Published online in http://ijam.co.in ISSN No: 0976-5921

International Journal of Ayurvedic Medicine, Vol 11 (3), 524-535

Efficacy of *Prakriti* specific Herbal Tea in Diabetes A Randomized controlled trial

Research Article

Sapna Sehgal[1], Huddar VG[2], Mangalagowri V Rao[3*]

1. Medical Officer, ESIC Hospital, Manesar, Hariyana,
2. Associate Professor, All India Institute of Ayurveda, New Delhi,
3. Associate Professor, Department of Swasthavritta and Yoga, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University, Varanasi.

Abstract

Introduction*: Prakriti* has an influential role in diagnosis and management of any disease. Increasing pandemic of diabetes leads to early mortality and decreased quality of life due to severe complications and side effect of contemporary medicines. The present study reveals *Prakriti* specific combination of herbs in form of tea with antidiabetic effect and no side effects. Materials and methods: 115 patients were enrolled which was randomly distributed in 2 group. Group A was *Prakriti* specific Herbal tea trial group and Group B was control. Both subjective and objective parameters were assessed. Results:Highly significant results with p value <0.0001 were seen in Polyuria (*Prabhutmutrata*), Laziness (*Alasya*), Excess Sleep (*Nidraadhikya*), Dryness in Mouth(*Gala Talu Shosha*), Excessive Thirst (*Ati Pipasa*), with maximum improvement in Polyuria (*Prabhutmutrata)*.Significant results were seen in Burning Sensation in hands and legs *(Karpaddaha),*Numbness in palm and foot *(Karpadasuptata),* Cramps *(Pindikodweshtana)*. Highly significant results were seen in Fasting, Postprandial Blood sugar, HbA1c and urine fasting glucose was seen in *Prakriti* specific Herbal tea group with p value <0.0001. Maximum improvement were seen in *Kapha Prakriti* patients with p value < 0.0001 followed by *Vata Prakriti* patients. *Vata* and *Kapha* Herbal Tea found equally effective.Conclusion: *Prakriti* specific Herbal Tea is a better option of Diabetes Mellitus with high efficacy.

Key Words: *Prakriti, Diabetes, Herbal tea, Prameha.*

Introduction

Diabetes Mellitus has emerged as an important public health problem globally. It is estimated that global economic burden will increase from U.S. $1.3 trillion (95% CI 1.3–1.4) in 2015 to $2.2 trillion (2.2–2.3) in the baseline, $2.5 trillion (2.4–2.6) in the past trends, and $2.1 trillion (2.1–2.2) in the present scenarios by 2030 (1) Diabetes Mellitus can be correlated with *Prameha/Madhumeha* due to similarity in their aetiology and characteristic features.In Ayurveda, *Prameha* is a *Tridoshaja Vyadhi* (2)with genetic predisposition(3) as well as improper diet and lifestyle Progression of *Prameha* to *Madhumeha* (*Ojomeha*) occurs with progression of time leading to the loss of *Ojus* (the essence part of all body tissues).The Ayurvedic management principles consist of *Samshodhana* (Purification), *Samshamana* (alleviation therapy), *Nidana parivarjana* (avoiding causative factors) in the form of *Aahara* (Diet) and *Vihara* (Lifestyle) is based on *Dashavidha Parikshya Bhavas(* Ten diagnostic factors) . *Prakriti* has key role in incidence and management of disease, which is described as first and most important factor in *Parikshya Bhavas*. Thus *Prakriti* based diet and management is highly essential for better results. In the present day lifestyle, tea forms the most important component in diet of most individuals. So the *Prakriti* based Herbal tea, which includes kitchen herbs and spices as major ingredients with proven antidiabetic effects, would benefit the individuals and can be incorporated in the daily routine easily. As per studies only 41% of patients on anti-diabetic therapy had optimal glycaemic control with conventional management.(4) As holistic approach the study was conducted to give emphasis on alleviation of disease without any adverse effect. Ingredients included in *Prakriti* specific Herbal tea (*Kapha, Vata, Pitta)* are suitable for specific *Prakriti* and pacify the *Vitiated dosha* of *Madhumeha* by rectifying the *Agni* especially *Dhatvagni* resulting in proper metabolism and control of blood sugar.

*** Corresponding Author:**
Mangalagowri V Rao
Associate Professor,
Dept. of Swasthavritta and Yoga, Faculty of Ayurveda,
Institute of Medical Sciences,
Banaras Hindu University, Varanasi-221005, India
Email Id: mangowri@gmail.com

Aims and objectives

- To evaluate the efficacy of Prakriti specific Herbal Tea (Phanta) along with ongoing standard hypoglycaemic drugs in patients with Diabetes Mellitus type 2.
- To compare the results with the existing generalised Ayurvedic diabetic diet.

Materials and Methods

The present study was conducted in two phases. Preliminary phase and clinical trial phase. Preliminary phase consist of identification and procurement of herbs, preparation of herbal tea and Analytical study of herbal tea.List of herbs used in three *Prakriti* specific herbal tea are given below.

Ingredients of *Vata* Herbal tea for *Vatapradhana Prakriti*

Sunthi (*Zingiber officinale Rosc*) 500 mg, *Tulasi* (*Ocimum sanctum Linn*) 500 mg, *Ela* (*Elaterria cardamomum Maton*) 500 mg, *Lavanga* (*Syzygium aromaticumLinn.* 250 mg, *Mishreya* (*Foenieulum vulgare Mill.*) 500 mg, *Patra (Cinnamomum tamala Nees & Eberm*) 500 mg, *Jatiphala* (*Myristica fragrans Houtt*) 100 mg, *Tagar* (*Valeriana wallichii DC*) 250 mg, *Meshashringi* (*Gymnema sylvestre R Br*) 2.5 gm, *Jeerak* (*Cuminum cyminum Linn*.) 500 mg.

Ingredients of *Kapha* Herbal tea for *Kaphapradhana Prakriti*

Twak (Cinnamomum zeylanicum Breyn.) 1 gm, *Brihatela (Amomum subulatum Roxb*) 250 mg, *Bilwa Patra (Aegle marmelos Corr.)* 250 mg, *Mishreya (Foenieulum vulgare Mill.*)250 mg, *Jatiphala (Myristica fragrans Houtt)* 100 mg, *Sunthi (Zingiber officinale Rosc.)* 250 mg, *Meshashringi (Gymnema sylvestre R Br*.) 2.5 gm, *Jambu (Syzygium cumini Linn)* 500 mg, *Lavang (Syzygium aromaticumLinn*.) 200 mg, *Tulsi (Ocimum sanctum Linn*.) 500 mg, *Maricha (Piper nigrum Linn.)* 100 mg

Ingredients of *Pitta* Herbal tea for *Pittapradhana Prakriti*

Dhanyaka (Coriander sativum Linn.) 500 mg, *Haridra (Curcuma longa Linn.)* 500 mg, *Mishreya (Foenieulum vulgare Mill.)* 500 mg, *Ela (Elaterria cardamomum Maton)* 500 mg, *Asana (Pterocarpus marsupium Roxb.)* 2.5 gm, *Sunthi (Zingiber officinale Rosc.)*500 mg, *Tulasi (Ocimum sanctum Linn)* 500 mg, *Udumbara (Ficus glomerata Roxb.)*1 gm

Manufacturing of *Prakriti* specific Herbal Tea powder

Preparation of Prakriti specific Herbal tea powder was done by Multani pharmaceuticals with authenticated ingredients under the supervision of competent authority.

