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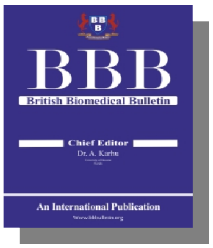

Original

"Evaluation of Select Medicinal Plants to Assess Their Evidence as Anti-Diabetic by Using Mathematical and Statistical Techniques"

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ABSTRACT

Background: Diabetes Mellitus is considered as one of the five leading causes of death in the world. Apart from currently available therapeutic options, many herbal medicines have been recommended for the treatment of diabetes. Traditional plant medicines are used throughout the world for a range of diabetic presentations.
Objective: Keeping in view the above background, comprehensive mathematical and statistical analysis of selected potential herbal drugs were evaluate and statistically signify their efficacy data in the treatment of diabetes mellitus. The present study based on the statistical and mathematical studies of three selected plants. All the extract of all three plants were confirmed by various tools. All extract were found to be safe and useful in diabetes and its complication.
Result: This paper confirmed the possible mechanism of action of the phyto principles for their antidiabetic response with help of statistical and mathematical tools. These tools will provide the help with reference to safety, efficacy and toxicity data for the selected medicinal plants and the rationale behind their use as anti-diabetic drugs. This study will enhance their claim to be used as regular anti-diabetic drugs.

Introduction

Epidemiology is the science that studies the patterns, causes, and effects health and disease conditions in defined populations. It is used to cover the description and causation of epidemic disease also non-disease health-related conditions, such as diabetes, high blood pressure and obesity. Epidemiology is based on how the pattern of the disease cause changes in the function of everyone. Statistics is the science of obtaining and it deals with the data including the planning of data collection in terms of the design of surveys and experiments. Mathematical techniques of statistics has been became a united with the art and individuality of medicine, providing indispensable tools for the design[1]. Whereas Biostatistics is developed from the application of statistics in various research aspects i.e. biology, biomedical care, and public health. It plays an important role in measuring, understanding, and describing the overall health and well-being of a population.

Diabetes Mellitus is a multiple syndromes which is characterized by hyperglycemia, altered metabolism of lipids, carbohydrates and proteins and a risk of complications from vascular disease. It can be classify clinically as either type I diabetes or IDDM (insulin dependent diabetes) and type II diabetes or NIDDM (non-insulin dependent diabetes)[2]. The objectives were based on to assess their evidence as anti-diabetic by using mathematical and statistical techniques.

Materials and Methods

Selection of the plant

In the present study all the three plants were selected on the basis of literature review. The original authors who have carried out the pre-clinical research work for the selected potential medicinal plants were communicated for providing the data and results. Also ask for the manuscript. Finally various statistical and mathematical tools were applied to confirmed their evidence as anti-diabetic.

Data sources, search strategy, and selection criteria

A systematic review of the published literature were carried out using the suitable search strings in the following data sources: Google, MEDLINE (via PUBMED), Biological and Chemical Abstracts, global health, National Science Library and the reference books. Search terms shall include but not limited to the key words viz. Name of the medicinal plant, antidiabetic, antioxidant, free radical scavenging, anti-hyperlipidemic, etc. After the selections of plants were tools were selected to judge their activity.

Result

Hypothesis

Let us take the null hypothesis that there is no change in Blood Glucose. (See table 1.)

Probabilistic approach of effect of *H. isora* on blood glucose tolerance

The diabetes recovery model from Khajehnasiri *et al*. divides the diabetes rats (N (t)) into the following sub-groups: diabetes individuals (D_i (t)), diabetes individuals Treated with plant extract (T_{PT} (t)) and have recovered from Diabetes (R_D (t)). Thus, the total variable diabetic population size at time t is given by, $N(t) = D_i(t) + (T_{PT}(t)) + (R_D(t))$. It is assumed that diabetic rats are recruited into the population at per capita rate Λ.The model parameters incorporated are μ (the natural mortality rate) and λ (the probability of diabetic rats. Hence,

$$\frac{d(D_i(t))}{dt} = \Lambda - \lambda D - \mu D$$

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The population of diabetic rats individuals is generated at the rate λ. This population is decreased by death due to natural mortality, recovery rats, severely disabled and which disability cannot be cured α, v, ʌ and μ, respectively. Hence,

$$\frac{d(T_{PT}(t))}{dt} = \lambda D_i(t) - \alpha(T_{PT}(t)) - v(T_{PT}(t)) - \mu(T_{PT}(t))$$

