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Informant consensus for anti-diabetic medicinal plants by traditional healers in Tanzania

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Abstract

Number of patients diagnosed with diabetes in Tanzania is growing gradually. Unfortunately majority in Tanzania are not even aware whether they have the disease. This is complicated further with slackness to attend regular health check. In rural areas of Tanzania, majority are attended by traditional healers who may not be conversant with the diabetes case and its associated conditions. Moreover, the skills of traditional healers in management of diabetes and its associated conditions cannot be ignored. This paper has reviewed informant consensus in traditional management of diabetes basing on popular medicinal plants reported from various parts of Tanzania namely *Uvariopsis bisexualis* Verdc., *Ochna confusa* Burt Davy & Greenway., *Phyllanthus species*, *Chassalia umbraticola* Vatke., *Cyphostemma species*, *Deinbollia borbonica* Scheff., *Cassia abbreviata* Oliv. *Maprounea africana* Müll. Arg., and *Crossopteryx febrifuga* (Afzel. ex G.Don) Benth. Informant Consensus Factor of 0.78 is an indication of agreement in management of diabetes by traditional healers whereas; three of the recorded nine species i.e *C. abbreviata*, *M. africana* and *C febrifuga* have support from laboratory experiments. Four species (*P. species*, *C. umbraticola*, *C. species* and *D borbonica*) are reported to have anti-diabetic activity elsewhere while two (*U. bisexualis*, *O. confusa*) do not have supporting information at all. Plant species without supportive information are novel sources of new investigation. The review was made in various online databases such as PUBMED, science direct, African journal, NAPRALERT, PROTA, Annual Reviews, JSTOR and ACS publishing center. This study has contributed information that would be useful for scientists and researchers for further research and production of drugs capable of treating diabetes.

Keywords: *Phyllanthus species*, *Chassalia umbraticola* Vatke

Introduction

Diabetes is a chronic disease associated with abnormally high levels of the sugar glucose in the blood, which occurs when the pancreas does not produce enough insulin, or when the body cannot effectively use the insulin produces (William *et al.* 2017: WHO 2016) [29, 7]. The number of people with diabetes in Tanzania is on the increase, and this is attributed to the change in life styles associated with increased physical inactivity, overweight, smoking, alcohol intake and aging Kinimi *et al.* (2017). Diabetes was previously regarded as the disease of the rich and mostly the disease of developed countries. However, it is rapidly occurring among poor people residing in low-income countries (Mbanya *et al.*, 2010) [15]. Being one of the None Communicable Diseases, is not common to the rural communities of Tanzania. Even majority of Traditional Healers are not conversant with typical symptoms and its management. It is generally reported that over 60% of people with diabetes in Tanzania do not know whether they have the disease (Kavishe *et al.*, 2015) [10]. Less awareness on diabetes management by traditional healers in Tanzania poses risk to the health of their patients in two ways: first, most traditional healers do not admit incapability to manage some cases that are beyond their knowledge. To some traditional healers, financial income supersedes patient's welfare, as such, to let patient go unattended means to let money go. Secondly, different conditions resembling those of diabetes may erroneously be managed as diabetes. The conditions such as cancerous slow soars, weight wasting for HIV patients or Tuberculosis case may be confused with diabetes case. As such, the referral to the health facility may be delayed. Clinically, diabetes cases can only best be prescribed at the health facilities. This is because diabetes is associated with a number of complications such as hypertension, atherosclerosis, eye complications, Foot complications, Skin complications, disorders Heart problems, Mental

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health, Hearing loss, Gum disease, Gastroparesis, Hyperosmolar Hyperglycemic Nonketotic Syndrome (HHNS), peripheral arterial disease (PAD), Stroke, erectile dysfunction, healing of wounds and microcirculatory disorders (Ojewale *et al.*, 2013) [19]. It is also associated with the long term complications, including retinopathy, nephropathy, neuropathy and angiopathy. Managing blood sugar levels and keeping it closer to normal values is able to reduce the risk of diabetes and death by these complications (Suresh, 2016) [12]. Comprehension and proper diagnosis of all these conditions are beyond lay practitioners.