Clinical study

Present study was conducted at Kayachikitsa OPD and Swasthavritta OPD in All India Institute of Ayurveda, Delhi. Approval from Institutional Review Board was taken followed by Ethical clearance from Institutional Ethical Committee with number IEC-AIIA/ 2017/PG-37. Further, it was registered in Clinical Trial Registry of India with number CTRI/2018/03/012483 on March 2018. About 115 patients of *Prameha* (Diabetes Mellitus) belonging to 30-60 yrs. of age group and both gender were selected based on fulfilment of diagnostic criteria and randomly allocated in 2 groups after getting the informed consent. The *Prakriti* of the individual subject was evaluated based on *Prakriti*, Prototype *Prakriti* Analysis Tool (PPAT) (5).

Inclusion Criteria

FPG ≥126 mg/ DL (7.0 mmol/L) -Fasting is defined as no caloric intake for ≥8 hours to 220mg/dl, 2-hr PG ≥200(11.1 mmol/L) to 300mg/dl, both newly and previously diagnosed diabetes mellitus patients with less than 7 years

Exclusion Criteria

Patients having serious cardiac disorders like cardiac failure, patients having major illness like IDDM, patients having a history of untreated thyroid disorders, pregnant females and lactating mothers, renal insufficiency.

Intervention

In Group A patients were administered with 80-100ml of *Prakriti* specific Herbal tea twice a day at 40°C-50°C along with *Pathyaapthya* advice with their ongoing treatment for diabetes Mellitus for the duration of 3 months. The patients in group B were given only *Pathyaapathya* advice and lukewarm water at 40°C-50°Calongwith their ongoing treatment for Diabetes Mellitus for the duration of 3 months.

Preparation of *Prakriti* specific Herbal Tea (Phanta)

6 gm of Herbal Tea powder was mixed in 80-100 ml of water followed by roll boiling method. Herbal tea was administered in the morning and evening. The dosage of tea i.e. 80-100 ml bid is as per general tea consumption amount.

Total Monitoring period = 3 months with an interval of 1 month

Assessment parameters

Objective parameters:

CBC, Serum Cholesterol, Serum Triglyceride, Fasting Blood Glucose, Postprandial Blood Glucose, and HbA1c.

Subjective parameters:

Prabhutmutrata (Polyuria), *Avilamutrata* (Turbidity In Urine), *Karpaddaha* (Burning Sensation In Hands And Legs), *Madhuryamasya* (Sweet Taste In The Mouth), Alasya (Laziness), *Nidraadhikya* (Excess Sleep), *Atikshudha* (Excessive Hunger), *Karapadasuptata* (Numbness In Palm And Foot) , *Gala Talu Shosha* (Dryness In Mouth), *Pindikodveshtana* (Cramps), *Ati Pipasa* (Excessive Thirst), *Swedadhikya* (Excess Perspiration), assessed by grading criteria (6).

Statistical analysis

Paired t test, unpaired t test, one way ANOVA and repeated measured ANOVA was applied by using Graph Pad Prism version 5.03.

Observations and results

Out of 115 Patients 20 patients in Group A and 20 patients from Group B dropped out at different follow-ups. 40 in group A and 35 in group B have completed the study.

In the present study Maximum patients were females (58.2%) belonging to 40 to 60 years of age (72.6 %). Most of the patients had sedentary habits (54.7%) and came under middle income group (62%). BMI range in maximum patients (40%) was 25.0-29.9.45.2% of patients had positive family history for diabetes. About 10 % patients consumed alcohol occasionally, and about 8% patients were smokers and 2%chewed tobacco.

Diet history revealed mixed diet (58.2 %) practice in majority. 37.3% patients consumed *Guru guna* predominant diet, 22.6% with *Snighdha Ahara* and 33.9% patients took. *Lavana Rasa* predominant diet. About 57% patients consumed rice as a staple diet, 43.4% taking Red gram. Maximum patients (46.9 %) were regularly taking banana. 69.5% of patients were taking milk regularly, 59 % were taking curd regularly. 56.5% of patients were consuming mustard oil and 66.9% of patients were consuming baked items/fast food. Most patients (71.3%) consumed meals at irregular time.

The study data reveals that maximum number of patients i.e. 33.9% had *Kapha Pradhana Vata Anubandh Prakriti*, followed by 20.8% of *Vata Pradhana Kapha Anubandhan*, 17.3% *Vata Pradhan Pittaja Anubandh*, 20% *Kapha Pradhan Pittaja Anubandh*, 10% patients were of *Pittapradhana Vataja Anubandh Prakriti* and the least number of patients had *Pittapradhana Vataja Anubandh .Prakriti* i.e. 4.3%.Observations on various clinical features showed that the main presenting complaints of the patients were Polyuria (*Prabhutmutrata*), Burning Sensation In Hands And Legs *(Karpaddaha*), Laziness *(Alasya*), Excessive Hunger *(Atikshudha*), Numbness In Palm And Foot *(Karapadasuptata*), Dryness In Mouth *(Gala Talu Shosha*), Cramps *(Pindikodveshtana*), Excessive Thirst *(AtiPipasa*). It was also observed Polyuria *(Prabhutmutrata*), Laziness *(Alasya)* and Excessive Thirst *(Atipipasa)* were seen in 70 percent of patients.

Intra and Inter group cpmparison of Subjective Parameters

Table 1: Effect of *Prakriti* specific Herbal Tea treatment (Group A) in subjective parameters

Subjective parameters	BT	AT	P value (t test)	Percentage of relief
Prabhutmutrata (Polyuria)	2.744 ± 1.117	0.6103 ± 0.5916	< 0.0001	76%
Avilamutrata (Turbidity In Urine)	0.976 ± 0.871	0.9108 ± 0.4328	0.0532	0.06%
Karpaddaha (Burning Sensation In Hands And Legs)	1.063 ± 1.8012	0.8 ± 0.5214	0.034	24%
Madhuryamasya (Sweet Taste In The Mouth)	1.9876 ± 1.7654	0.7691 ± 0.4328	0.069	61%
Alasya (Laziness)	3.694 ± 2.7319	1.0621 ± 0.9761	0.0003	68%
Nidraadhikya (Excess Sleep)	3.102 ± 2.430	1.872 ± 1.209	0.0012	41%
Atikshudha (Excessive Hunger)	0.925 ± 1.163	0.313 ± 0.987	0.034	65%
Karapadasuptata (Numbness In Palm And Foot)	2.0931 ± 1.9724	1.212 ± 0.921	0.0231	42%
Gala Talu Shosha (Dryness In Mouth)	2.1534 ± 2.0198	0.9213 ± 0.8162	0.0009	57%
Pindikodveshtana (Cramps)	1.9501 ± 2.0198	0.9213 ± 0.8162	0.047	52%
Ati Pipasa (Excessive Thirst)	0.925 ± 1.163	0.420 ± 0.987	0.002	55%
Swedadhikya (Excess Perspiration)	3.067 ± 2.9540	1.6120 ± 0.7132	<0.0001	47%

