Knowledge and utilization of traditional medicine for type 2 diabetes mellitus among residents of Pakuri (St. Cuthbert's Mission) in Guyana

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ABSTRACT

Aim: This study was designed to determine the knowledge and utilization of traditional medicine for Type 2 Diabetes (T2DM) among residents of Pakuri (St. Cuthbert's Mission) in Guyana.
Methodology: The study utilized a descriptive cross sectional design. Systematic random sampling procedures were done to identify study population. Prior informed consent from the village council, the Ministry of Indigenous Peoples' Affairs and individual participants were sought before the commencement of the study. The study was conducted over a four- week period.
Results: Three hundred and eighteen (318) participants were recruited for the study. The mean (±SD) knowledge score was 85.1 ± 16.8 with 50.9% of the study participants having good knowledge in traditional medicine for diabetes. DM affected 40.3% of the study participants, of this, more than half of the participants used traditional medicine to control their symptoms. Significant association was seen with age, gender, education and marital status among participants using traditional medicine for diabetes.
Conclusion: It is concluded that the use of traditional medicine is becoming increasingly popular and as such, efforts need to be made to revive and coordinate the use of medicinal plants/herbs by the Ministry of Public Health and Ministry of Indigenous People's Affair including the native flora of the local ecosystems. In addition, conclusive evidence on the contribution of the traditional medicine on the final outcome of management of T2DM could not be reach since the study was not controlled.

Key words: *Alternative Medicine*, *Complementary Medicine, Indigenous Knowledge on Traditional Medicine, Type 2 Diabetes*

1. INTRODUCTION

Biodiversity plays an important role in ecosystem functions and it also provides supporting, provisioning, regulating, and cultural services to most countries in the world. These services are essential for human wellbeing. Currently, only few studies link changes in biodiversity with changes in ecosystem functioning to alterations in human wellbeing. Worldwide, plants biodiversity are used for a multitude of reasons, most notably, for food, shelter and medicines. It is worth noting that countless modern medicines have been patented from plants. Within the tropics, an estimated 25,000-30,000 plant species have been used in traditional medicines [1].

The Convention of biodiversity today accepts the important health services of biodiversity and the provision of drugs to treat diseases worldwide [2]. In Guyana, the knowledge of phytochemical and pharmacological studies of local plant biodiversity for the treatment of diabetes mellitus used by acculturated Arawaks (Lokono) indigenous communities is poorly known. Effective bio-prospecting for new drugs using local biodiversity need to consider the proper implementation of the Nagoya Protocol regarding the rights of indigenous communities [2].

The Guiana Shield region is considered among the highest biodiversity regions in the world with several species of all living plants being endemic. There are over 13,367 species of vascular plants with nearly 40% being endemic [3]. This region is considered a spectacular work of nature because it holds the world's largest undisturbed tropical rain forest [4], as well as known protected areas including, in Guyana, some internationally well known, such as the Iwokrama Forest, the Kaieteur and the Kanuku National Park.

There is still a tremendous gap about the knowledge that local communities have about the use of native biodiversity in the treatment of diabetes. Jagessar & Kingston, for instance refers to the use of several plant species commonly found in riparian forests ecosystems of Guyana as a natural treatment for diabetes [5]. Few studies of bioactive principles native plants in Guyana for treatment of diabetes can be found but none of them published in scientific literature. However, extensive work on *Momordica charantia* (Family: *Cucurbitaceae* and commonly known in Guyana as Karela) for its antidiabetic properties has been published [6, 7]. dePhillips (2004) would have identified several plants within the Guiana Shield with antidiabetic properties (Table 1) [8]. Worth noting, several studies have also been done to assess the antimicrobial properties of natural products like honey, *Ocium sanctum* and *Calotropis gigantean* leaves [9, 10].

