within the age range of 36-45 years, while 20% were within the age range of 46-60 years. Most of the respondents are married (80%), male (80%) and traditional medicine practitioners (80%). Also, the majority of the respondents were primary school leavers (45%), and most of them claimed that they inherited the knowledge from their forefathers. The result is summarized in Table 1.

### Ethnobotanical survey

A total number of twenty-six (26) plants belonging to 18 families were described as being used for the management of diabetes mellitus in Zaria. The families Malvaceae, Amaryllidaceae, Fabaceae, Moraceae, Myrtaceae, Anarcadiaceae, Meliaceae, and Combretaceae were the most frequently mentioned families in this study, while leaves, stem bark, and roots were the most frequently used plant parts (Table 2). The informant consensus factor (ICF) has shown a high degree of consensus (0.87) among the respondents, while the fidelity level (FL) value revealed *Vernonia amygdalina* and *Mangifera indica* with high FL values of 82% and 64% respectively.



Figure 1. Map of Zaria city.

**Table 1.** Demographic characteristics of the respondents.

| Variable              | Specification             | Percentage (%) |
|-----------------------|---------------------------|----------------|
| Age                   | 25-35                     | 25             |
|                       | 36-45                     | 55             |
|                       | 46-60                     | 20             |
| Sex                   | Male                      | 80             |
|                       | Female                    | 20             |
| Marital status        | Single                    | 20             |
|                       | Married                   | 80             |
| Practice              | Traditional practitioners | 80             |
|                       | Herb sellers              | 20             |
| Years of experience   | 5-15                      | 25             |
|                       | 16-25                     | 55             |
|                       | 26 and above              | 20             |
| Method of treatment   | Herbal alone              | 100            |
| Tribe                 | Hausa                     | 75             |
|                       | Fulani                    | 20             |
|                       | Yoruba                    | 5              |
| Religion              | Islam                     | 90             |
|                       | Christianity              | 7              |
|                       | Pagan                     | 3              |
| Source of information | Ancestral                 | 65             |
|                       | Acquired                  | 35             |
| Educational status    | Primary                   | 45             |
|                       | Secondary                 | 35             |
|                       | Tertiary                  | 20             |

**Table 2.** Plants used for the treatment of diabetes mellitus in Zaria.

| No. | Plant name                    | Family         | Local name  | Common name      | Part used            | Method of preparation | Mode of application | Voucher name  |
|-----|-------------------------------|----------------|-------------|------------------|----------------------|-----------------------|---------------------|---------------|
| 1   | <i>Acacia nilotica</i>        | Mimosaceae     | Bagaruwa    | Egyptian mimosa  | Stem bark and leaves | Decoction             | Oral                | BDCKN/EB/1620 |
| 2   | <i>Adonsonia digitata</i>     | Malvaceae      | Kuka        | Boabab           | Seeds                | Infusion              | Oral                | BDCKN/EB/1626 |
| 3   | <i>Allium cepa</i>            | Amaryllidaceae | Albasa      | Onion            | Whole plant          | Decoction             | Oral                | BDCKN/EB/1610 |
| 4   | <i>Allium sativum</i>         | Amaryllidaceae | Tafarnuwa   | Garlic           | Whole plant          | Swallowing            | Oral                | BDCKN/EB/1619 |
| 5   | <i>Anacardium occidentale</i> | Anacardiaceae  | Kashu       | Cashew           | Leaves               | Decoction             | Oral                | BDCKN/EB/1601 |
| 6   | <i>Anogeissus leiocarpus</i>  | Combretaceae   | Marke       | Chew stick tree  | Stem bark            | Decoction             | Oral                | BDCKN/EB/1607 |
| 7   | <i>Azadirachta indica</i>     | Meliaceae      | Dogon yaro  | Neem             | Stem bark and leaves | Maceration            | Oral                | BDCKN/EB/1618 |
| 8   | <i>Balanites aegyptiaca</i>   | Balanitiaceae  | Aduwa       | Desert date tree | Stem bark and leaves | Maceration            | Oral                | BDCKN/EB/1602 |
| 9   | <i>Brassica oleracea</i>      | Brassicaceae   | Kabeji      | Cabbage          | Leaves               | Infusion              | Oral                | BDCKN/EB/1611 |
| 10  | <i>Carica papaya</i>          | Caricaceae     | Gwanda      | Pawpaw           | Leaves               | Decoction             | Oral                | BDCKN/EB/1605 |
| 11  | <i>Citrus medica</i>          | Rutaceae       | Lemon tsami | Lemon            | Fruit                | Infusion              | Oral                | BDCKN/EB/1622 |
| 12  | <i>Eugenia caryophyllus</i>   | Myrtaceae      | Kanunfari   | Clove            | Seeds                | Decoction             | Oral                | BDCKN/EB/1613 |
| 13  | <i>Ficus sycamoros</i>        | Moraceae       | Baure       | Fig              | Leaves and Stem bark | Decoction             | Oral                | BDCKN/EB/1621 |
| 14  | <i>Ficus thonningii</i>       | Moraceae       | Chediya     | Loin cloth fig   | Leaves               | Decoction             | Oral                | BDCKN/EB/1617 |
| 15  | <i>Gossypium herbaceum</i>    | Malvaceae      | Auduga      | Cotton           | Leaves               | Decoction             | Oral                | BDCKN/EB/1609 |
| 16  | <i>Guiera senegalensis</i>    | Combretaceae   | Barbata     | Sabara           | Leaves and root      | Decoction             | Oral                | BDCKN/EB/1616 |
| 17  | <i>Khaya senegalensis</i>     | Meliaceae      | Madaci      | Mahogany         | Stem bark            | Infusion              | Oral                | BDCKN/EB/1612 |