Table 2: Effect on control Group B on subjective parameters

Subjective parameters	BT	AT	P value (t test)	Percentage of relief
Prabhutmutrata (Polyuria	1.983 ± 1.093	1.054 ± 0.9324	0.0034	47%
Avilamutrata (Turbidity In Urine)	1.165 ± 1.076	1.143 ± 0.9324	0.0671	0.013%
Karpaddaha (Burning Sensation In Hands And Legs)	0.9231 ± 0.8071	0.4359 ± 0.5980	0.0241	55%
Madhuryamasya (Sweet Taste In The Mouth)	0.9231 ± 0.8071	0.4359 ± 0.5980	0.0431	52%
Alasya (Laziness)	3.4231 ± 2.9990	2.339 ± 2.5980	0.972 (NS)	40%
Nidraadhikya (Excess Sleep)	3.001 ± 2.013	2.273 ± 1.9780	0.065 (NS)	24%
Atikshudha (Excessive Hunger)	1.091 ± 1.002	0.8621 ± 0.9901	0.620 (NS)	21%
Karapadasuptata (Numbness In Palm And Foot)	1.894 ± 1.221	0.4320 ± 0.8710	0.0003 (HS)	67%
Gala Talu Shosha (Dryness In Mouth)	2.0913 ± 1.6743	1.5462 ± 0.8023	0.0678 (NS)	25%
Pindikodveshtana (Cramps)	1.5927 ± 1.1603	1.4462 ± 0.8023	0.854 (NS)	10%
Ati Pipasa (Excessive Thirst)	0.9231 ± 0.8071	0.4359 ± .5980	0.0021	55%
Swedadhikya (Excess Perspiration)	2.4137 ± 2.9013	1.9820 ± 0.8120	0.067 (NS)	20%

Intra and Inter Group Comparison of Objective Parameters

Objective Parameters

Table 3: Effect of Trial Treatment on Fasting Blood Sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value	Response Calculation
Group A	196.8 ± 78	161.5 ± 45.94	142.7 ± 31.90	134.9 ± 25.08	<0.0001 (ANOVA)	31.4%
Group B	193.8 ± 71.48	187.1 ± 69.18	170.1 ± 61.21	175.25 ± 61.47	0.6308 (ns) (ANOVA)	9.5%
Between the group	P value =< 0.0001 (HS) (t test)					

Fig. 1: Effect of Trial Treatment on Fasting Blood Sugar

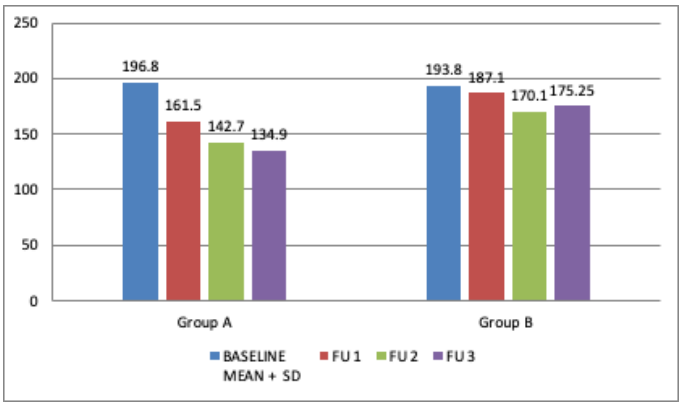

Fig. 2: Post Prandial Blood Sugar

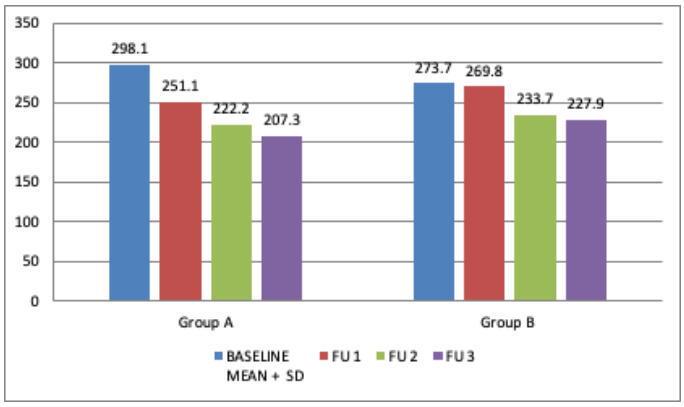

Table 4: Post Prandial Blood Sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value	Response Calculation
Group A	298.1 ± 76.44	251.1 ± 76.44	222.2 ± 49.24	207.3 ± 56.94	<0.0001(HS) (ANOVA)	30.4%
Group B	273.7 ± 99.19	269.8 ± 99.95	233.7 ± 72.31	227.9 ± 67.71	0.0448(s) (ANOVA)	16.7%
Between the group	P value = <0.0001 (HS) (t test)					

Table 5: Glycated Hemoglobin HbA_1C

	Baseline Mean ± SD	After Treatment	P Value (t test)
Group A	9.515 ± 2.297	8.145± 1.637	<0.0001
Group B	8.985± 4.761	8.113± 2.891	0.0029
Between the Group	P value = 0.0382 (S) (t test)		

Fig. 3 : Glycated Haemoglobin HbA_1C

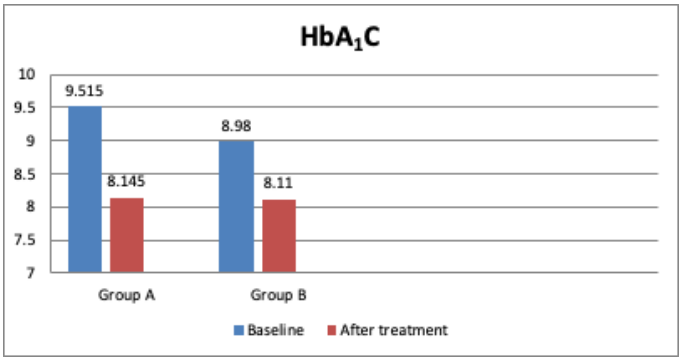

Fig.4: Urine Fasting Glucose

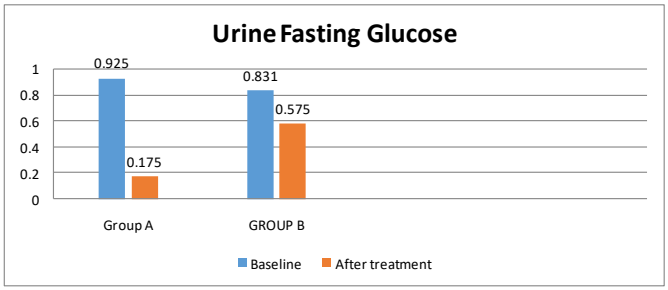

Table 6: Urine Fasting Glucose

	Baseline Mean ± SD	After Treatment	P Value (t test)
Group A	0.925± 1.163	0.1750± 0.3848	<0.0001(HS)
Group B	0.863± 1.961	0.5750± 0.848	0.0003(Hs)
Between the group	P value = 0.0371(S) (t test)		