Although traditional medicine plays an important role in the Guyanese society, knowledge about the extent and characteristics of traditional healing practices and practitioners is limited and has frequently been ignored in the national health system. The 1992, United Nations Convention on Biological Diversity (CBD) recognized "close and traditional dependence of many indigenous and local communities embodying traditional lifestyles on biological resources" and that Governments "subject to national legislation, respect, preserve, and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biodiversity". The CBD also recommends the "approval and involvement of the holders of such knowledge, innovations and practices" and encourages "the equitable sharing of the benefits arising from the utilization of such knowledge, innovations, and practices" [11]. Considering the potential use of local plant-based medicines in Guyana, this study was designed to determine if indigenous residents of Pakuri (St. Cuthbert's Mission) in Guyana have a fairly good understanding of knowledge, attitude and utilization of traditional medicine to treat their T2DM.

Table 1. Species useful for diabetes in the Guiana Shield (DePhillips 2004)[8]

Family	Species	Part of Plant used
Apocynaceae	Catharanthus roseus (L.) G. Don (Lochnera rosea (L.) Rchb.)	Flowers
	Geissospermum argenteum Woodson	Bark
	Geissospermum laeis (Vell.) Miers	Bark
Araceae	Montrichardia arborescens (L.) Schott (Caladium arborescens (L.) Vent.)	Leaves
Aristolochiaceae	Aristolochia stahehi O.C. Schmidt	Stem
Asteraceae	Bidens pilosa L.	Whole plant
	Bidens cynaiifolia Kunth	Whole plant
Boraginaceae	Heliotropium indicum L.	Whole plant
Caesalpiniaceaea	Senna occidentalis (L) Link	Whole plane
	Senne obtusifolia (L.) Irwin & Barneby (Cassia obtusifolia L.)	Whole plant
Caricaceae	Carica papaya L	Fruit Juice
Cucurbitaceae	Momordica charnatia L. (Momordica balsamina sensu Descort., non L)	Leaves, fruit, stem
Dilleniaceae	Pinzona coriacea Martius & Zucc. (Pinzona calineoides Eich.)	Whole plant
	Tetracera volubilis L	Sap
Ebenaceae	Diospyros discolor Willd	Leaf
Euphorbiaceae	Euphorbia neriifolia L	Leaf
Fabaceae	Cajanus cajan (L) Millsp	Leaf, flower
Meliaceae	Azadirachta indica A. Juss.	Leaf
Menispermaceae	Telitoxicum sp.	Wood
	Tinospora crispa (L) Miers	Stem
Siparunaceae	Siparuna guianensis Aublet	Leaf, bark
Moraceae	Artocarpus altilis (Parkinson) Fosberg	Leaves
Myrtaceae	Eucalytus camaldulensis Dehnh	Leaves
	Syzgium cumini (L) Skeels	Leaves
Phytolacaceae	Microtea debilis Swartz	Whole plant
	Phytolacca rivinoides kunte & Bouche	Stem, Leaves
Portulacaceae	Portulaca mucronata Link	Whole Plant
Simaroubaceae	Quassia amara L	Bark
Verbenacese	Stachytarpheta cayennensis (L.C Rich.) Vahl	Whole Plant, Leaves

2. MATERIALS AND METHODS

A community based cross-sectional study design was employed to assess knowledge and utilization of the residents of Pakuri (St. Cuthbert's Mission) in Guyana towards traditional medicine (TM) used to treat and manage diabetes mellitus. The study took place over a four-week period.

2.1 Study Area

The study was conducted in Pakuri (St. Cuthbert's Mission) located at 6.36^0 LN, 58.08 LW; the current population is of 200 households, where approximately 1800 persons are currently living.

