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CLINICAL STUDY ON ANTIDIABETIC ACTIVITY OF KARANJA (*PONGAMIA PINNATA*)

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Abstract: Background: Diabetes Mellitus (DM) is one of the most common non-communicable diseases. The prevalence of Type 2 DM in India between age group 20-79 yr. is 61.3 million in year 2011 and expected data in 2030 is 101.2 million according to International Diabetes Fedration. **Objectives:** The present clinical study was done with an aim to evaluate the role of *Karanja* seed powder and stem bark decoction in the management of *Madhumeha*. **Materials and methods:** 75 registered cases were divided into 5 groups: Group 'A' patients were taking conventional doses of Gliclazide: Group 'B' Patients taking (*Karanja* seed powder): Patients of group 'C' were treated with stem bark decoction of *Karanja* : Patients of group 'D' were treated with combination of seed powder and Gliclazide: Patients of group 'E' were treated with combination of bark decoction and Gliclazide. **Results:** Significant changes both statistically and clinically were observed in group 'D' having BT – F3 value 9.549 (p =0.000) and in group 'E' with BT – F3 value is 9.513 (p= 0.000) which is highly significant in both groups. **Conclusion:** Lastly it is concluded that both seed powder and stem bark decoction of *Karanja* is an effective therapeutic medicine for management of *Madhumeha*.

Keywords: *Madhumeha*, Decoction, Diabetes Mellitus

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INTRODUCTION

According to *Ayurveda Madhumeha* is defined as the disease in which patient voids urine similar to Madhu in taste and colour. *Madhumeha* is a subtype of *Vataja Prameha . Ayurvedic* scholars have defined *Madhumeha* as *Maharoga* or *Mahagada. Sushruta* has narrated the term *Ksaudrameha* in place of *Madhumeha* means in which patient voids urine similar to *Ksaudra* or *Madhu* i.e. of *Kasaya* and *Madhura* taste and *Ruksa* texture and honey like colour. Further he narrated that when all the *Prameha* ill treated or neglected get converted into *Madhumeha*. Type 2 Diabetes Mellitus is defined as the disease which is non-autoimmune, complex, heterogeneous and polygenic metabolic disease condition in which pancreas fails to produce enough insulin and results in abnormal glucose homeostasis. The most important demographic change to diabetes prevalence across the world appear to be the increase in the proportion of people>65 years. By the 2030 it is estimated that number of people with diabetes >64 age will be >82 million in developing countries and >48 million in developed countries.

Long term Diabetes lead to several complications like diabetic retinopathy, neuropathy, nephropathy and so on, so it is necessary to use such drugs which cure the Diabetes along with its complications.

So we are here carrying out study about *Karanja (Pongamia pinnata*) belongs to family Fabaceae [1] whose properties are *Pramehagna* (antidiabetic) by its *Rasa, Guna, Virya, Vipaka. Karanja (Pongamia pinnata*) has been mentioned in *Charak Samhita* in *Lekhaniya Mahakasaya*[1], *Bhedaniya Mahakasaya* [2]and *Kandughna Mahakasaya*[3] also in *Katu* [4] and *Kasaya Skandha* [5]. It is mentioned in *Sushruta Samhita* in *Aragavadhadi* [6], *Varunadi* [7], *Arkadi* [8] and *Syamadi gana* [9]. It is also described in *Astanga Samgraha, Astanga Hridaya*[10], and most of the *Nighantus.*

Aims and objectives:

Clinical evaluation of *Karanja* seed powder and bark decoction effect in the management of *Madhumeha.*

Materials and Methods:

A) Preparation of drug and dosage:

Test drug consists of *Karanja* seed powder in dose of 12gms daily in two divided doses. *Karanja* stem bark decoction 80 ml daily in two divided doses before meal.

B) Selection of patients:

Total 75 patients with Type-2 DM were selected from Out Patient Department (OPD) and In Patient Department (IPD) of Department of Dravya Guna, S.S. Hospital B.H.U. Out of these 5patients are not followed the whole treatment. Among these most of the patients were known case of DM Type 2 and a few were diagnosed for the first time.

C) Inclusion Criteria:

All the patients were examined clinically for signs and symptoms of type-2 DM for e.g. polyurea, polyphagia, polydypsia, weakness, numbness of limbs, tingling and burning sensation in sole and palm, cramps in legs and weight loss over few months etc. However new diagnostic criteria given by WHO, was adopted as anchoring diagnostic criteria.