Table 2 (continued...)

| No. | Plant name                     | Family        | Local name    | Common name     | Part used            | Method of preparation | Mode of application | Voucher name  |
|-----|--------------------------------|---------------|---------------|-----------------|----------------------|-----------------------|---------------------|---------------|
| 18  | <i>Lawsonia inermis</i>        | Lythraceae    | Lalle         | Egyptian priest | Stem bark            | Decoction             | Oral                | BDCKN/EB/1604 |
| 19  | <i>Mangifera indica</i>        | Anacardiaceae | Mangwaro      | Mango           | Leaves and stem bark | Decoction             | Oral                | BDCKN/EB/1625 |
| 20  | <i>Moringa oleifera</i>        | Moringaceae   | Zogale        | Drumstick       | Leaves               | Squeezing             | Oral                | BDCKN/EB/1623 |
| 21  | <i>Parkia biglobosa</i>        | Fabaceae      | Dorawa        | Locust bean     | Fruits               | Grinding              | Oral                | BDCKN/EB/1608 |
| 22  | <i>Piliostigma reticulatum</i> | Fabaceae      | Kalgo         | Camel foot tree | Stem bark            | Infusion              | Oral                | BDCKN/EB/1615 |
| 23  | <i>Psidium guajava</i>         | Myrtaceae     | Goba          | Guava           | Leaves               | Infusion              | Oral                | BDCKN/EB/1624 |
| 24  | <i>Solanum incanum</i>         | Solanaceae    | Gauta         | Bitter apple    | Fruits               | Eating fresh fruits   | Oral                | BDCKN/EB/1603 |
| 25  | <i>Vernonia amygdalinia</i>    | Asteraceae    | Shiwaka       | Bitter leaf     | Leaves               | Soup                  | Oral                | BDCKN/EB/1614 |
| 26  | <i>Ziziphus mucronata</i>      | Rhamnaceae    | Magaryar Kura | Buffalo thorn   | Leaves               | Decoction             | Oral                | BDCKN/EB/1606 |

N=22 Respondents

### Characteristics of recipes used

Recipes were made mostly from combination of different parts of two plant species (Table 3), while some were made from a single plant part. Decoction is the most preferred method of

preparation, while oral administration was the only mode of administration. Leaves are the most used plant parts in the management of Diabetes mellitus in this study; this is followed by stem bark and fruits (Fig. 2).

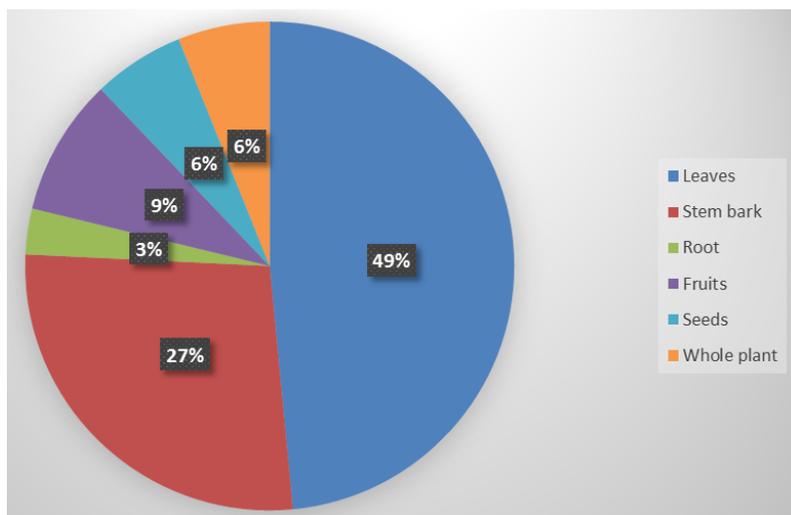


Figure 2. Percentage occurrence of plant parts used for the management of diabetes mellitus in Zaria.