Despite the possible complications involved in local management of diabetes cases, some traditional healers mentioned herbal remedies claimed to manage diabetes cases. These could not be taken for granted before making any cross reference with scientific backup. This study is aware of some effective management and drugs in the pharmacy shelves for diabetes such as insulin injection and hypoglycemic agents, but these compounds are also reported to possess several adverse effects or sometimes do have no effects on diabetes complications in long term (Mahmoud, 2014). These limitations accounts for the need to broaden the search for alternative therapies including herbal formulations. Plant products have been long used in the treatment of diabetic patients through improving the diabetic status in terms of blood sugar (Ojewale *et al.*, 2013) [19]. Therefore, there is a need to search and share information on natural products that can be further studied for treatment of diabetes and its complication.

The aim of the study was to assess similitude in management of diabetes by traditional healers in Tanzania for facilitated identification of plants with anti-diabetic activity for possible development of potent drugs for treatment of diabetes for the welfare of all.

The report is justifiable as the presented list of medicinal plants have recorded scientific backup from other studies elsewhere for facilitated inclusion in more detailed and clinical research. Nonetheless, the information provided doesn't align listed plants to the commonly known diabetes types namely insulin dependent, non-insulin dependent or gestational diabetes. Ethnobotanical Indices including Informant Consensus Factor (ICF) are a requisite for identifying plants that can be chosen for their pharmacological property and chemical ingredients. ICF is among common arithmetic models for choosing most promising plant species of cultural importance for pharmacological investigations. The factor as proposed by Heinrich *et al.* (1998), is used to analyze if there is an agreement in the use of plants in the ailment categories between the plant users, It also reveals intra-cultural and inter-cultural importance and validation. The main use of ICF is to select disease categories where there is consensus on the use

of plants among the informants and to identify species with particular importance.

Materials and Methods

The ICF was calculated using the following formula (Heinrich *et al.* 1998):

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

Where Nur refers to the number of use-reports for a particular ailment category and Nt refers to the number of taxa used for a particular ailment category by all informants.

The product of this factor ranges from 0 to 1. A high value (close to 1.0) indicates that relatively few taxa are used by a large proportion of the informants.

A low value indicates that the informants disagree on the taxa to be used in the treatment within a category of illness or values will be low (near 0) if plants are chosen randomly, or if informants do not share information about their use.

The information on the reported medicinal plants for management of diabetes is an extract from discrete ethnobotanical studies in different parts of Tanzania. This is not a onetime study rather a selection with focus to medicinal plants claimed to manage diabetic cases and the associated conditions. Some mentioned plants were not directly linked to diabetic case; rather traditional healer's explanations were associated with some diabetes conditions. For example when a plant was used to manage slow healing and chronic wound, this was associated with some conditions of diabetes even if the practitioner did not make the link. Literature was investigated for any scientific evidence confirming the uses of these plant species in the management of diabetes and the associated conditions. The information has been collected in various online databases such as PUBMED, science direct, African journal, NAPRALERT, PROTA, Annual Reviews, JSTOR and ACS publishing center. In this respect, some plant species have scientific support, while some have ethnobotanical information but no scientific support so far.

Results

From a huge ethnobotanical data by a researcher (Appendix 1) of 190 disease categories, diabetes had highest CIF of 0.77. Nine medicinal plants from 8 different plant families as shown in table 1, were selected as candidate's regimens for diabetes. Three of all nine plants i.e. *Cassia abbreviata*, *Maprounea africana* and *Crossopteryx febrifuga* have support from laboratory experiments. Four species (*Phyllanthus species*, *Chassalia umbraticola*, *Cyphostemma species* and *Deinbollia borbonica*) are reported to have anti-diabetic activity elsewhere while two (*Ochna confusa* and *Uvariopsis bisexualis*) do not have supporting information at all.