1. Patients having classical symptoms of diabetes with random plasma glucose ≥11.1mmol/L (≥200 mg/dl).
2. Increased fasting blood glucose ≥7.0mmol/L (≥ 126 mg/dl), more than two occasions in different days.
3. Increased post-prandial glucose ≥11.1mmol/L (≥200 mg/dl) during an oral glucose tolerance test.[11]

A patient filling any two of the above this criteria was confirmed having diabetes.

D) Exclusion Criteria:

1. Patients having type 1DM,
2. Severe complications of Diabetes (Nephropathy, Cardiomyopathy, Neuropathy, Retinopathy etc.), any other chronic diseases like Tuberculosis, Rheumatic Heart disease, Rheumatoid arthritis etc.

3. Patients of type 2 DM taking insulin were also not included in the study.

E) Grouping of the patients:

Registered patients were divided into 5 groups –

- Group A was given a conventional dose of Gliclazide (40-160 mg/day).
- Group B was given seed powder of *Karanja.*
- Group C was given stem bark decoction of *Karanja.*
- Group D was treated with combination of seed powder and Gliclazide.
- Group E was treated with combination of bark decoction and Gliclazide.

F) Criteria to assess the effect of trial drug:

All the selected patients were advised to come for follows up at every 1 month interval up to three 3 months.

Assessment was done under the headings subjective and objective-

a. Subjective Assessment:

It depends on symptomatology and grade depends on symptoms told by patient. In each follow up patients were assessed for the subjective improvement, i.e. polyurea, polydipsia, loss of weight and other complications.

This clinical symptomatology was divided into four grades (0-3) and changes in gradations of each symptom were assessed. The clinical grade was decided a follows.

Grading scale of symptoms:

Symptoms	Score	Grade	Grading Criteria of Symptoms
Polyurea	0	Absent	Normal frequency 1-4 times in a day, 0-2 times at night and normal volume.
	1	Mild	Frequency 5-7 times/day, 3-5 times/night with normal volume
	2	Moderate	Frequency 8-10 times/day, 3-5 times/night with excessive volume
	3	Severe	Frequency > 10 times/day, > 8 times/night and with excessive volume
Polydipsia	0	Absent	Normal 1.5-3 L/day
	1	Mild	Increased but controlled; 3-4 L/day
	2	Moderate	Increased but uncontrolled ;4.5 L/day
	3	Severe	Very much increased ;> 5 L/day
Polyphagia	0	Normal	Main meal 2, light breakfast 1/day
	1	Mild	Main meal – 2 light breakfast 2-3/day
	2	Moderate	Main meal 2 , but light breakfast 3-5/day
	3	Severe	Main meal 2 0r 3 light breakfast > 5/days
Weakness	0	Absent	No feeling of weakness
	1	Mild	Mild feeling of weakness
	2	Moderate	Routine activities disturbed
	3	Severe	Severe weakness leads to bed ridden.
Loss of weight	0	Absent	0-2Kg /year
	1	Mild	2-4Kg / year
	2	Moderate	4-6Kg/year

	3	Severe	>6 kg/year
Other Complications			
Cramps in legs	0	Absent	No Gramps
	1	Mild	Cramps after walking 1 km
	2	Moderate	Cramps after waling ½ km
	3	Severe	Inability to walk even up to ½ km
Tingling and burning sensation	0	Absent	No tingling and burning sensation
	1	Mild	Sense of burning and tingling in palm and soles of mild degree.
	2	Moderate	Sensation like crawling of ants all over the body and burning that hamper patients routine work.
	3	Severe	Loss of sensation

b. Objective Assessment:

- Fasting and post prandial blood sugar was done in each follow up.
- Lipid profile was done before and after completion of the treatment.
- HbA1c was done before and after completion of the treatment.
- Serum creatinine was done before and after treatment to check out renal function.
- Regular checkup of body weight in each follow up.

Observations and Results:

The observation and result have been made in the present work on the basis of demographic, constitutional and clinical profiles of 75 patients having Type 2 Diabetes Mellitus. Out of 75 patients, 5 patients not followed the whole treatment [Table 1].