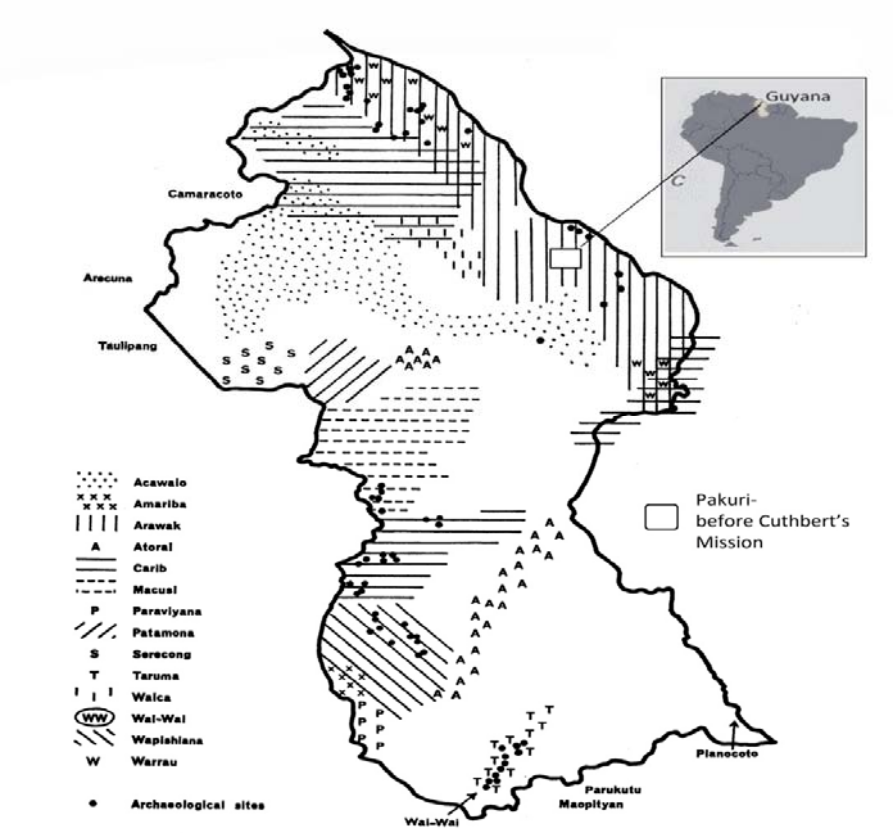

Figure 1. Study Area, modified after Brothwhell (1967)

Pakuri was said to be the "cultural capital" amongst the remaining Arawak Amerindian settlements (Figure 1)[12]. The name of the town was given for the abundance of the species named Pakooru *Platonia insignis* from the Botanical Family Guttiferae, an important forestry species with high exploitation since colonial times [13].

2.2 Study sample

Households within Pakuri (St Cuthbert's Mission) were the source population for the study. However, systematic random sampling was used to recruit specific households. The sampling units were households, while the study units were adult individuals available in the household during the interview. Participants were included in the study once they met the following criteria;

1. Individuals should be 18 years or older
2. Must be living in the community for no less than six (6) months.
3. Must sign the informed consent form before commencing the study.

Prior consent from the village council and Ministry of Indigenous Peoples' Affairs were given before the study commenced.

Sample Size Calculation

N = population size

z = z-score

e = margin of error

p = standard of deviation

$$\frac{\frac{Z^2 \cdot p(1-p)}{e^2}}{1+\left(\frac{Z^2 \cdot p(1-p)}{e^2 N}\right)}$$

Sample size was determined to 317 participants

2.3 Sampling Procedure

A systematic random sampling technique was used to select households. The first household was selected from the list of initial 6 households by lottery method. Then every 6th household was selected and adults in the household were interviewed.

2.4 Data collection

Data were collected using structured interviewer-administered questionnaire adapted from standardized questionnaires used by international organizations and published articles in peer-reviewed journals. The study was conducted over a four-week period. See Questionnaire (Appendix A)

2.5 Data analysis

Data were first entered in MS Excel and analyzed in SPSS version 20.0. The results were presented using simple frequencies with percentages in appropriate tables to display the descriptive part of the result. True and False questions were asked for each respondent regarding harmful TMs, side effects of TMs, and importance of training about TMs. The number of questions for which the respondent gave correct responses was counted and scored. This score was then pooled and the mean score was computed to determine the overall knowledge of respondents; respondents who score greater than or equal to the mean value were grouped to have good knowledge and those who score less than the mean value poor knowledge level. All data were expressed as actual mean number and as mean percentage with standard deviation (SD). A value of $p<0.05$ was taken as significant.