Finally, the recovered population is increased by diabetic rats treated who recovered at the rate α and decreases by the natural mortality at the rate μ. Thus,

$$\frac{d(R_D(t))}{dt} = \alpha(T_{PT}(t)) - \mu(R_D(t))$$

In summary,

$$\frac{d(D_i(t))}{dt} = \Lambda - \lambda D_i(t) - \mu D_i(t) \quad \text{----------(1)}$$

$$\frac{d(T_{PT}(t))}{dt} = \lambda Di(t) - \alpha(T_{PT}(t)) - v(T_{PT}(t)) - \mu(T_{PT}(t)) \quad \text{----------(2)}$$

$$\frac{d(R_D(t))}{dt} = \alpha(T_{PT}(t)) - \mu(R_D(t)) \quad \text{----------(3)}$$

Hence the control representing the level of efforts on prevention and recovery, the models 1, 2 and three becomes

$$\frac{d(D_i(t))}{Dt} = \Lambda - \lambda(1-u_1(t))D_i(t) - \mu D_i(t) \quad \text{----(4)}$$

$$\frac{d(T_{PT}(t))}{dt} = \lambda(1-u_1(t))D_i(t) - \alpha u_2(t) - (v+\mu)(T_{PT}(t)) \quad \text{---------(5)}$$

$$\frac{d(R_D(t))}{dt} = \alpha(T_{PT}(t)) - \mu(R_D(t)) \quad \text{----------(6)}$$

The control functions, $u_1(t)$ and $u_2(t)$ are bounded, Lebesgue integrable functions. The control, $(1-\mu_1(t))$, represents the effort on prevention of diabetic rats having diabetes to reduce the number of diabetic individuals. While the control $\mu_2(t)$ is the effort on recovery from diabetes to increase the number of recovered individuals. Thus, the total variable diabetic population size at time t is given by, $N(t) = D_i(t) + (T_{PT}(t)) + (R_D(t))$.

30=12+12+6.

Hence,

$0 = \Lambda - 12\lambda - 12\mu$

$0 = 12\lambda - 12\alpha - 12v - 12\mu$

$0 = 12\alpha - 6\mu$

From equation 1, 2 and 3

$0 = \Lambda - 12\lambda - 12\mu$

$0 = 12\lambda - 12\alpha - 12v - 12\mu$

$0 = 12\alpha - 6\mu$

From Equation 4, 5 and 6 we get,

$0 = \Lambda - \lambda(1-u_1(t))*12 - 12\mu$

$0 = \lambda(1-u_1(t))*12 - \alpha u_2(t)*12 - (v+\mu)*12$

$0 = \alpha u_2(t)*12 + u_1(t)*6 - 6\mu$

From the equation it has been confirmed that the value which were assumed for the study and the partial differential equation comes for the probabilistic approach in diabetes. Hence the assumed values confirmed our data. In conclusion, our optimal results show how recovery in *H. isora* may reduce the number of diabetes.

Hypothesis

Let us take the null hypothesis that there is no change in Blood Glucose Tolerance. (See table 2.)

Hypothesis

Let us take the null hypothesis that there is no change in Blood Glucose Tolerance. (See table 3.)

Survival analysis

For the survival analysis the percentage was calculated according to the formula (See figure 2).

Survival analysis= (T-C)*100/C

Where T= Treated animals.

The present study based on the statistical and mathematical studies of three selected plant. Keeping in view the above background, comprehensive statistical analysis of selected potential extracts were carried out to evaluate and statistically signify

their efficacy data in the treatment of diabetes mellitus[3-7]. The efficacy data of the selected medicinal plants were applied to critical statistical tools for their anti-diabetic activity. The statistical and mathematical analysis were carried out for the antidiabetic selected medicinal plants. In decision analysis (Fig 1), a decision tree and the closely related influence diagram were used for the determination of oral glucose test in different plant extract with analytical decision support tool, and the expected values were calculated on the basis of various tools in different plant extracts. In decision analysis, a decision tree and the closely related influence diagram were used for the analytical decision support tool, and the expected values were calculated on the basis of various tools in different plant extracts. The different extract of *H. isora, C. attenuata* and *P. oleracea* were also tested for anti-diabetic activity, earlier by glucose tolerance test. And this hypothesis confirmed by T-test. The oral glucose tolerance test (OGTT) measures the body's ability to use a type of sugar, called glucose that is the body's main source of energy. The extract (100mg/kg and 250mg/kg) prevented the increase in blood glucose levels significantly after glucose load in three selected medicinal plants. The maximum glucose tolerance was noted for *H. isora* extract at the 90th min after glucose loading followed by *P. oleracea* and *C. attenuata* and is comparable with tolbutamide activity by t-test (Table 1, 2, and 3) probabilistic equation and finally this was confirmed by recovery percentage (Fig 2). In the plants *H. isora*, *P. oleracea* and *C. attenuata* it was found that the calculative value of the t-test at 1 % level of significance is less than table value of t test at 1 % level of significance.

