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Full Length Research Paper

Informant consensus selection method: A reliability assessment on medicinal plants used in north western Nigeria for the treatment of diabetes mellitus

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In this study, the reliability of informant consensus as a method of selecting medicinal plants for pharmacological screening was tested. Ten plants were selected based on the method and screened for antidiabetic properties using animal experimental model of the disease. The plants were selected from a list of medicinal plants obtained from a botanical survey of the region. A correlation between the two sets of data (Informant vs Experimental ranking orders) was examined. The results show that all the extracts of the selected plants (200 mg/kg) exhibited various degrees of blood glucose lowering activity. *Vernonia amygdalina* (67%), *Calotropis procera* (59%), *Cassia gorotensis* (53%) and *Magnifera indica* (35%) extracts produced a significant (P < 0.0.5%) reduction in blood glucose levels in diabetic rats while *Angeissus leiocarpus* (30%), *Cassia arereh* (19%), *Gossypium hirsutum* (17%), *Khaya senegalensis* (4%), *Senna occidentalis* (4%) and *Moringa oleifera* (4%) produced a non significant (P < 0.05%) effect. *V. amygdalina* was ranked highest both by the informant consensus and biological evaluation. There was a significant correlation (Rs = 0.8897) between the two sets of data. The study concluded that, informant consensus is a reliable method of selecting medicinal plant for pharmacological evaluation.

Key words: Informant consensus, diabetes mellitus, medicinal plants, screening.

INTRODUCTION

The problems associated with the study of the pharmacology of medicinal plants in underdeveloped countries had since been recognized (Alba, 1996). Enormous cost and time are involved in the development of a new drug and as such, many researchers in developing countries do not have the financial resources or technology to initiate these activities (Uguru, 2005). Many African countries still depend on traditional medicine whose potential use in primary health care has been recognized by the World Health Organization (WHO) since 1978. Accordingly, WHO has also evolved guidelines for assessment of the efficacy and safety of herbal medicine (WHO, 1991, 1993). Medicinal plant research may be pursued with several goals: the understanding of a native medical system, the elucidation of the rational basis for the medicinal use of a certain species, the development of low cost phytotherapeutics and the discovery of prototypic drugs are some of the basic considerations (Elisabetsky, 1991).

A search for a medicinal plant with specific properties from a wide range of plant sources do present with a selection difficulty. The various methods which have been used include: Informant consensus/citation scores from various interviews (Trotter and Logan, 1986), random selection (Fabricant and Farnsworth, 2001), direct report (Soejarto and Farnsworth, 2001) and selection from traditional herbal practices using documented historical records (Lewis and Elvin-Lewis, 1977). Eli Lilly used selection algorithms to identify the important antitumour agents, Vinblastin and Vincristine (Okpako, 1991). The same method was used by Clark et al. (1997) and Lautie et al. (2008) to search for plants with antimoluscicidal and antitumour properties respectively. The present study is

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aimed at testing the reliability of informant consensus (citation scores from various interviews) as a method of selecting medicinal plants for pharmacological screening by using the method to select plants used locally in north western Nigeria for the treatment of *Diabetes mellitus* and subsequently evaluating them for antidiabetes properties. The correlation between the two sets of data would also be examined.

MATERIALS AND METHODS

This study was carried out in the Department of Pharmacology, Usmanu Danfodiyo University, Sokoto (UDUS), Nigeria, between the months of January and April, 2009.

Drugs and equipment

The following drugs were used in this study: Alloxan monohydrate produced by Auighkar Lab. Tech. Chemical, India with (Lot No. 230500D). Normal saline produced by Diana Pharm. Nigeria Ltd. and Metformin manu-factured by Hovid, Ipoh- Malaysia with Batch No.VUDIA 11-0. The Glucometer used for the measurement of blood glucose was produced by Accu-chek, Roche Diagnostics, Indianapolis (Lot no. 1157764).

Preparation of plant extracts

Ten plants namely; *Moringa oleifera, Gossypium hirsutum, Calotropis procera, Cassia goratensis, Vernonia amygdalina, Khaya senegalensis, Mangifera indica, Angeissus leiocarpus, Senna occidentalis and cassia arereh* were ranked and selected for antidiabetes properties screening based on informant consensus scoring system (Table 1).