3. RESULTS AND DISCUSSION

The study recruited 318 participants based on systematic random sampling. Of these, 60.1% were females and 39.9% were males. The majority of the participants, (30.5%) were found in the >60 age group, followed by the 50-59 age group with 28.9% and with the age group 20-29 years having the least number of participants (7.2%). These results clearly shows that as people age they are more susceptible to diabetes.

The study recorded 57.9% of participants with secondary education, 37.7% with a primary education and only 4.4% acquiring tertiary education. From the total participants, 61% were married, 23.3% single, while 1.9%, 5.3% and 8.5% were separated, divorced and widowed, respectively. Approximately 55% of the participants were employed (having jobs with the Government) while 45% were unemployed (Table 2). It should be noted here that even though person were considered unemployed (not having a job with the Government), the majority of these participants were pensioners. In addition, some participants, who were not employed by the Government, undertook farming of cash crops as means of sustaining themselves. Some participants also had small shops in which they commercialize goods and services.

Table 2: Demographic data of all participants. Values are given as actual number and percentages with *p values (significant).

Gender	n (%)	p-value
Female	191 (60.1)	
Male	127 (39.9)	0.00*
Age Group		

20-29	23 (7.2)	
30-39	45 (14.2)	
40-49	61 (19.2)	
50-59	92 (28.9)	
>60	97 (30.5)	0.00*
Education		
Primary	120 (37.7)	
Secondary	184 (57.9)	
Tertiary	14 (4.4)	0.00*
Marital status		
Single	74 (23.3)	
Married	194 (61.0)	
Separated	6 (1.9)	
Divorced	17 (5.3)	
Widowed	27 (8.5)	0.00*
Employment status		
Employed	175 (55.0)	
Unemployed	143 (45.0)	0.07
Diabetes status		
No	190(59.7)	
Yes	128 (40.3)	0.001*

The mean (±) SD value of knowledge score was 85.1 ± 16.8. The data showed that 50.9% (n=162) of the study participants were found to have good knowledge about the use of traditional medicine and 49.1% (n=156) had poor knowledge (Table 3). Even though, half of the study participants had good knowledge of traditional medicine a study done by Agbaje and Babatunde (2005) showed only 44.7% of the study participants were considered as having good knowledge [14]. This can be due to more information sharing and renewed interest in TM as an alternative to avoid the side effects of conventional medicine. The results also show that only 40.3% (n=128) of the study participants were affected by T2DM. With 49% (n=155) having a family history of diabetes. In addition, differences in sample size can account for the variations.

Table 3: Data showing the knowledge results in the study. Data are expressed as mean percentage ± SD

Variable	**n (%)**	**95% CI**	**p value**
Knowledge Grade			
Poor	156 (49.1)	43.4-54.7	
Good	162 (50.9)	45.3-56.6	0.70
	Mean ± SD		
Knowledge	85.1±16.8	83.3-86.9	

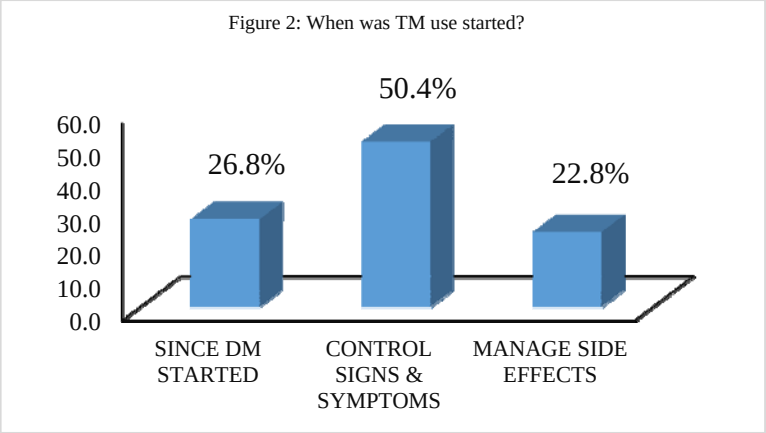

Figure 2: Bar charts showing the inception of T2DM, use of traditional medicine (TD) to treat/control T2DM following the onset of the diabetic symptoms and use of TM to treat diabetes-induced side effects. Data are mean percentage