Conclusion

The present study identifies and confirmed the active extract(s) responsible for the anti-diabetic activity of selected medicinal plants on the basis of various statistical and mathematical tools. Moreover, this work will enhance the possible mechanism of action of the various extract for their pharmacological response with help of statistical and mathematical tools. These tools will also help in safety, efficacy and toxicity of selected medicinal plants and the rationale behind their use as anti-diabetic drugs. These tools will enhance their claim to be used as regular anti-diabetic drugs.

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Table 1. Effect of *H. isora* on glucose tolerance by t-test

Treatment	Basic value	90 mins	D	D1	D-D1	(D-D1)*(D-D1)
Normal	78.99	80.16	1.17		-14.012	196.3361
Control	79.25	114.71	35.46		20.278	411.1973
Treatment (100mg/kg)	80.62	122.95	42.33		27.148	737.0139
Treatment (250 mg/kg)	79.03	83.52	4.49		-10.692	114.3189
Tolbutamide	64.48	56.94	-7.54		-22.722	516.2893
			75.91	15.182	0	1975.155
	S	22.22136067				
	T	1.527718511				
	D.F	4				

Table value of t at 1% level of significance is 4.6.calculative value of t < table value of t. Hence the hypothesis hold true. There is no change in Blood Glucose.

Table 2. Effect of *P. oleracea* on glucose tolerance by t-test

Treatment	Basic value	90 mins	D	D1	D-D1	(D-D1)*(D-D1)
Normal	79.12	81.11	1.99		-11.144	124.1887
Control	79.91	116.71	36.8		23.666	560.0796
Treatment (100mg/kg)	82.42	109.58	27.16		14.026	196.7287
Treatment (150 mg/kg)	81.03	88.42	7.39		-5.744	32.99354
Tolbutamide	66.41	58.74	-7.67		-20.804	432.8064
			65.67	13.13	0	1346.797
	S	18.34937				
	T	1.600519				
	D.F	4				

Table value of t at 1% level of significance is 4.6.calculative value of t < table value of t. Hence the hypothesis hold true. There is no change in Blood Glucose Tolerance.

Table 3. Effect of *C. attenuata* on glucose tolerance by t-test

Treatment	Basic value	90 mins	D	D1	D-D1	(D-D1)*(D-D1)
Normal	79.25	80.91	1.66		-13.23	175.0329
Control	81.28	114.71	33.43		18.54	343.7316
Treatment (100mg/kg)	84.53	106.73	22.2		7.31	53.4361
Treatment (150 mg/kg)	80.23	104.93	24.7		9.81	96.2361
Tolbutamide	64.48	56.94	-7.54		-22.43	503.1049
			74.45	14.89	0	1171.542
	S	17.1139				
	T	1.9455				
	D.F	4				

Table value of t at 1% level of significance is 4.6.calculative value of t < table value of t. Hence the hypothesis hold true. There is no change in Blood Glucose Tolerance.