The system involved interviewing the Herbal practitioners on the plants they used for the treatment of *Diabetes mellitus* and scoring the plants based on the numbers of citations. The names of the plants and their frequency of citation numbers were obtained from our previous study on the ethnobotanical survey of medicinal plants in the area.

The plant materials were collected and subsequently authenticated by a Taxonomist. Voucher specimens were prepared, labeled and deposited in the Herbarium of Pharmacology Department, UDUS. The plant materials were then washed with tap water, air dried to a constant weight and pulverized into dry powders. 250 g of each of the ten different plant materials were extracted with distilled water using a Sohxelet apparatus. The filtrates were further concentrated in an oven at a temperature between 45 - 50°C. The percentage yields were calculated and the extract residues stored in a deep freezer at about -17°C pending further investigation (Odebiyi and Sofowora, 1979).

Experimental animals

Male wistar rats weighing between (150 - 220 g) and age 12 - 16 weeks were used for this study. They were kept in stainless steel cages in the experimental room under the temperature range (32 ± 5°C, 12 h day/ night cycles), fed with standard rat pellets (Pfizer Feed, Nigeria Ltd.) and given free access to tap water for 2 weeks before the experiment.

Determination of test dose

A limit test dose (3000 mg/kg) of each extract (OECD, 2001) was administered orally to five rats in sequence and observed for 48 h to determine the safety or otherwise of dose to be use in the study.

Antidiabetic test of the extracts

The method of Yananrday and Colak (1998) was slightly modified and used in this study. Male wistar rats were used for the study. The animal were deprived of food but given free access to water for 18 h before drug treatment. Alloxan monohydrate 150 mg/kg (b.wt.) was administered intraperitoneally to the rats to induce hyperglycemia. The animals were allowed to resume feeding one hour after the drug administration. The blood glucose levels were measured using Glucometer through tail tipping 72 h after alloxan administration (Antia et al., 2005). The rats with blood glucose level above 150 mg/dl were considered to be hyperglycemic and were selected for extract treatment. Sixty alloxan induced diabetic rats were selected and divided into 12 groups (n = 5) labeled 2 to 13 while group 1 was made up of non diabetic rats. The baseline blood glucose level of each rat was taken. The rats in group 1 (normal control) were treated orally, with normal saline (5 ml/kg). Those in group 2 (Diabetic control) were left without treatment. The animals in groups 3 - 12 were given 200 mg/kg of aqueous extract of *M. indica, A. leiocarpus, M. oleifera, C. arereh, C. gorantensis, S. occidentalis, K. senegalensis, G. hirsutum, C. procera and V. amaygdalina*, respectively. The rats in group 13 received metformin (100 mg/kg), a standard oral hypoglycemic agent. Thereafter, the blood glucose level of each rat was measured at 30, 60, and 120 min intervals by tail tipping method using a Glucometer.

Statistical analysis

The results obtained are presented as mean ± standard

Table 1. List of medicinal plants used for the treatment of diabetes mellitus cited by the herbalist.

Botanical names	Common names	Plant parts	No. of citation	Ranking
*Vernonia amygdalina**	Bitter leaf	Leaf	17	1
*Mangifera indica**	Mango	Leaf	17	1
*Calotropis procera**	Sodom apple	Leaf	16	3
*Khaya senegalensis**	Mahogany	Bark	16	3
*Cassia goratensis**	Golden shower	Leaf	15	5
*Angeissus leiocarpus**	Giant fern	Bark	10	6
Cassia arereh *	Indian senna	Bark	10	6
*Moringa oleifera**	Horse dish tree	Leaf	9	8
*Senna occidentalis**	Coffee senna	Leaf	8	9
*Gossypium hirsutum**	Cotton	Leaf	6	10
Psidium guajava	Gwava	Leaf	5	11
Ipomoea batatas	Sweet	Leaf	4	12
Ficus thonnigii	Loin cloth fig tree	Leaf	4	12
Blighia sapida	Akee apple	Bark	4	12
Euphorbia covuludiodes	Corn cob cactus	Bark	4	12
Zizyphus mucronata	Buffalo	Leaf	4	12
Zizyphus spina	Christ's thorn	Bark	3	17
Annona senegalensis	Wild custard apple	Leaf	3	17
Allium sativum	Garlic	Leaf	3	17
Alluvium cepa	Onion	Leaf	2	20
Citrus medica	Sour orange	Leaf	2	20
Parkta filicoidea	African locust bean tree	Bark	2	20
Lawsonia inermis	Egyptians priest	Leaf	2	20
Vitillarta paradoxa	Shea butter tree	Bark	2	20
Azadirachta indica	Neem	Leaf	2	20
Balanites aegyptica	Desert date tree	Bark	2	20
Vitex gekowskii	Black plum	Bark	1	27
Lannea kerstingii	-	Bark	1	27
Daucus carota	Carrot	Root	1	27
Bauhinia reticulate	Camel foot tree	Bark	1	27
Eugenia caryophyllata	Clove	Bark	1	27
Anacardium occidentalis	Cashew	Leaf	1	27
Acacia nilotica	Egyptian mimosa	Bark	1	27
Ficus sycomorus	Sycamore / Tree of life	Bark	1	27