Table 1: Therapy wise details of the groups:

Group	No. of registered patients	No. of patients completed the follow-up	Drug
A	15	14	Gliclazide
B	15	14	Seed powder of *Karanja*
C	15	12	Stem bark decoction of *Karanja*
D	15	15	Seed powder and Gliclazide
E	15	15	Bark decoction and Gliclazide
Total	**75**	**70**	

Majority of the cases belong to the age group of 46-55 yr. (48.57%), among these most of the cases were male (72.9%), married (91.47%), Hindu (85.7%), middle class (65.7%) and live in urban area (71.4%). Maximum patients belong to graduated group (34.3%) , having mixed diet (57.1%) and poor digestive power (34.3%). High prevalence of disease in service class (28.6%), addicted to tobacco (27.1%), bowel habit irregular (61.4%), duration of illness was more than 6yr. (38.57%). Maximum cases were reported with family history of type-2 DM (60%) and sedentary life style (50%).

It was observed that (78.57%) patients were seen with Polydypsia followed by Polyurea (75.71%) and Polyphagia (58.57%). Majority of patients having Weakness and Tingling and burning sensation which were (85.71%) and (80%) respectively, while loss of weight and numbness were complained by (57.14%) and (57.14%) respectively.

Effect of treatment:

As per paired t test all 5 groups (group A, B, C, D and E) shows statistically significant results in above mentioned subjective and objective parameters. Some of the important criteria are explained in the Table 2- 7.

Table – 2 Improvement in polyurea:

Polyurea	BT Mean ± S.D.	AT			Within the group paired 't' test value BT - F3	Mean difference	Between the group comparison one way Anova on difference of BTandF3
		F1	F2	F3			
Group A	1.14 ± 0.86	0.93 ±0.83	0.71 ±0.83	0.50 ±0.76	3.00 P=0.002	0.64	- 0.559 P<0.05
Group B	1.07 ± 0.83	0.86 ± 0.86	0.71 ± 0.83	0.64 ± 0.75	3.12 P=0.008	0.43	
Group C	1.17 ± 0.718	0.92 ± 0.79	0.67 ± 0.78	0.42 ± 0.67	4.18 P=0.002	0.75	
Group D	1.00 ± 0.76	0.87 ± 0.83	0.53 ± 0.83	0.13 ± 0.35	5.25 P=0.00	0.87	
Group E	1.13 ± 0.74	0.80 ± 0.86	0.47 ± 0.74	0.20 ± 0.41	6.09 P=0.00	0.93	

BT – before treatment; AT – after treatment; F1, F2, F3 – follow up 1, 2, 3 respectively.

Table – 3: Improvement in polydypsia:

Polydipsia	BT Mean ±S.D.	AT			Within the group paired 't' test value BT - F3	Mean difference	Between the group comparison one way Anova on difference of BTandF3
		F1	F2	F3			
Group A	1.29 ±1.069	0.71 ±0.994	0.29 ±0.611	0.21 ±0.579	4.83 P=0.00	1.071	- 0.34 P<0.05
Group B	1.29 ±0.994	1.00 ±1.109	0.50 ±0.941	0.21 ±0.579	5.491 P=0.00	1.071	
Group C	1.08 ±0.669	0.67 ±0.778	0.58 ±0.793	0.25 ±0.622	5.00 P=0.00	0.833	
Group D	1.27 ±0.961	0.87 ±0.915	0.27 ±0.594	0.07 ±0.258	5.392 P=0.00	1.200	
Group E	1.13 ±0.834	0.67 ±0.724	0.27 ±0.594	0.07 ±0.258	5.870 P=0.00	1.067	

Table –4: Improvement in polyphagia:

Polyphagia	BT Mean ±S.D.	AT F1	AT F2	AT F3	Within the group paired 't' test value BT - F3	Mean difference	Between the group comparison one way Anova on difference of BTandF3
Group A	1.00 ±1.038	0.57 ±0.938	0.36 ±0.633	0.29 ±0.611	3.68 P=0.003	0.714	-0.035 P<0.05
Group B	0.86 ±1.027	0.57 ±0.756	0.43 ±0.756	0.21 ±0.579	3.23 P=0.007	0.643	
Group C	0.83 ±0.937	0.58 ±0.793	0.33 ±0.651	0.25 ±0.622	2.55 P=0.027	0.583	
Group D	1.20 ±1.082	0.53 ±0.915	0.20 0.561	0.07 ±0.258	4.43 P=0.001	1.133	
Group E	1.07 ±0.961	0.60 ±0.91	0.27 ±0.594	0.20 ±0.561	4.51 P=0.000	0.867	