Table 1: Anti-diabetic medicinal plants

Scientific Name	Vernacular Name	Family	Major area	Preparation
<i>Crossopteryx febrifuga</i> (Afzel. ex G.Don) Benth.	Nakasabuni (yao)	Rubiaceae	Lake Victoria zone	Root and stem back
<i>Maprounea africana</i> Müll. Arg.	Mtunu (Yao)	Euphorbiaceae	Ruvuma region	Roots boil and give the decoction to patient to drink
<i>Cassia abbreviata</i> Oliv.	Mkundekunde	Fabaceae	Coastal region	Root decoction
<i>Deinbollia borbonica</i> Scheff.	Mpilipili	Sapindaceae	Coastal region	Boil the root and give the decoction to drink
<i>Cyphostemma species</i>	Mhogomwitu	Vitaceae	Ruvuma Region	Whole root. ashes from dried root added to porridge or lick
<i>Chassalia umbraticola</i> Vatke.	mfufya	Rubiaceae	Coastal region	Not specified
<i>Phyllanthus species</i>	Mlea watoto	Phyllanthaceae		Not specified
<i>Ochna confusa</i> Burt Davy & Greenway.	Mnungamo(Yao)	Ochnaceae	Ruvuma region	Not specified
<i>Uvariopsis bisexualis</i> Verdc.	Ntaka (yao)	Annonaceae	Ruvuma Region	Roots boil and drink

Discussion

The highest CIF for diabetes in this report is an indication of consensus in practice by traditional healers. It also reveals cultural importance of the mentioned medicinal plants regardless that practitioners come from different cultures and geographical locations in Tanzania. It is encouraging that the mentioned plant species have supporting ethnobotanical references and laboratory test backups.

Root and stem bark of *Crossopteryx febrifuga* is reported to manage diabetes in Coastal regions of Tanzania. To complement the information, there are two *in-vivo* studies that reported *Crossopteryx febrifuga* to possess potential hypoglycemic and hypolipidemic activities. The ethanolic roots extract of *Crossopteryx febrifuga* in alloxan-induced diabetic rats showed significant decrease ($p < 0.05$) in both blood glucose, triglycerides and low density lipoprotein LDL-cholesterol levels and a significant decrease ($p < 0.05$) in high density lipoprotein HDL-cholesterol level compared to diabetic untreated rats (Ojewale *et al.* 2013) [19]. In the second experimental results, ethanolic roots extract of *Crossopteryx febrifuga* modulated hyperglycemic by potentiating insulin release from the beta cells of the pancreas and ameliorated dyslipidaemia (A.O. Ojewale *et al.* 2014) [18]. In other literature the *Crossopteryx febrifuga* appeared to be a good source of antioxidants and in tropical Africa the stem bark is used in treatment of wound. (Maiga *et al.*, 2006; Edeoga *et al.*, 2005) [13, 6].

Besides anti-bilharzia activity, roots of *Maprounea Africana* are boiled and decoction is served for management of diabetes in Ruvuma region Tanzania. The *in-vivo* experiment fraction of the ethanol root extract of *Maprounea africana* tested for noninsulin-dependent diabetes mellitus db/db mouse model showed potent glucose lowering properties when given by the oral route, this maprouneacin compound has been reported to be used as an antidiabetic agent (Carney *et al.*, 1999) [2]. Other literature reported dried leaf of *Maprounea africana* has antihyperglycemic activity when given by the oral route (Muanza *et al.*, 1994) [16].

Cassia abbreviate is reputed for management of a number of diseases. In this case the dry root decoction is claimed to manage diabetes in Morogoro region of Tanzania. The *in-vitro* test for the ability of *Cassia abbreviate* to inhibit baker's yeast α -glucosidase and α -amylase activities showed that plant species had activity at low concentrations, with 1.0 mg/ml and above resulting in inhibition of over 70%. Concentrations of antioxidants are reduced in diabetic patients so this antioxidant activity plays a role in the treatment of diabetes (Raphael *et al.*, 2002 and Valabhji *et al.*, 2001, Shai LJ *et al.* 2010) [22, 27, 24]. *In vivo* experiment of the effects of *Cassia abbreviate* (stem bark) and *Helinus integrifolius* (leaves) water extracts on glucose absorption and expression of glucose transporters (GLUTs) 1 and 4 by muscle cell (Seabi *et al.*, 2016) [23]. Other literature reported *Cassia abbreviate* roots has aphrodisiac activity and wound healing acceleration when taken orally and the dried stem bark has antihypertensive activity when taken orally (Parry and Duri. 1994: Chhabra *et al.*, 1987: Van Wyk and Gericke. 2007) [20, 3, 28].