Data extracted from previous study; *Plants with high citation numbers (optimum consensus) selected for evaluation.

error of mean (SEM). One way ANOVA was used to compare the means of different groups and results that showed statistical significant differences were further tested using Turkey - Kraimer multiple comparison test. P values less than 0.05 were accepted as significant.

RESULTS

The ranking of the antidiabetic potentials of the medicinal plants based on informant consensus placed both *V. amygdalina* and *M. indica* in the highest positions (Table 1). Administration of 3000 mg/kg of the various extracts did not cause any death in the rats. Intraperitoneal administration of 150 mg/kg of alloxan monohydrate successfully raised the blood glucose levels in 70% of the treated rats to 150 mg/dl after 72 h. Seven rats were recorded dead and twenty three rats (19.1%) did not develop diabetes mellitus.

The treatment with 200 mg/kg of the various extracts produced variable percentage reduction in the glucose levels of the rats following *Diabetes mellitus* induction with alloxan. *V. amygdalina, C. procera, C. goratensis* and *M. indica* aqueous extracts produced a significant reduction ($P < 0.05$) in the blood glucose levels of the rats (Table 1). The baseline blood glucose level in the rats following induction with alloxan was 514.7 ± 37.4 mg/dl, but administration of 200 mg/kg of *V. amygdalina* extract

Table 2. Mean glucose levels of diabetic rats following treatment with plants extract.

	Time intervals in minutes			
	0	**30**	**90**	**120**
Normal control	112.7± 8.0	113.0 ± 8.1	108.0 ± 7.6	107± 8.1
Diabetic control	252.4± 3.5	257.4 ± 3.8	262.3 ± 2.7	250.2 ± 4.1
Vernonia amygdalina	514.7± 34.7	356.7 ± 31.7	253.3 ± 51.1*	169.3 ± 21.4***
Calotropis procera	270.6 ± 43.7	210.0 ± 36.0	176.0 ± 48.1	110.3 ± 26.3*
Cassia goratensis	178.0 ± 10.1	145.0 ± 11.3	113.3 ± 15.1*	87.3 ± 3.3**
Mangifera indica	227.2 ± 29.7	194.3 ± 31.7	168.0 ± 45.3	146.3 ± 45.3*
Angeissus leiocarpus	436.3 ± 16.1	389.7± 81.8	334.7± 53.3	302.7± 53.6
Cassia arereh	340.0 ± 59.5	366.7± 32.0	335.7± 42.3	273.7± 73.8
Gossypium hirsutum	256.0 ± 34.0	264.7± 18.4	238.7±13.5	212.0 ± 33.3
Khaya senegalensis	619.0 ± 20.2	605.3 ± 18.6	592.3± 15.2	592.0 ± 10.3
Senna occidentalis	268.7± 67.3	251.0 ± 40.5	254.3 ± 57.9	257.0 ± 38.3
Moringa oleifera	468.6 ± 131.8	447.6 ± 131.0	460.0 ± 133.5	458.0 ± 134.0
Metformin	489.3 ± 50.9	367.0 ± 12.5	239.0 ± 37.8*	178.3 ± 61.9**

Values are Mean ± SEM; n = 5 animals in each group; Comparison were made between 0 hour values vs 30 min, 60 min and 120 min; * = significant; ** = highly significant; ***= extremely significant.

reduced the blood glucose level to 169.3 ± 21.4 mg/dl after 120 min. *A. leicarpus, C. arereh* and *G. hirsutum* extracts produced a non significant reduction (P > 0.05) in blood glucose levels in the rats after treatment. The aqueous extracts of *M. Oleifera, S. occidentalis* and *K. senegalensis* produced a minimal effect (about 4% reduction) on the induced hyperglycemia in rats (Table 2). From Table 3 above, the Spearman's coefficient of rank correlation (Rs) was calculated for these two variables and it was found to be equal to 0.8897; critical value (2 - tail, 0.0001). This value is considered extremely significant with N = 10. Therefore the correlation between the two sets of data is statistically significant (P = 0.0001).