Of the person affected by diabetes, 50.4% (n=66) started using TM to control signs and symptoms, 22.8% (n=29) started using traditional medicine as a way to manage side effects and only 26.8% (n=33) started using since being diagnose with Type 2 Diabetes (Figure 2). The results clearly shows that traditional medicines have a tremendous beneficial cost-effective effects in the treatment of both the symptoms and side effects, thereby, preventing long–term complications of T2DM among the participants.

Table 4 shows a list of plants/herbs used for treating and managing diabetes identified by the participants. The most widely used traditional medicine was seen as karela (*Momordica charantia*), Cinnamon (*Cimmamomum herun*) and Neem (*Azadirachta indica*), which were used in the form of infusion of the leaves. Participants also used TM along with several Oral Hypoglycemic Agents (OHA). In Guyana there are no regulations as to the use of traditional medicine, more so, its use in combination with conventional treatment for diabetes mellitus. The most widely used OHA was Metformin (64.6%), which was also used in combination with Daonil (18.9%) and Glycazide (16.5%) (Figure 3). Participants have also reported that prepare the plants in different dosage forms and administer them by mixing with water, tea and in some instances honey or without any mixing (Table 4). Several studies have also reported similar practices [15, 16].

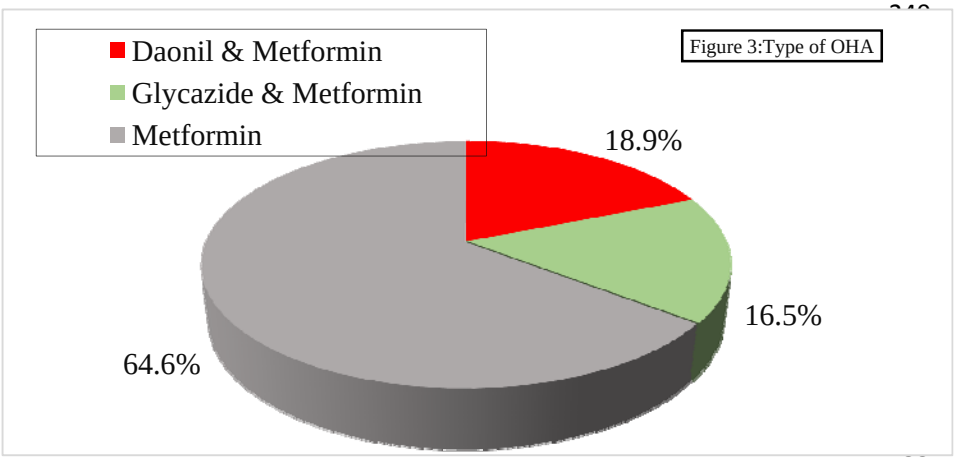

Figure 3: Pie chart showing the current oral hypoglycemic agents (OHA) used by participants in combination with traditional medicine in this study. Significantly, more participants were prescribes with metformin (64.6%) compared to combination of glycoside and metformin (16.5% and daonil and metformin (18.9%).

In this study, an association between independent variables and knowledge scores on TM for diabetes mellitus was calculated using Pearson's Chi square. It was found that the use of TM for diabetes melltius was significantly associated with the age, gender, education and marital status of the population (p value = 0.00). Medicinal plants have been cultivated and transferred along the history of humanity from regions of origin to another regions and all plants are commonly known as traditional medicine. However, there seems to be gaps regarding the use of species from the flora of local ecosystems in the traditional medicine, which is probably due to the fact that most plants/herbs named in Table 4 as being used are cultivated. From the list of plants/ herbs identified by the Arawaks (Lokono) participants, the only native species to forested areas of Northern South America mentioned by them were Mauby, Sand bitters and Rose of the Mountain. Given that previous ethnobotanical studies in the Guianas[8] indicate a group of species from the native ecosystems, the results also are suggesting a relative loss of knowledge about biodiversity of native ecosystems probably due to a process of acculturation.