Deinbollia borbonica was mentioned for diabetes management in Coast region-Tanzania. Hedberg *et al.* (1983) [8] also report that dried leaf and root are used for wound healing acceleration when applied externally, Other reports that may be related to some diabetes according to Chhabra *et al.* 1987, [3] 1991 [5] and 1993 [4] are cardiotoxic activity when leaf infusion of *D. borbonica* is taken orally for

antihypertensive activity when taken orally with *Cussonia zimmermannii*.

The ethnobotanical information in Ruvuma region in Tanzania recorded claims that *Chassalia umbraticola* is used to manage diabetes. The literature reported other conditions mostly linked to diabetic cases. The dried root of *C. umbraticola* has aphrodisiac activity when taken orally by human adult male (Chhabra *et al.* 1991) [5]. Experimentally, the genus *Chassalia* is reported to have anti-hypertensive activity (Kadir and Omar, 2014) [9]. These are some conditions related with diabetics in some instances.

Phyllanthus cf. junceum was recorded for management of diabetes in Coast region in Tanzania. Ayurvedic medicine *Phyllanthus* has a long tradition of use to treat diabetes and other literatures have also reported that the plant provides antidiabetic activities and antibacterial activities (Tang *et al.* 2013: Tang *et al.* 2014: Ramadasan *et al.* 2011) [25, 26, 21]. In India, species of genus *Phyllanthus* are widely used in indigenous medicine. *Phyllanthus reticulatus*, *Phyllanthus polyphyllus* and *Phyllanthus acidus* these herbs have been used as remedies for diabetes and wound. In Thailand, eight herbs of this genus are widely used by residents. *Phyllanthus amarus*, *Phyllanthus urinaria* and *Phyllanthus virgatus* all of which were used for treating diabetic and liver disease, *Phyllanthus acidus* has been used as a remedy for hypertensive. In Peru, the *Phyllanthus amarus* leaves are employed for diabetic therapy. *Phyllanthus muellerianus* is the most popular herbal drugs of this genus in Africa. In Ghana and Cameroon, the stem bark is used for the therapy of wounds (Xin Mao *et al.*, 2016)

Cyphostemma adenocaula was mentioned for management of diabetes and soars in Mtwara Region in Tanzania. Hedberg *et al.* 1983 [8] reported *C. adenocaula* has been used to accelerate wound healing. Entire dried plant is boiled and applied to the wound externally. Dried root has antibacterial activity for treatment of wound.

Ochna confusa and *Uvariopsis bisexualis* are recorded to have been used in the management of diabetes in Ruvuma region in Tanzania, however there is no literature supporting these two plant species to have antidiabetic activities.

Conclusion

The agreement in practice by traditional healers in management of diabetes in Tanzania as supported by scientific tests is an indication that the mentioned plants are potential starters for investigation of bioactive molecules for regimens against diabetes. More research is invited on the presented plant list for development of new drugs against diabetes

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Appendix 1

Desease category	Number of mentioned (Nur)	number of taxa (Nt)	Nur-Nt	Nur-1	CIF
Abdominal pain	133	57	76	132	0.575758
Abdominal pain in pregnant woman	2	2	0	1	0
Abnomial swelling	2	2	0	1	0
Abortion	13	11	2	12	0.166667
Abscess	1	1	0	0	#DIV/0!
Swollen finger	3	2	1	2	0.5
AIDS	8	5	3	7	0.428571
Amenorrhoea	4	4	0	3	0
Anemia	7	5	2	6	0.333333
Ant hypertensive	5	4	1	4	0.25
Ant snake bite	26	19	7	25	0.28