Intra and Inter Group Comparison of Kapha Prakruti Patients
Objective Parameters
Table 7: Fasting Blood Sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value (ANOVA)
Group A	200.6 ± 71.41	163.4 ± 40.09	147.6 ± 32.50	139.3 ± 28.18	<0.0001(HS)
Group B	199.8 ± 77.10	194.9 ± 77.93	184.9 ± 61.21	174.4 ± 52.48	0.0171(S)
Between the group	P value = 0.0362 (S)(t test)				

Table 8: Post prandial blood sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value (ANOVA)
Group A	324.8± 111.1	255.0 ± 75.11	231.8 ± 48.20	206.5 ± 57.54	<0.0001(HS)
Group B	330.8 ± 97.40	328.7 ± 98.90	291.1 ± 54.44	279.2 ± 49.04	0.0303(S)
Between the group	P value = 0.0632 (NS)(t test)				

Table 9: Glycated haemoglobin HbA_1C

Groups	Baseline Mean ± SD	After Treatment	P Value (t test)
Group A	10.19 ± 8.66	8.66± 1.76	0.0005
Group B	9.348± 6.61	8.113± 2.891	0.0369
Between the Group	P value = 0.045 (S) (t test)		

Intra and Inter Group Comparison of *Vata Prakruti* Patients
Objective Parameters
Table 10: Fasting Blood Sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value (ANOVA)
Group A	182.1 ± 87.25	158.7 ± 54.85	135.2 ± 29.07	127.7 ± 18.18	0.0019(S)
Group B	155.2 ± 71.41	148.7 ± 40.09	147.1 ± 32.50	143.1 ± 40.68	0.0378(S)
Between the group	P value = 0.0362 (S)(t test)				

Table 11: Post prandial blood sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value (ANOVA)
Group A	267.2 ± 95.1	244.4 ± 84.52	204.2 ± 52.90	211.4 ± 60.37	0.0053(S)
Group B	232.7 ± 76.80	226.8 ± 76.40	195.8 ± 60.36	193.7 ± 58.84	<0.0001(HS)
Between the group	P value = 0.094 (N S)(t test)				

Table 12: Glycated haemoglobin HbA_1C

	Baseline Mean ± SD	After Treatment	P Value (t test)
Group A	9.09 ± 7.14	8.98± 5.76	0.0293(NS)
Group B	9.14± 8.51	9.01± 6.88	0.692(S)
Between the Group	P value = 0.911(NS) (t test)		

Intra and Inter Group Comparison of Pitta *Prakruti* Patients
Objective Parameters
Table 13: Fasting Blood Sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value (ANOVA)
Group A	200.6 ± 71.41	163.4 ± 40.09	147.6 ± 32.50	183.3 ± 28.18	0.932(NS)
Group B	199.8 ± 77.10	194.9 ± 77.93	184.9 ± 61.21	174.4 ± 52.48	0.0201(S)
Between the group	P value = 0.921 (NS)(t test)				

Table 14: Post prandial blood sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value (ANOVA)
Group A	280.8± 92.1	261.0 ± 89.12	290.8 ± 61.20	269.5 ± 45.24	0.710(NS)
Group B	305.8 ± 80.10	301.4 ± .93	291.1 ± 54.44	280.2 ± 35.64	0.020(S)
Between the group	P value = 0.610 (NS)(t test)				

Table 15: Glycated haemoglobin HbA_1C

Groups	Baseline Mean ± SD	After Treatment	P Value (t test)
Group A	8.14 ± 8.06	8.72 ± 3.72	0.639
Group B	9.810± 7.31	9.713± 2.41	0.402
Between the Group	P value = 0.914 (NS) (t test)		

SUBJECTIVE PARAMETERS

Intra and Inter Group Comparison of *Kapha Prakruti* Patients

Table 16: Effect of Trial Treatment on Polyuria *(Prabhutamutrata)*

Groups	*Prabhuta Mutrata* MEAN ± SD		P Value (t test)	Percentage of relief
	BT	AT		
Group A	3.214 ± 1.019	0.291 ± 0.671	< 0.0001	90%
Group B	2.902 ± 1.193	1.820 ± 0.719	0.437	36%
Between the group comparison	P value =< 0.0001(t test)		HS	

Table 17: Effect of Trial Treatment on Laziness (*Alasya)*

Groups	*Alasya* MEAN ± SD		P VALUE (t test)	Percentage of relief
	BT	AT		
Group A	3.001 ± 1.934	0.491 ± 0.602	< 0.0001	83%
Group B	2.313 ± 1.213	1.261 ± 0.861	0.0017	45%
Between the group comparison	P value =< 0.0001(t test)	HS		

Table 18: Effect of Trial Treatment on Excessive Eating (*Atikshudha)*

Groups	*Atikshudha* MEAN ± SD		P VALUE (t test)	Percentage of relief
	BT	AT		
Group A	2.905 ± 1.810	0.491 ± 0.602	< 0.0001	83.1%
Group B	2.973 ± 1.213	1.261 ± 0.861	0.0032	56%
Between the group comparison	P value =< 0.0001(t test)	HS		

INTRA AND INTER SUB GROUP COMPARISION OF *VATA PRAKRITI* PATIENTS

Table 19: Effect of Trial Treatment on *Prabhutamutrata* (Polyuria)

Groups	*Prabhuta Mutrata* MEAN ± SD		P VALUE (t test)	Percentage of relief
	BT	AT		
Group A	3.924 ± 1.18	0.183 ± 0.934	< 0.0001	90%
Group B	2.810 ± 0.713	1.634 ± 0.451	0.078	37%
Between the group comparison	P value =< 0.0001(t test)		HS	

Table 20: Effect of Trial Treatment on *Daurbalya* (Weakness)

Groups	*Daurbalya* MEAN ± SD		P VALUE (t test)	Percentage of relief
	BT	AT		
Group A	2.905 ± 2.18	0.870 ± 0.918	< 0.0001	69%
Group B	2.134 ± 1.17	1.851± 0.621	0.0401	13%
Between the group comparison	P value =< 0.0001(t test)		HS	

Intra and Inter Sub Group Comparison of Pittaprakruti Patients

Table 21: Effect of Trial Treatment on *Swedadhikya* (Excessive Perspiration)

Groups	*Swedadhikya* MEAN ± SD		P VALUE (t test)	Percentage of relief
	BT	AT		
Group A	1.981 ± 1.206	0.195 ± 0.721	< 0.0295	90.4%
Group B	2.171 ± 1.920	1.973 ± 0.416	0.437	9%
Between the group comparison	P value =< 0.0001(t test)		HS	

Table 22: Effect of Trial Treatment on *Daurbalya* (Weakness)