**Table 3.** Some antidiabetic recipes and mode of preparation

| No. | Recipe  | Method of preparation | Mode of administration |
|-----|---|-----------------------|------------------------|
| 1   | <i>Acacia nilotica</i> (leaves) + <i>Allium sativum</i> + Honey                           | Decoction             | Oral                   |
| 2   | <i>Adonsonia digitata</i> (Powdered fruits) + Cow milk                                    | Infusion              | Oral                   |
| 3   | <i>Allium cepa</i> + <i>Brassica oleracea</i> (leaves)                                    | Decoction             | Oral                   |
| 4   | <i>Anarcadium occidentale</i> (leaves) + <i>Carica papaya</i> (brown leaves) + Red potash | Decoction             | Oral                   |
| 5   | <i>Anogeissus leiocarpus</i> (Stem bark) + <i>Guiera senegalensis</i> (Leaves)            | Decoction             | Oral                   |
| 6   | <i>Azadirachta indica</i> (leaves) + <i>Vernonia amygdalina</i> (leaves)                  | Maceration            | Oral                   |
| 7   | <i>Balanites aegyptiaca</i> + <i>Mangifera indica</i> (leaves)                            | Maceration            | Oral                   |
| 8   | <i>Carica papaya</i> (leaves) + Red potash  | Decoction             | Oral                   |
| 9   | <i>Citrus medica</i> (fruits) + Honey   | Decoction             | Oral                   |
| 10  | <i>Eugenia caryophyllus</i> + <i>Citrus medica</i>  | Decoction             | Oral                   |
| 11  | <i>Ficus symorus</i> (leaves) + Red potash  | Decoction             | Oral                   |
| 12  | <i>Gossypium herbaceum</i> (leaves) + <i>Citrus medica</i> (fruits)                       | Decoction             | Oral                   |

N=12 Respondents

## DISCUSSION

The present study has documented the ethnomedicinal management of diabetes mellitus in Zaria local government area of Kaduna State, Nigeria. The indigenous population still relies on medicinal plants to meet their healthcare needs because of the perceived effectiveness, presumed safety, moderate side effects, accessibility and affordability (Vliathan, 1998).

The claim made by most of the respondents that they inherited the knowledge of ethnomedicinal uses of plants from their forefathers further corroborates the fact that the knowledge of traditional medicine is passed from parents to their children and spouses (Enwere, 2009).

Some of the plant species identified in this study were also reported to be used by the indigenous people of Southwestern Nigeria, India, North Centre of Morocco and South Eastern Morocco for the same purpose. The plants include *Azadirachta indica*, *Carica papaya*, *Parkia biglobosa* and *Vernonia amygdalina* (Abo et al., 2008). Therefore, these plant species could be considered as promising candidates for further scientific validation in the search for new, effective and affordable anti-diabetic drugs.

The antidiabetic activity of some plant species reported in this study has been demonstrated using different diabetic models (*in vitro* and *in vivo*). The plants include *Acacia nilotica* (Mwangi et al., 2015) *Azadirachta indica* (Perez-Gutierrez and Domain-Guzman, 2012), *Carica papaya* (Oke, 1998), *Ficus sycomorus* (Mousa, 1994), *Khaya senegalensis* (Ibrahim and Islam, 2014) and *Psidium guajava* (Sabjan and Vinoji, 2012).

The leaves formed the most frequently used plant parts in the management of diabetes mellitus in the present study. The use of leaves could be attributed to easy availability and also due to the presence of high amount of chemicals compounds, which could be easily extracted and used in different forms (Imran et al., 2014). Leaves are the most commonly used plant parts by traditional healers (Ngbolua et al., 2014).

The combination of different plants and parts in the preparation of antidiabetic herbal remedy is common among the respondents, and they believed that some plants enhance the action of other herbs. Polyherbal therapies have the synergistic and agonistic/antagonistic pharmacological agents within themselves that work together in a dynamic way to produce therapeutic efficacy with minimum side effects (Tiwari and Rao, 2002; Alexandros, 2007; Ebong et al., 2008).

Most of the respondents preferred to use fresh plant parts. Previous studies had shown that there were quantitative and qualitative differences in the essential oil components of fresh and dry plant materials (Fateme et al., 2006; Okoh et al., 2008).

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## CONCLUSIONS

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The study has documented different traditional practices used for the management of diabetes mellitus in Zaria. Further studies should be carried out to investigate the antidiabetic activity of other plant species that have not yet been studied, and also the bioactive compounds responsible for the antidiabetic activity need to be evaluated.

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## CONFLICT OF INTEREST

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The authors declare no conflict of interest.

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**Author contribution:**

| Contribution                       | Abubakar US | Abdullahi S | Victoria A | Shettima K | Usman SH | Ayuba MK |
|------------------------------------|-------------|-------------|------------|------------|----------|----------|
| Concepts or Ideas                  | X           | X           | X          |            |          |          |
| Design                             | X           | X           | X          | X          | X        | X        |
| Definition of intellectual content | X           | X           | X          | X          | X        | X        |
| Literature search                  | X           |             | X          | X          |          |          |
| Data acquisition                   | X           | X           |            |            | X        | X        |
| Data analysis                      | X           | X           | X          | X          | X        | X        |
| Statistical analysis               | X           | X           | X          | X          | X        | X        |
| Manuscript preparation             | X           | X           | X          |            |          |          |
| Manuscript editing                 |             |             |            |            | X        | X        |
| Manuscript review                  |             |             |            | X          |          |          |

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