Table 4: A list of anti-diabetic plants and method of utilization of the various plant species used by residents of Pakuri

Local Names	Scientific Names	Part of Plant	Dosage form used	Route of Administration	Method of Preparation	Frequency	Source of Plant
Aloe (Origin- North Africa)	*Aloe vera* L. Burm f.	Leaves	Semi-solid	Oral	Eaten	Twice daily	Home garden
Cinnamon (Origin- Sri Lanka)	*Cimmamomum verum* J. Presl.	Bark	Liquid	Oral	Tea	Once daily	Market
Dandelion (Origin- Eurasia)	*Taraxacum officinale* L. (Weber ex F.)	Root and Leaves	Liquid	Oral	Tea	Once daily	Home garden
Garlic (Origin- Central and South Asia, Southwestern Siberia)	*Allium sativum* L.	Bulb	Liquid	Oral	Tea	Once daily	Market
Ginger (Origin- South East Asia)	*Zingiber officinale* Rosc.	Root	Liquid	Oral	Tea	Once daily	Market
Karela (Origin- Africa)	*Momordica charantia L.*	Fruit	Liquid	Oral	Water	Once daily	Home Garden
Mauby (Origin- Neotropics)	*Colubrina elliptic* (Sw.) Brizicky & W.L. Stern	Bark	Liquid	Oral	Water	Once daily	Market
Neem (Origin- India)	*Azadirachta indica* (Juss).	Leaves	Liquid	Oral	Tea	Once daily	Market
Pawpaw (Origin- Central America)	*Carica papaya L.*	Leaves	Liquid	Oral	Tea	Once daily	Home garden
Pear (Origin- Central America)	*Persea americana Mill.*	Leaves	Liquid	Oral	Tea	Twice daily	Home garden
Sand bitters (Origin- North and South America)	*Unxia camphorata L.*	Leaves	Liquid	Oral	Boiling with water	Twice daily	Home garden

Sour Sop (Origin- Unknown, native of tropical regions of the Americas and the Caribbean)	*Annona muricata*	Leaves	Liquid	Oral	Boiling with water	Twice daily	Home garden
Rose of the Mountain (Origin- Neotropical Forests)	*Brownea latifolia L.*	Leaves	Liquid	Oral	Tea	Once daily	Home garden
Turmeric (Origin- South West India)	*Curcuma longa L.*	Root	Liquid	Oral	Tea	Once daily	Market
Zeb grass (Origin- Eastern Asia)	*Miscanthus sinensis Andersson*	Leaves	Liquid	Oral	Boiling with water	Twice daily	Home garden

This study also indicated that more than two-thirds (89.3%) of the participants had no previous training on the benefits and adverse effects of traditional medicine, but would have gotten information from relatives and friends. However, (100%) of participants showed interest to acquire education in this regard. This emanated from the good attitude that was seen from the majority of the participants towards traditional medicine.

4. CONCLUSION

In conclusion, the results from this study indicate that knowledge about medicinal plants and their usage in treating and managing diabetes is important, although knowledge from the flora of local ecosystems might be vanishing among the Arawaks (Lokono) due to processes of acculturation. Therefore, strong efforts are required to revive and coordinate the use of medicinal plants/herbs at the level of Ministry of Public Health and Ministry of Indigenous Peoples' Affair in Guyana. It must also be noted that the use of traditional medicine is becoming increasingly popular as the need for alternative medicines is on the rise. Majority of the population showed interest in being educated on the benefits and adverse effects of traditional medicine and as such, this should not be ignored. To add, botanical inventories on herbal medicines to treat diabetes should be done on the different vegetation types representing the biodiversity in the surroundings of the community, with the description of uses and phyto-constituents which can serve as the library to regain access to the knowledge of native species to treat diabetes cost-effectively as compared to orthodox medicines since diabetes is the second most debilitating disorder in Guyana and is becoming a leading cause of death worldwide.