Groups	*Daurbalya* MEAN ± SD		P VALUE (t test)	Percentage of relief
	BT	AT		
Group A	2.193 ± 2.02	0.951 ± 0.932	< 0.0001	56%
Group B	2.296 ± 1.831	0.193 ± 0.821	0.0003	91.4%
Between the group comparison	P value =< 0.0001(t test)		HS	

Table23: Effect of Trial Treatment on *Karpadadaha* (burning sensation in hand and feet)

Groups	*Karpadadaha* MEAN ± SD		P VALUE (t test)	Percentage of relief
	BT	AT		
Group A	2.182 ± 1.962	1.061 ± 0.692	< 0.004	47%
Group B	2.567 ± 1.819	2.791 ± 0.813	0.921	-
Between the group comparison	P value =< 0.0001(t test)		HS	

Inter subgroup comparison of *Vata* and *Kapha* HerbalTea in Group A

Table 24: Fasting blood glucose

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value
Group A *Vata Prakriti* tea	182.1 ± 87.25	158.7 ± 54.85	135.2 ± 29.07	127.7 ± 18.18	0.0019(S) (ANOVA)
Group A *Kapha Prakriti* tea	200.6 ± 71.41	163.4 ± 40.09	147.6 ± 32.50	139.3 ± 28.18	<0.0001(HS) (ANOVA)
Between the *Prakriti*	P value = 0.572 (NS) (t test)				

Table 25: Post prandial blood sugar

Groups	Baseline Mean ± SD	FU 1	FU 2	FU 3	P Value
Group A *Vata Prakriti* tea	267.2 ± 95.1	244.4 ± 84.52	204.2 ± 52.90	211.4 ± 60.37	0.0053(S) (ANOVA)
Group A *KaphaPrakriti tea*	324.8± 111.1	255.0 ± 75.11	231.8 ± 48.20	206.5 ± 57.54	<0.0001(HS) (ANOVA)
Between the group	P value = 0.078 (NS) (t test)				

Table 26: Glycated haemoglobin A1c

Groups	Baseline Mean ± SD	After Treatment	P Value (t test)
Group A *Vata Prakriti tea*	9.09 ± 7.14	8.98± 5.76	0.0293
Group A *KaphaPrakriti tea*	9.348± 6.61	8.113± 2.891	0.0369
Between the Group	P value = 0. 721(NS) (t test)		

Table 27: *Prabhutamutrata* (Polyuria)

Groups	*Prabhuta Mutrata* Mean ± SD		P Value (t test)	Percentage of relief
	BT	AT		
Group A *Vata Prakriti* tea	3.214 ± 1.019	0.291 ± 0.671	< 0.0001	90%
Group A *Kapha Prakriti* tea	3.924 ± 1.18	0.183 ± 0.934	< 0.0001	94%
Between the group comparison	P value =< 0.0001(t test)	HS		

Discussion

The *Prakriti* approach is adopted for assessment of proneness of the disease (7), diagnosis and treatment to incorporate appropriate diet plan and regimen.In the present study 45.3 % *Kapha Pradhana prakriti (KaphaVatapradhana* =28 %, *Kaphapittapradhana prakriti* =17.3 %) patients were found. This shows that Diabetes Mellitus correlated to *Prameha Kaphapradha vyadhi* is prevelant in *Kapha prakriti* individuals. This is similar to study conducted in SDM Hassan, in which 83 % *Kapha Pradhana prakriti (KaphaVatapradhana* = 48%, *Kaphapittapradhana prakriti* =35 %) patients were found (7). If proper *Kaphahara* diet and lifestyle is implemented since childhood properly, incidence can be reduced to marked extent.

In the present study the intragroup comparison findings between Herbal Tea group and control group were found highly significant in Fasting, (fig 1) Post Prandial Blood Glucose (fig 2) and HbA_1C (fig 3). Reduction in Urine Glucose showed significant results with p value 0.0371. (fig 4). Serum Cholesterol and Serum Triglyceride values were found nonsignificant as the values were within normal range.

Role of *Kapha* Herbal Tea in *Kaphapradhana Prakriti* Diabetes Patients

Kapha has *Madhura (*Sweet*), Sheeta (*Cold), *Sthira (*Stable), *Pichilla (*slimmy), *Guru* (Heavy) properties, the ingredients used in *Kapha* Herbal Tea were *Katu* (pungent*), Tikta (*bitter), *Kashya (*astringent) *Rasa Pradhana*, *Laghu (*light*), Ushna (hot), Kapha* or *Tridoshashamak* and *Mehahara* (antidiabetic*)* properties. Research studies on *Sunthi* (*Zingiber officinale Roxb)* shows that it is a potent treatment for Diabetes Mellitus. The intra and inter group comparison of *Kaphaja* Herbal Tea on fasting blood glucose was highly significant with p value < 0.0001 and 0.0362 respectively (Table7). This effect seen may be contributed to the effect of ginger as seen in previous study which shows 24-53% reduction of fasting blood Glucose (8). *Twak* (9) and *Jambu* both have significant effect on fasting glucose levels seen both in animal studies and Randomized controlled trials, one of the study observed a statistically significant reduction (P < 0.001) by 10.6% in the mean fasting blood glucose levels (10). Clove (*Syzygium aromaticum Linn.)* flower buds extract significantly reduce the blood glucose level in Type 2 Diabetic KK-A(y) mice (11) Similarly the intra group comparison of *Kaphaja* Herbal Tea in group A on post prandial blood sugar was highly significant with p value < 0.0001.(Table 8).This reduction in post prandial Blood Sugar levels probably seen with the effect of *Meshashringi (Gymnema sylvestre).* The mode of action of the drug is through stimulation in insulin secretion from pancreas(12) Stem bark of Ceylon cinnamon (*Twak*) Cinnamtannin B1, activates the phosphorylation of the insulin receptor β-subunit on adipocytes as well as other insulin receptors (13). Further the action of herbs like *Jambu (*14*), Lavanga (*15), *Tulasi (16)* on PPBS is seen in various studies with potent reduction of 17.6% and 7.3% in the levels of fasting and postprandial blood glucose, respectively. Activities of *Myristica fragrans Houtt* nutmeg have also reported to its insulin-like biological activity (17) The effect of the *Gymnema sylvestre* leaf extracts are highly beneficial for subjects suffering from Diabetes mellitus and is synonymous to 4 unit/kg of Insulin (18) *Piperine* for 2 weeks partially protects against Diabetes induced oxidative stress (19) The aqueous extract of leaves of *Ocimum sanctum Linn.* showed the significant reduction in Blood Sugar level in both normal and *Alloxan* induced diabetic rat(20).The values of HbA_1C were highly significant on intra group comparison of *Kaphaja* Herbal Tea in group A (Table 9). The reduction of Glycated Haemoglobin level is found probably due to effect of cinnamon which demonstrated HbA_1C reduction of 40.2 % in cinnamon treated rats compared to untreated Diabetic Rats(21)Cinnamon (*Cinnamomum zeylanicum Breyn) is* dietary component that has been shown to contain biologically active substances that have insulin-mimetic properties and regulate blood glucose, it enhances glucose uptake by activating insulin receptor kinase activity, auto-phosphorylation of the insulin receptor and glycogen synthase activity. The cinnamon extracts shown better Glycaemic control in Diabetes-induced animals as demonstrated by the stable HbA1c in the cinnamon group as opposed to the Diabetic control group (22). However results were non-significant in inter group comparisons.