Ant T.B	17	14	3	16	0.1875
Anthelmintic	25	7	18	24	0.75
Anti diarrhea	108	75	33	107	0.308411
Anti fungal	5	4	1	4	0.25
Anti Hypersecretion	1	1	0	0	#DIV/0!
anti-dote	9	7	2	8	0.25
Antispasmodic	2	2	0	1	0
Aphrodisiac	42	32	10	41	0.243902
appendicitis	1	1	0	0	0
Asthma	45	27	18	44	0.409091
back ache	13	11	2	12	0.166667
biten by rodent	1	1	0	0	0
bleeding from nose, mouth and nose	1	1	0	0	0
Blocked falopian tubes	4	2	2	3	0.666667
Blood pressure	7	4	3	6	0.5
Body weakness	8	8	0	7	0
Boils	5	4	1	4	0.25
Breast problem	1	1	0	0	0
Cancers	13	13	0	12	0
Cardiac diseases	1	1	0	0	0
Cellulitis	1	1	0	0	0
Cervical prolapse	3	3	0	2	0
Hernia	2	2	0	1	0
Chest pain	10	10	0	9	0
Chicken pox	2	2	0	1	0
Cholesterol	1	1	0	0	0
Cleaning the blood	2	2	0	1	0
cold	1	1	0	0	0
Colic fever	3	3	0	2	0
Conjunctivitis	4	4	0	3	0
Constipation	38	33	5	37	0.135135
Convulsions	20	17	3	19	0.157895
Conversion	16	14	2	15	0.133333
coughing	69	47	22	68	0.323529
fastern delivery	9	8	1	8	0.125
depression	1	1	0	0	0
Diabetes	31	8	23	30	0.766667
Cleaning of dirty stomach	2	1	1	1	1
Ear discharging	2	2	0	1	0
Dizziness	16	15	1	15	0.066667
dysentery	12	11	1	11	0.090909
Dysmenorrhoea	17	12	5	16	0.3125
Ear pain	7	6	1	6	0.166667
elephantiasis	1	1	0	0	#DIV/0!
Encelopathy	5	5	0	4	0
Enlarged stomach	1	1	0	0	0
Epilepsy	60	42	18	59	0.305085
Expectorant	2	1	1	1	1
Eye problems	20	16	4	19	0.210526
Eye sight	3	3	0	2	0
Eyes ache	2	2	0	1	0
Birth control	1	1	0	0	0
Fever	76	60	16	75	0.213333
fibroids	1	1	0	0	0
Flue	1	1	0	0	0
Fractures	4	2	2	3	0.666667
fresh burns	3	3	0	2	0
fresh cut	2	2	0	1	0
Gastritis	1	1	0	0	0
General body pain	21	21	0	20	0
Genital sores	1	1	0	0	0
Glandular swelling	1	1	0	0	0
Glaucoma	1	1	0	0	0
Gonorrhoea	39	34	5	38	0.131579
Gyconological problems	23	21	2	22	0.090909
Haemoglobin	5	5	0	4	0
haemoptysis	1	1	0	0	0
Haemorrhage	1	1	0	0	0
Hallucination	2	2	0	1	0