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The authors of this study would like to thanks the residents of Pakuri (St. Cuthbert's mission) for their participation in this study.

COMPETING INTEREST

Each author declare that there is no conflict of interest

AUTHORS' CONTRIBUTION

Cecil Boston and Rajini Kurup were involved in the conceptualization of the research project and participated in study design, methodology, data analysis, interpretation and final draft of the paper.

Judith Rosales was involved in the data analysis and interpretation and final draft of the paper. Jaipaul Singh was involved in data interpretation and proof reading the final draft.

Ethical Approval, Consent:

Formal letter of approval was obtained from the Village Council and the Ministry of Indigenous People's Affair. Each participant of the study was informed about confidentiality. Each participant of the study agreed to participate voluntarily. Participants were allowed to discontinue the interview when they needed. All participants of the study declared their willingness to participate and approved by their consents.
Prior consent from the village council and Ministry of Indigenous Peoples' Affairs were given before the study commenced.

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APPENDIX A

Informed Consent

This Informed Consent Form is for the participants of this research.

Knowledge and utilization of traditional medicine for type 2 diabetes mellitus among residents of Pakuri (St. Cuthbert's Mission) in Guyana

As the title of the project states, the research seeks to understand indigenous knowledge in the treatment and management of type 2 diabetes. The study is strictly for academic purposes and as such I would appreciate your voluntary support to complete the questionnaire and consent to access your laboratory analysis. All information that you provide will be treated with the strictest of confidence and

will only be used for the achievement the above mentioned aim. You participation in this study is voluntary, thus you are free to refuse to participate or stop at any time.

Any questions or queries you might have concerning this study can be answered by the interviewer/investigator.

Signature of Participant/employee: ---------- Date: ----------

I hereby agree that all data obtained from the above-signed participant, will be treated with the strictest of confidence and will only be used for the above-mentioned purposes.

Signature of investigator: ---------- Date: ----------

Signature of witness: ---------- Date: ----------

Socio-Demographic Data

1. What is your gender?

   Male ☐ Female ☐

2. What is your age?

   <20 ☐ 20- 29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ >60 ☐

3. What is the level of education you have attained?

   ☐ Illiterate
   ☐ Primary
   ☐ Secondary
   ☐ Tertiary

4. Marital Status

   ☐ Single
   ☐ Married
   ☐ Separated
   ☐ Divorced
   ☐ Widowed

5. What is your employment status?

   ☐ Employed
   ☐ Unemployed

Diabetes Mellitus

6. Do you suffer from Diabetes Mellitus

☐ No
☐ Yes

7. Type of Traditional Medicine used to treat and manage Diabetes Mellitus, if any. (Please list the name, part of the plant, dosage, method of preparation, source, and route)
……
……
……
……
……

8. Type of OHA, if any, along with Traditional Medicine
……
……

9. When did you start using Traditional Medicine

☐ Since diagnose with DM
☐ During treatment with Conventional Medication to control signs and symptoms
☐ During treatment with Conventional Medication to management side effects

10. Do you have a family history of DM

☐ No
☐ Yes

Knowledge

11. Do you prefer Traditional Medicine or Conventional Medicine

☐ No
☐ Yes

12. Is Traditional Medicine accepted as a form of treatment

☐ No
☐ Yes

13. There is no harmful Traditional Medicine

☐ True
☐ False

14. Traditional Medicines have no adverse effects

☐ True
☐ False

15. Traditional medicines are more effective and safer than modern health services

☐ True
☐ False

Feedback

16. Would you recommend Traditional Medicine

- ☐ No
- ☐ Yes

17. Do you think acceptance is culturally related

- ☐ No
- ☐ Yes

18. Would you attribute good outcomes to the use of Traditional Medicine

- ☐ No
- ☐ Yes

19. Have you ever attended any training about Traditional Medicine

- ☐ No
- ☐ Yes

20. Should there be training or workshops on traditional medicine

- ☐ No
- ☐ Yes

21. Health Education about risk and benefits of traditional medicine is important

- ☐ True
- ☐ False

THANK YOU