Table 5: Effect of treatment on FBS

(FBS) Fasting Blood Sugar	BT Mean ±S.D.	AT F1	AT F2	AT F3	Within the group paired 't' test value BT - F3	Mean difference	Between the group comparison one way Anova on difference of BT and F3
Group A	170.996 ±43.662	158.532 ±27.065	147.715 ±19.454	135.549 ±18.544	4.097 P=0.001	35.450	0.12 P>0.05
Group B	173.56 ±44.344	158.937 ±25.467	148.849 ±18.969	135.160 ±18.878	4.347 P=0.001	38.402	
Group C	164.78 ±38.653	155.660 ±26.580	146.524 ±20.563	134.820 ±19.820	4.571 P=0.001	29.964	
Group D	171.96 ±56.94	160.078 ±56.152	149.229 ±52.635	143.406 ±51.336	9.549 P=0.000	28.555	
Group E	172.18 ±55.31	160.011 ±56.207	149.229 ±52.635	141.790 ±50.671	9.513 P=0.000	30.396	

Table 6: Improvement in Post Prandial blood sugar -

Post Prandial Blood Sugar (PPBS)	BT Mean ± S.D.	AT F1	AT F2	AT F3	Within the group paired 't' test value BT - F3	Mean difference	Between the group comparison one way Anova on difference of BTandF3
Group A	277.854 ±31.765	251.726 ±28.098	223.143 ±22.528	201.797 ±20.616	16.186 P=0.000	76.057	- 1.3 P<0.05
Group B	281.921 ±33.634	256.200 ±29.258	220.121 ±35.968	204.392 ±19.898	14.079 P=0.000	77.529	
Group C	272.746 ±30.868	244.784 ±23.127	218.167 ±20.255	197.130 ±18.024	13.918 P=0.000	75.617	
Group D	282.399 ±87.986	260.943 ±80.150	241.707 ±72.112	229.257 ±71.766	8.209 P=0.000	53.477	
Group E	283.389 ±87.986	260.943 ±80.150	241.707 ±72.111	228.443 ±71.994	8.562 P=0.000	54.946	

Table 7: Effect of treatment on HbA1C-

HbA1c	BT Mean ±S.D.	AT Mean ±S.D.	Paired 't' test value BT - AT	Mean difference	Between the group one way Anova on difference of BT and AT 'F Value'
Group A	7.68 ±1.82	6.94 ±1.78	9.672 P=0.000	0.750	0.377 P>0.05
Group B	7.84 ±1.92	6.94 ±1.72	8.45 P=0.000	0.892	
Group C	7.46 ±1.57	6.79 ±1.57	8.36 P=0.000	0.667	
Group D	7.75 ±1.83	6.49 ±1.33	7.23 P=0.000	1.263	
Group E	7.61 ±1.70	6.35 ±1.08	6.44 P=0.000	1.261	

Group 'A' showed significant relief in polyurea (64.29%), polydipsia (85.71%), polyphagia (78.57%), weakness (71.43%), loss of weight (85.71%), cramps in legs (78.57%), tingling and burning sensation (85.71%) and improvement in numbness (78.57%).

Group 'B' showed significant result in polyurea (50%), polydipsia (78.57%), polyphagia (85.71%), weakness (78.57%),

loss of weight (78.57%), cramps in legs (85.71%), tingling and burning sensation (85.71%) and improvement in numbness (85.71%).

Group 'C' showed significant relief in polyurea (66.67%), polydipsia (83.33%), polyphagia (83.33%), weakness (83.33%), loss of weight (91.67%), cramps in legs (83.33%), tingling and burning sensation (83.33%) and improvement in numbness (83.33%).

Group 'D' showed highly significant decrease in symptoms of polyurea (86.67%), polydipsia (93.33%), polyphagia (93.33%), weakness (93.33%), loss of weight (86.67%), cramps in legs (93.33%), tingling and burning sensation (93.33%) and improvement in numbness (93.33%).

Group 'E' showed highly significant decrease in symptoms of polyurea (80.00%), polydipsia (93.33%), polyphagia (86.67%), weakness (93.33%), loss of weight (93.33%), cramps in legs (100%), tingling and burning sensation (86.67%) and improvement in numbness (93.33%).

Discussion and Conclusion:

In *Caraka Samhita* use of *Karanja* is indicated in *kustha* (skin diseases) [12] , *krmi roga* (worm infestation) [12] , *kandu* (itching) [12] , *apasmara* (epilepsy) [13] , *visa* (poisoning) [13] , *unmada* (psychosis) [13] , *jvara* (fever) [13] and also *bhutabadha* [13]. It is also used in *grahani* (irritable bowel syndrome) [14] , *pandu* (anemia) [15] , *madatyaya* (alcoholism) [15] , *ajirna* (indigestion) [15] etc.