Headache	21	20	1	20	0.05
Heart	4	4	0	3	0
Heart disease	7	5	2	6	0.333333
Heart pain	6	6	0	5	0
Heart palpitation	7	7	0	6	0
Heart problems	5	4	1	4	0.25
Hernia	101	57	44	100	0.44
Herpes-labialis	1	1	0	0	00
Hiccup	2	2	0	1	0
Hydrocele	6	5	1	5	0.2
hypermenorrhea	1	1	0	0	0
Impotence	10	9	1	9	0.111111
Impotence	2	2	0	1	0
Strength to children	1	1	0	0	0
Induce menstruation	4	4	0	3	0
induce movement of a child in womb	2	1	1	1	1
Induction of labour	7	5	2	6	0.333333
Infertility	2	2	0	1	0
Inflammation	3	3	0	2	0
Insect repellent	1	1	0	0	0
Irregular menstruation	5	5	0	4	0
Jaundice	4	4	0	3	0
Pneumonia	12	6	6	11	0.545455
kidney	4	4	0	3	0
kidney problem	9	9	0	8	0
Back pain	10	9	1	9	0.111111
Snake repelant	1	1	0	0	0
Clean uterus	2	2	0	1	0
Lactation	3	3	0	2	0
Leprosy	13	11	2	12	0.166667
Lipidemia	2	2	0	1	0
Liver disease		2	2	0	1
Lumbago	1	1	0	0	0
Malaria	35	17	18	34	0.529412
Male organs problems	1	1	0	0	#DIV/0!
Fungus	6	2	4	5	0.8
Measles	2	2	0	1	0
Meningitis	1	1	0	0	0
Menorrhagia	8	8	0	7	0
Menstruation problem	2	2	0	1	0
Mental illness	33	26	7	32	0.21875
Miscarriages	4	4	0	3	0
Monthyl period	6	6	0	5	0
Muscles pain	4	3	1	3	0.333333
nausea/vomiting	27	21	6	26	0.230769
Obstetrics	1	1	0	0	0
Oedema	4	4	0	3	0
Oral disease	3	3	0	2	0
Otitis media	5	4	1	4	0.25
Over bleeding during, Menstruation	6	5	1	5	0.2
Oxytocin	8	6	2	7	0.285714
pain during menstruation	4	4	0	3	0
Painful legs	2	2	0	1	0
paralysis	3	3	0	2	0
Pneumonia	8	7	1	7	0.142857
Polio	4	3	1	3	0.333333
polymenorrhea	1	1	0	0	#DIV/0!
Pregnancy	12	9	3	11	0.272727
Prolapse of uterus	17	14	3	16	0.1875
Prolapse of vignal	6	6	0	5	0
Prolonged menstruation	12	10	2	11	0.181818
Pruritus	1	1	0	0	#DIV/0!
Psychiatry	20	17	3	19	0.157895
Psychosomatic	3	2	1	2	0.5
Purgative	6	6	0	5	0
Pyomyositis	1	1	0	0	0
rectal prolapse	22	20	2	21	0.095238
Rheumatism	9	8	1	8	0.125
Rib pain	5	4	1	4	0.25

Rushes around male or female organs	1	1	0	0	0
Scapula pain	1	1	0	0	0
Schistosomiasis/bilharzia	34	30	4	33	Schistosomiasis/bilharzia
skin disease	14	13	1	13	0.076923
skin itching	1	1	0	0	#DIV/0!
skin rushes	8	7	1	7	0.142857
sleep related disease	1	1	0	0	0
Sleeping Sickness	1	1	0	0	0
STD'S	1	1	0	0	0
Steatorrhea	1	1	0	0	0
Sterility	27	24	3	26	0.115385
Stiff chest	2	2	0	1	0
Stimulate heart	1	1	0	0	0
stomach ache	193	106	87	192	0.453125
Stomach ache at menstruation period	5	4	1	4	0.25
suprapubic pain	1	1	0	0	0
Swollen legs	2	2	0	1	0
swelling of the body	18	16	2	17	0.117647
Swelling of vigna	2	1	1	1	1
swollen stomach	6	6	0	5	0
swollen breast	3	3	0	2	0
Syphilis	11	11	0	10	0
Tachycardia	1	1	0	0	0
Throat sores	4	4	0	3	0
Raise HB	7	7	0	6	0
Tongue condition	1	1	0	0	o
Tonic	2	1	1	1	1
Tooth growth	1		1	0	0
Toothache	10	10	0	9	0
Twins promotion	1	1	0	0	0
Ulcers	7	6	1	6	0.166667
Urethritis	1	1	0	0	0
Duretic	10	10	0	9	0
Venereal desease	2	2	0	1	0
Warts	1	1	0	0	0
Watery vaginal discharge	8	3	5	7	0.714286
worms	11	11	0	10	0
wound	13	13	0	12	0
Wrist pain		1	-1	-1	1
Yellow fever	2	2	0	1	0