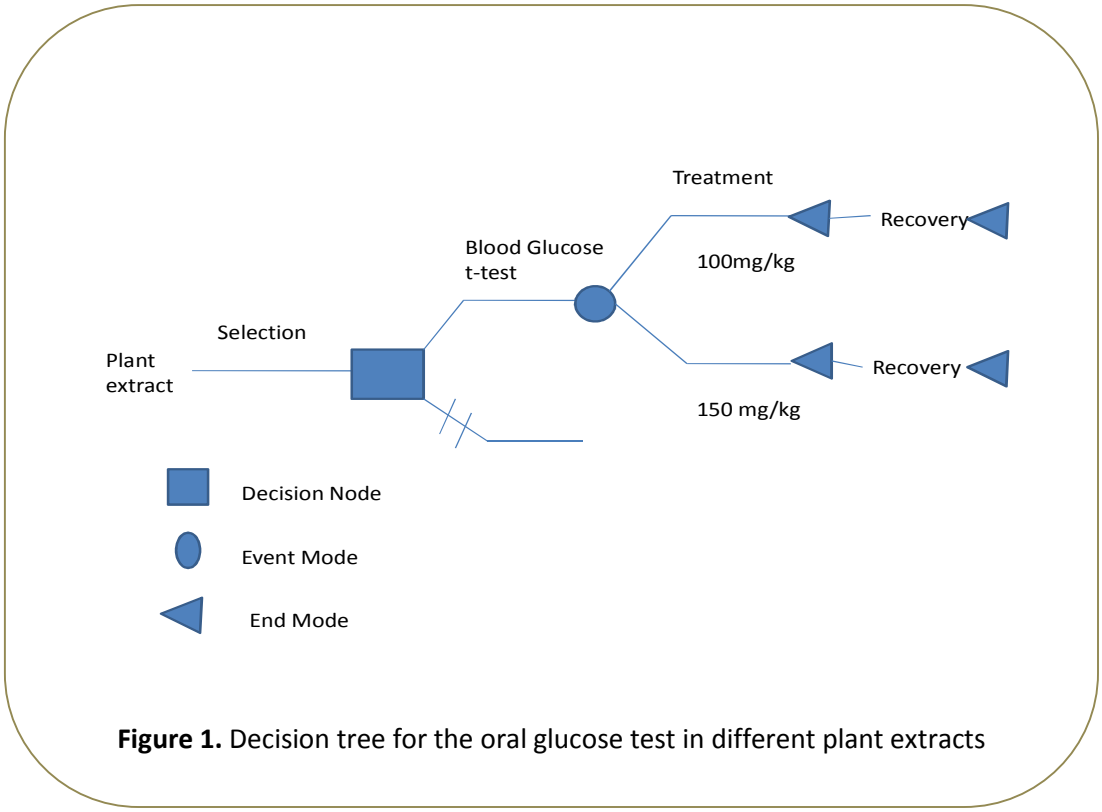

Figure 1. Decision tree for the oral glucose test in different plant extracts

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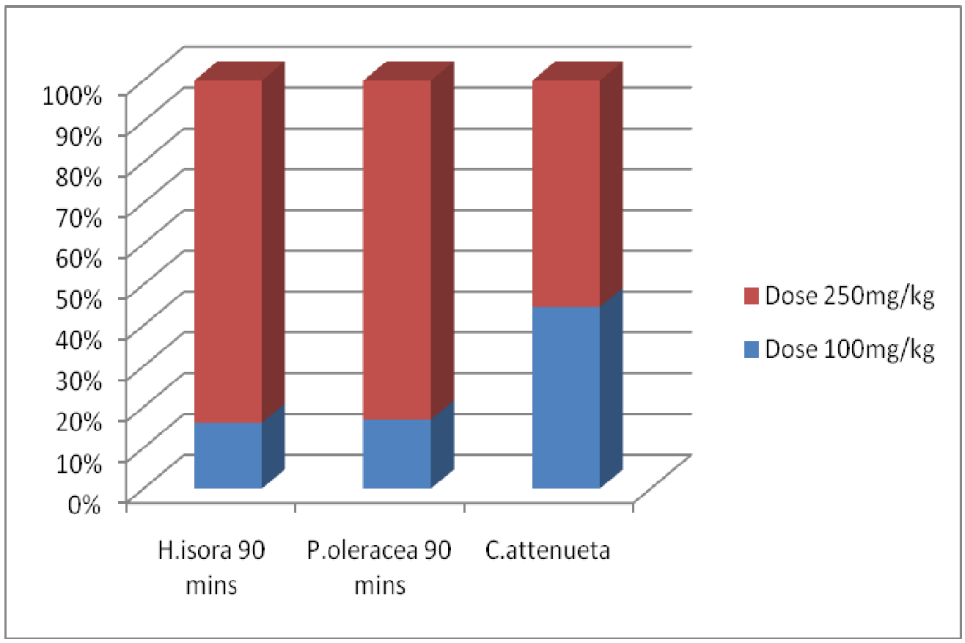

Figure 2. Survival analysis in three selected plants with OGTT parametres