In *Susruta Samhita* it is indicated in *prameha* (diabetes mellitus) [16] , *kustha* (skin disorder) [17] , *bhagandara* (fistula in ano) [17] , *gandamala* [18] , *nadi vrana* (sinus) [18] , *netra roga* (eye disease) [19] , *raktapitta* (haemorrhagic disorder) [20] .

While in *Astanga Hrdaya* it is indicated in *prameha* (diabetes mellitus) [21], *udara roga* (GIT disorder) [21] , *garadosa* (poisoning) [22] , *ajirna* (indigestion) [22], *vrana* (wound) [23] , *kustha* (skin disease) [24] , *tvakdosa* (skin disorder) [25] , *sopha* (oedema) [26] etc.

- In *Dhanwantari Nighantu, Karanja* has been mentioned as *Naktamala*, *it has tikta rasa, usna virya, karma kapha-pittahara* [27].
- In *Madanapala Nighantu* it is described as *Naktamala, Naktahva, Ghrtavarnaka. Karanja Phala* has been mentioned as *kaphavatahara* and used in *prameha, arsa*, *krmi, kustha*. [28]
- In *Sodhala Nighantu,* it is mentioned as *usna virya* and *netrahita* in *karma*. [29]

By analyzing description of different *Nighantu's* it may be concluded that *Karanja* has *kasaya, katu* and *tikta rasa, tiksna* and *laghu guna, katu vipaka* and *usna virya*. It is *kapha vatasamaka* and *pittavardhaka*. All these properties make it suitable to combat *Madhumeha.*

Charaka has described two types of treatment for *pramehi*, for *krisha* and *durbala pramehi* he has narrated *brinhana* (nourishment of body) chikitsa and *samsodhana* (purificatory procedure) *chikitsa* for *sthula* (obese) and *balvana* (strong) *Pramehi*. [30]

WHO recommendations hypoglycemic agents of plant origin used in traditional medicines are important [31].

The improvement in the symptoms of polyurea was found statistically highly significant after treatment in entire groups. This shows that test drug is effective in polyurea because of its *Kasaya Rasa* which is *Stambhana* (absorbing property) and also reduces *Sariragata Kleda* (body fluid). This result shows that trial drug proved better synergistically with Gliclazide (OHG).

Many traditional plant treatments for diabetes mellitus are used throughout the world [32].

Reduction in polydypsia was observed statistically highly significant in group D and E this may be due to its *Tikta Rasa* which is claimed to be *Trsnasamaka* (decreases thirst). Improvement in polyphagia was statistically highly significant in group 'E'. With respect to weakness response of treatment was found more pronounced with test drug in comparison to standard drug. Reduction in loss of weight was statistically significant in group E while it was less significant in group 'B'. Considering cramps on walking effect of test drug was more profound in comparison to Gliclazide. Relief in this symptom observed with test drug, this may be due to its *Vatasamaka* property. Regarding tingling and burning sensation as well as numbness the treatment with test drug was found statistically significant.

In 'D' and 'E' group statistically significant changes were observed in reduction of FBS while in group 'A' it was less significant. Effect on PPBS was significant in test drug groups at the same time it was highly significant in group 'D' and 'E'. Results show that trial drug proved better synergistically with OHG. It lowers the PPBS might be due to its *Katu, Tikta Rasa* and *Katu Vipaka* which pacify *Kapha* and *Meda. Kapha* and *Meda* are the causative factors to increase *Madhuratva* (sweetness). It may have acarbose like action to which causes reduction in glucose absorption. Reduction in HbA1c was statistically significant in group 'D' and 'E'. Overall the observations were found more effective in group 'D' and 'E', where the test drug was continued with the modern drug. It was more significant due to its synergistic action.

Being *usna virya* it pacify *vata,* and by virtue of *kasaya rasa* it reduces *sariragata kleda*. This seems here it acts by *guna prabhava*. Improvement in physical strength observed in the test subjects could not be explained by its properties and action therefore, this benefit may be due to *dravya prabhava*. So we may infer that the drug acted by both *guna prabhava* and *dravya prabhava*.

It can be concluded from this study that *Karanja* fruit seed powder and bark decoction both are very effective for the treatment of *Madhumeha* (Type -2 DM) for long term.

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