Role of *Vata* Herbal Tea in *Vatapradhana Prakriti* Diabetes Patients

The second highest prevalent *Prakriti* is seen in the present study was *Vata Pradhana prakriti which is* 44 % *(VataKaphapradhana* = 24%, *Vatapittapradhana prakriti* = 20%). This shows the importance of vata in Diabetes Mellitus which is *Kapha Vata Anubandh Tridoshja vyadhi* and as it is said that *Madhumeha i*s the last subtype of *Vataja Prameha*. *Vata* due to its *Ruksha* (dry*), Laghu (*light) *Guna* deteriorate the *Dhatus* which causes either *Avarana or Kshaya* of *Dhatus* leading to *Madhumeha* which becomes incurable due to lots of complications.Hence balancing of vata is equally important in management of disease.

The ingredients used in *Vata* Herbal Tea having *Vatapradhana doshashamaka* or *Tridoshashamaka* properties. Few Ingredients of *Vata* Herbal Tea are same as in *Kapha H*erbal tea due to their same *Doshashamaka* action like *Sunthi, Meshashringi, Jatiphala*, *Lavanga, Tulasi*, these all are potent antidiabetic herbs as discussed earlier. Further, other ingredients. A single study by Barros et al (23) reported that fennel can improve rat glucose tolerance.Similarly the *Tagar* (*Valeriana wallichii)* plant also possesses Anti-Diabetic properties thus can be used for treating individuals suffering from Diabetes (24). A recent systematic review and meta-analysis of valerian evidenced, that valerian is a safe herb associated with only rare adverse events (25) Another spice is *Tejapatra* (*C. tamala*), extract of *C. tamala* exhibit significant antihyperglycemic activities in STZ-induced rats. The extract also showed improvement in lipid profile, body weight and oral glucose tolerance test (OGTT) results, hence might be valuable in Diabetes (26).The intra group comparison of *Vata* Herbal Tea in Group A on Fasting Blood sugar was highly significant with p value < 0.0001 and maximum difference in mean values were observed (Table 10). The observed results in Group A is due to the antidiabetic effect of *Tulasi , Sunthi , Lavanga ,Tagar* as discussed earlier. The effect of the *Gymnema sylvestre* leaf extracts is synonymous to 4 unit/kg of insulin thus highly beneficial for individuals suffering from Diabetes Mellitus (27), The leafs of *Cinnamomum tamala* leaves showed significant results in diabetic rats (28) further the extract of *Cuminum cyminum* possesses anti-diabetic effect in Diabetic Rats through reduction of Plasma Glucose levels and elevation of insulin in plasma (29). The results on postprandial blood sugar were found significant in Herbal Tea group (Table 11) which is seen due to effective Anti hyperglycemic effect of *Ela* (Elaterria *cardomum Maton)* as supplementation by suppression of α-amylase and α-glucosidase enzymes may regulate glucose metabolism (30) in addition to the other antidiabetic herbs used in *Vata* tea as mentioned earlier. Similarly the intra group comparison of HBA_1C in *Vata* Herbal Tea in group A was significant (Table 12). This antidiabetic effect may be achieved by cumin seeds which has marked results on HbA_1C reduction along with lipid profile (31) levels. Along with it another herb *Myrstica fragnansHoutt* evidenced significant reduction of glucose and triglyceride (TG) levels (maximal effect of 53% reduction of glucose) (32).

Role of *Pitta* Herbal Tea in *Pittapradhana Prakriti* Diabetes Patients

Pitta is the most important factor responsible for *Samagni*. Metabolism is regulated by pitta only. One study describes the concept of *Prakriti* in aging stating that the pitta predominance *Prakriti* type individuals have high basal metabolic rate (BMR) and energy consumption leading to tissue destruction and premature aging and average life span, while *Kapha* predominance *Prakriti* type have a tendency to delayed manifestation of aging and longer life span(33). Diabetes is a metabolic disease which is initiated by *Agnimandya* leading to Ama formation that result in *Apachita Dhatus* and finally the disease. As stated earlier in this study while assessing the *Prakriti* of the subjects enrolled *Pittaanubandha* is seen in 50 percent of the cases, although *Pitta Pradhana Prakriti* subjects were less, *Pittakaphaja* - 4% and *Pitta Vataja* - 6%.

The ingredients of P*itta* Herbal Tea were not very *Ushna, Tikshna* to balances the *Prakritidosha,* but the ingredients are mainly *Agni Deepana, Pachana* and *Tikta Kashaya Rasa Pradhana*. The Herbs have *Pittahara, Tridoshara* Properties. The major ingredient of this tea is *Asana* (*Pterocarpus marsupium Roxb*.) is called *Rasayana* (34). In Ayurveda, aqueous extract of heart-wood of *P. marsupium* is used in treatment of Diabetes (35) Although there are several reports on *P. marsupium* as Anti-Diabetic (36)(37)(38).

According to Acharyas, *Nishaamalak*i is described as a potent treatment for Diabetes mellitus.The spice Turmeric, which is derived from the root of the plant *Curcuma longa Linn.* Administration of various dosages of curcumin in rat models were able to prevent body weight loss, reduce the levels of Glucose, Haemoglobin, and Glycosylated Haemoglobin (HbA1c) in blood (39), and improve insulin sensitivity(40) (41). Another study on coriander leaf and stem extract showed a significant reduce in the blood glucose levels and blood lipids as the total cholesterol, TC, VLDL, LDL Kar et al.(42), has reported that ethanol extract of *Ficus racemosa* (250 mg/kg/day, once, twice, and thrice daily, per oral normalized the blood glucose, lowered the urine sugar, and helped it to reach a level of zero within two weeks, in alloxan-induced diabetic albino Wister rats(43).

In the present study the results of Fasting, (Table 13). Postprandial Blood Glucose (Table 14). and HbA1c(Table 15) found non-significant due to very less sample of *Pitta Pradhana prakriti.*

Role of *Prakriti* specific Herbal Tea on Subjective Parameters

***Kapha* Herbal Tea**

In present study there is highly significant improvement in *Prabhutamutrata* (Table 16) and *Alasya*(Table 17) and *Atikshudha*(Table 18)in group A. This result on *Prabhutamutrata* is propably seen due to *Kashaya rasa* and *Sangrahi guna*of*Jambu (Syzyzium cumini Linn.*)and *Tikta* rasa of Bilwa Patra along with *Mehahara* properties of *Meshashringi. Laghu* (light), *Ruksha* (dry) , *Ushna* (hot) and *Kapha Shamak* properties of *Brihatela , Lavanga , Twak , Sunthi And Tulasi* may acted upon the *Alasya guna* which is due to increase *Guruta* and Kapha in body. *Sunthi* and *Kali Mirch*, which are *Pachana Dravyas* may influence the metabolism and hence due to correction of Agni patients feels *Kshudha* on proper time with normal frequency. *Kashaya Tikta Rasa* of ingredients cause early satiety hence could prevent overeating.