DISCUSSION

In this study, ten plants out of 34 were ranked top based on the citation frequency or informant consensus. These qualified them for antidiabetic screening. Oral administration of 3000 mg/kg of each extract as a test dose to the animals did not produce any death or symptoms of toxicity in the rats. This indicated that, all the extracts might be safe at the dose (200 mg/kg) selected for efficacy study.

Administration of 150 mg/kg body weight of alloxan monohydrate induced hyperglycemia in 70% of the rats after 72 h. The chemical is reported to induce diabetes by forming highly reactive superoxide radicals which destroy the insulin producing cells in the pancreas (Szkudelski, 2001). Chemical induction though widely criticized because its induces type 1 rather than type II diabetes is by far the most frequently used model of studying antidiabetic effect of compounds in experimental animals (Balamurugan et al., 2003). Federiuk et al. (2004) induced *Diabetes mellitus* in rats by administering 65 mg/kg of alloxan Monohydrate intravenously. Masiello (2006) achieved a similar result in wistar rats by giving 40 mg/kg of alloxan intravenously. A higher dose of alloxan monohydrate was used in this study because the drug was given intraperitoneally (Yananrday and Colak, 1998).

Administration of 200 mg/kg of aqueous extracts *V. amygdalina, C. procera, C. goratensis and M. indica* produced a significant reduction (P < 0.05) in blood glucose levels in the alloxan induced diabetic rats. Antidiabetic activities of *C. procera and C. gorantensis* have never been reported to our knowledge. However, in a study carried out in Siren Valley district, *C. procera* was shown to possess antihelmintic activity (Matin et al., 2001). The anti diabetic activity of aqueous leaves of *M. indica* had been previously reported by Aderibigebe et al. (1999). The hypoglyceamic effect of this plant was thought to be by reduction of intestinal absorption of glucose. Antihyperglycaemic activity of aqueous stem bark extract of *M. indica* was also reported by Ojewole (2006). The extract administered intraperitoneally in streptozotocin induced diabetics rats produced a significant reduction in blood glucose level in rats. Also the anti diabetic effect of *V. amygdalina* aqueous leaves extract in rats was reported (Erato et al., 2005).

Comparative analysis of the ranking order of medicinal plants with anti diabetic potentials based on informant consensus and experimental evaluation (Table 3) revealed that, the two set of data were closely correlated (Rs = 0.8897). Besides, 10 plants out of 34 selected for screening based on this method all gave a positive result. This indicates that, informant consensus method of selecting medicinal plants for pharmacological evaluation may be reliable and dependable. This finding agrees with

Table 3. Comparative ranking orders of the medicinal plants based on percentage reduction of blood glucose level and informant consensus index

Plant name	Percentage Glucose reduction (%)	Ranking by EE	Ranking by ICI
Vernonia amygdalina	67	1	1
Calotropis procera	59	2	3
Cassia goratensis	53	3	5
Mangifera indica	35	4	1
Angeissus leiocarpus	30	5	6
Cassia arereh	19	6	6
Gossypium hirsutum	17	7	10
Khaya senegalensis	4	8	3
Senna occidentalis	4	8	9
Moringa oleifera	4	8	8

ICI = Informant consensus index; EE = Experimental evaluation.

the views of Khafagi and Dewedar (2000) that, Informant consensus/citation scores from various interviews approach which is based on traditional medicinal uses of the plant(s) as the selection method for pharmacological screening show greater percentage yield of bioactive useful medicinal compounds over other methods of random selection and screening.

Conclusion

This study has identified two new plants: *C. procera* and *C. gorantensis* as possessing high potentials for antidiabetic properties and demonstrated that, informant consensus is a reliable method of selecting medicinal plants for pharmacological screening.

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