***Vata* Herbal Tea**

This study reveals that there is significant improvement in *Prabhutamutrata* (Table 19) *due to*

Kashaya and *Tikta Rasa* of major ingredients like *Jeeraka, Patra,* causes reduction in urine quantity and frequency. The ingredients like *Sunthi which is Vrishya by Prabhava, Tulasi* has immune booster properties. *Further herbs* like *Ela (44) Jeeraka(45)* enhances antioxidants in body causing diminishing of symptoms like *Daubalya* (Table 20).

***Pitta* Herbal Tea**

In subjective parameters there is improvement in *Swedadhikya* (Table 21)., *Karpadaha*,(Table 22) and *Daurbalya* (Table 23)in Group A. The activity of *Asana* and *Haridra* which are *Katu, Kashaya* may reduce perspiration .The burning sensation of hands and feet may be reduced due to *Shheeta* properties of *Mishreyak, Asana, Udumbara,* and *Ela.* In addition, Antioxidant effect of *Haridra, Tulasi, Asana and Ela, Mishreya* provide significant result in *Daurbalya.*

Inter sub group comparison of *Vata* and *Kapha* Herbal Tea in Group A (Objective Parameters)

The inter sub group comparison of Fasting (Table 24), Post prandial Blood Sugar(Table 25) and HbA_1C (Table 26) levels between *Kapha* and *Vata* Herbal Tea shows insignificant results with p 0.572 , p 0.078 and p 0.721 respectively. This indicates that both the Herbal Teas are equally effective in management of Diabetes Mellitus, Further it is important to analyse the *Prakriti* before the treatment of any disease which infer the importance of *Prakriti* specific Herbal Tea in the management of Diabetes mellitus.

Intersubgroup comparison between *Kapha* and *Pitta* or *Vata* and *Pitta* could not be calculated due to very small sample of *Piita Prakriti* patients.

Inter sub group comparison of *Vata* and *Kapha* Herbal Tea in Group A (Subjective Parameters)

Prabhuta mutrata was a common symptom which show highly significant results (Table 27) in both the Tea which infer equal effect of both the herbal tea in *Prabhuta mutrata*

Conclusion

Prameha can be correlated with diabetes mellitus, with its increased occurrence in *Kapha Pradhana Prakriti* followed by *Vata Pradhana Prakriti*. Hence, preventive measures should be adopted from early life among Kapha and Vata pradhana Prakriti individuals. Inter subgroup comparison showed, significant improvements in both objective and subjective parameters among all three Herbal teas. The *Kapha* Herbal tea has higher efficacy followed by *Vata* Herbal tea. *Pitta* Herbal tea the results were statistically not significant, however symptomatic relief was observed in most of the cases. These differences may be due to small sample size. Significant reduction in Fasting Blood sugar, Post prandial Blood Sugar, HbA1C, Urine fasting glucose was observed in Group A (Trial) as compared to Group B (Control). Prakriti specific herbal tea is simple formulation with no reported adverse effects and cost effective. Hence, tea can be substituted with Herbal tea for better management and control of disease.

References

1. Bommer C , Global Economic Burden of Diabetes in Adults: Projections From 2015 to 2030.,Diabetes Care. 2018 May; 41(5):963-970.
2. Charaka Samhita by Agnivesha with 'Vidyotini Hindi Commentary by Pt. Kashinath Shastry and Dr. Gorakhnath Chaturvedi, Part 1, Chaukhamba Bhauati Academy, Varanasi, reprint 2011, page 630
3. Charaka Samhita with 'Vidyotini Hindi Commentary by Pt. Kashinath Shastry and Dr. Gorakhnath Chaturvedi, Part 2, Chaukhamba Bhauati Academy, Varanasi, reprint 2011, Page 233
4. Akshay A. Agarwal, Pradeep R. Jadhav, and Yeshwant A. Deshmukh, Prescribing pattern and efficacy of anti-diabetic drugs in maintaining optimal glycemic levels in diabetic patients , J Basic Clin Pharm. 2014; 5(3): 79–83.
5. Rastogi Sajneev, Development and validation of a Prototype Prakriti Analysis Tool (PP AT):Inferences from a pilot study, AYU journal,2012, 33(2): 209-218
6. Clinical Evaluation Of Varadi Kwatha In The Management Of Madhumeha (Type-2 Diabetes Mellitus) - An Attempt To Provide Evidence Based Data To The Classical Therapeutic Claims,Gyaneshwarsing Guddoye,1 B.K. Dwibedy2 And O.P. Singh3, J Res Educ Indian Med, Jan.-March 2014; Vol. Xx (1): 37-44
7. Pdt. Harisadashivshashtri paradkar, Astanga Hridaya SarvangaSundara vyakhya and ayurveda rasayana Tika , Varanasi: Chaukhambha Surbharati Prakashan;2016: Sutra 12/67-68.
8. Annie M sithara et al , a cross sectional survey to analyse Deha prakruti and the major risk factors of type 2 Diabetes Mellitus, international journal research Ayurveda pharmacy , 2015; 6/6: 714-719
9. Minpai kiloda et al ,Hypoglycaemic effects of clove (Syzygium aromaticum flower buds) on genetically diabetic KK-A y mice and identification of the active ingredients, Journal of Natural Medicines 2012, 66 (2): 394-9
10. UK Prospective Diabetes Study (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33) Lancet. 1998;352: 837–53
11. Leigh Broadhurst C, Marilyn M. Polansky, Richard A. Anderson. Insulin like Biological Activity of Culinary and Medicinal Plant Aqueous Extracts in vitro. J. Agric. Food Chem. 2000; 48:849−852.
12. Tiwari P, Ahmad K and Hassan Baig M. (2017). Gymnema sylvestre for diabetes: from traditional herb to future's therapeutic. Current pharmaceutical design, 23(11), 1667-76.
13. Krishnapura Srinivasan, Black Pepper (Piper nigrum) and Its Bioactive Compound, Piperine,

Molecular Targets and Therapeutic Uses of Spices, May 2009:25-64.

14. Vats V., Grover J.K., Ra,thi S.S. Evaluation of anti-hyperglycaemic and hypoglycaemic effect of *Trigonella foenum-graecum Linn*, *Ocimum sanctum Linn* and *Pterocarpus marsupium Linn* in normal and alloxanized diabetic rats. J. Ethnopharmacol. 2002; 79:95–100
15. Ojewole JAO. Analgesic, anti-inflammatory and hypoglycaemic effects of ethanol extract *of Zingiber officinale* (Roscoe) rhizomes (Zingiberaceae) in mice and rats. Phytotherapy Research. 2006; 20 (9):764–772.
16. Ojewole JAO. Analgesic, anti-inflammatory and hypoglycemic effects of ethanol extract of *Zingiber officinale* (Roscoe) rhizomes (Zingiberaceae) in mice and rats. Phyto. Res. 2006; 20: 764-772
17. Priyanga Ranasinghe et al *Cinnamomum zeylanicum* (Ceylon cinnamon) as a potential pharmaceutical agent for type-2 diabetes mellitus: study protocol for a randomized controlled trial, September 2017, 18: 446
18. Jeyaraj S. Effect of jamun seed powder supplementation on the body mass index and fasting plasma glucose levels in woman with type 2 diabetes mellitus. Panacea J Health Sci 2012; 3:16-20.
19. Patel SS, Shah RS, Goyal R, Anti-hyperglycaemic, anti-hyperlipidemic and antioxidant effects of Dihar, a polyherbal ayurvedic formulation in streptozotocin induced diabetic rats.,Indian J Exp Biol. 2009 Jul; 47(7):564-70
20. Taher M, Fadzilah Adibah AM, Mohomad RS. A proanthocyanidin from *Cinnamomum zeylanicum* stimulates phosphorylation of insulin receptor in 3 T3-L1 adipocytes. J Teknologi. 2006; 44: 53–68.
21. Mandlik R.V., Desai S.K., Naik S.R., Sharma G., Kohli R.K. Antidiabetic activity of a polyherbal formulation (DRF/AY/5001) Indian J Exp Biol. 2008;46(8):599–606.
22. Khathi A, et al., Effects of Syzygium aromaticum-derived triterpenes on postprandial blood glucose in streptozotocin-induced diabetic rats following carbohydrate challenge. PLoS One. 2013 Nov 22; 8(11): 81632
23. Agrawal P1, Rai V, Singh RB, Randomized placebo-controlled, single blind trial of holy basil leaves in patients with noninsulin-dependent diabetes mellitus., Int J Clin Pharmacol Ther. 1996Sep;34 (9):406-9
24. Subash Babu P, Prabuseenivasan S, Ignacimuthu S. Cinnamaldehyde--a potential antidiabetic agent. Phytomedicine. 2007; 14(1):15–22.
25. Ahmed AS, Ahmed Q, Saxena AK, and Jamal P. Evaluation of in vitro antidiabetic and antioxidant characterizations of *Elettaria cardamomum (L.) Maton (Zingiberaceae), Piper cubeba L. f. (Piperaceae)*, and *Plumeria rubra L. (Apocynaceae*). Pak. J. Pharm. Sci. 2017; 30(1), 113–126
26. Barros L, Heleno SA, Carvalho AM, Ferreira IC. System-atic evaluation of the antioxidant potential of different parts of *Foeniculum vulgare Mill* from Portugal. Food Chem Toxicol.2009; 47 (10):2458-64.
27. Krishnat S Yadav, Characterization of Anti-Diabetic Herbs & Its Potential Agents in Indian Species: A Review, IOSR Journal of Dental and Medical Sciences 16(2, Version III) February 2017:70-78 ·
28. Taibi DM, Landis CA, Petry H and Vitiello MV. (2007). A systematic review of valerian as a sleep aid: safe but not effective. Sleep Medicine Reviews, 11(3), 209 -30.
29. Usha Chakraborty and Hariswami Da, Antidiabetic and Antioxidant Activities of *Cinnamomum tamala* Leaf Extracts in Stz-Treated Diabetic Rats, Global Journal of Biotechnology & Biochemistry 2010 ,5 (1): 12-18
30. Doha Abdou Mohamed, Ibrahim Mohamed Hamed and Karem Aly Fouda ,Anti-oxidant and Antidiabetic Effects of Cumin Seeds Crude Ethanol Extract , Journal of Biological Sciences 2018 Volume 18(5): 251-259
31. D.K. Arulmozhi, R. Kurian, A. Veeranjaneyulu & S.L. Bodhankar, Antidiabetic and Antihyperlipidemic Effects of Myristica fragrans. in Animal Models, journal of pharmaceutical biology, Oct 2008, Pages 64-68
32. Ahmed AS, Ahmed Q, Saxena AK, Jamal P.,Evaluation of in vitro antidiabetic and antioxidant characterizations of *Elettaria cardamomum (L.) Maton (Zingiberaceae), Piper cubeba L. f. (Piperaceae)*, and *Plumeria rubra L. (Apocynaceae),* Pak J Pharm Sci. 2017 Jan;30(1):113-126
33. Purva MC, Meena MS. A review on role of Prakriti in aging. AYU 2011;32: 20–4
34. Govindarajan R, Pushpangadan P, Vijayakumar M. Anti-oxidant approach to disease management and role of rasayana herbs of Ayurveda. J Ethnopharmacol. 2005; 99: 165–78.
35. Rajasekharan S, Tuli SN. Vijayasara, Pterocarpus marsupium in the treatment of madhumeha(diabetes mellitus)-A Clinical trial. J Res Indian Med Yoga Homeo. 1976;11:9–14
36. Dhanabal SP, Suresh B, Kokate CK, Ramanathan M, Kumar EP. Hypoglycemic activity of *Pterocarpus marsupium Roxb*. Phytother Res. 2006; 20: 4–8.
37. Manickam M, Ramanathan M, Jahromi MA, Chansouria JP, Ray AB. Anti-hyperglycemic activity of phenolics from *Pterocarpus marsupium*. J Nat Prod. 1997; 60: 609–10.
38. Kidwai JR, Ahamad F, Khalid P, Khan MM, Chaubey M, Rastogi AK. Hypoglycemic activity of *Pterocarpus marsupium* wood. J Ethnopharmacol. 1991; 35:71
39. Arun N, Nalini N. Efficacy of turmeric on blood sugar and polyol pathway in diabetic albino rats.Plant Foods for Human Nutrition. 2002; 57 (1):41–52.
40. Murugan P, Pari L. Influence of tetrahydrocurcumin on hepatic and renal functional markers and protein levels in experimental type 2 diabetic rats. Basic

and Clinical Pharmacology and Toxicology. 2007; 101 (4):241–245.

41. Wesom kooti et al., The role of medicinal plants in the treatment of diabetes: a systematic review, electron physician 2016;1832-1842
42. Sreelatha S, Inbavalli R (2012) Antioxidant, anti-hyperglycaemic, and antihyperlipidemic effects of *Coriandrumsativum* leaf and stem in alloxan-induced diabetic rats. J Food Sci 77:119-123.
43. Kar A, Choudhary BK, Bandyopadhyay NG. Comparative evaluation of hypoglycaemic activity of some Indian Medicinal Plants in alloxan diabetic rats. J Ethnopharmacol. 2003; 84: 105
44. Ahmed AS, Ahmed Q, Saxena AK, Jamal P.,Evaluation of in vitro antidiabetic and antioxidant characterizations of *Elettaria cardamomum (L.) Maton (Zingiberaceae), Piper cubeba L. f.* (Piperaceae), and *Plumeria rubra L.* (Apocynaceae), Pak J Pharm Sci. 2017 Jan; 30 (1):113-126
45. Doha Abdou Mohamed, Ibrahim Mohamed Hamed and Karem Aly Fouda, Anti-oxidant and Antidiabetic Effects of Cumin Seeds Crude Ethanol Extract , Journal of Biological Sciences 2018Volume 18 (5): 251-259.

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