



## REVIEW ARTICLE

# A QUADRANGULAR APPROACH TOWARDS PREVENTION AND MANAGEMENT OF NON-INSULIN DEPENDENT DIABETES MELLITUS (NIDDM) THROUGH AYURVEDA

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## ABSTRACT

Over the last century human life style and food habits have drastically changed which lead to various diseases. Sedentary life style and stress, in today's life, is the reason for development of metabolic disorders like diabetes mellitus. In *Ayurveda*, Diabetes mellitus can be correlated with *Madhumeha* which is described under the heading of *vataja Prameha*. *Ayurveda* literatures vividly describe about the etiology, pathogenesis, prognosis, complications, and its management and also scientifically attributed the causal relationship of dietary, lifestyle, environmental and genetic factors. The present review, provides an insight about the description of disease *Madhumeha* (diabetes mellitus); *Samprapti* (pathogenesis); *Upadrava* (compilactions) and then its management. *Nidanaparivarjana*; *Pathyaaahara* i.e *katu* (spicy), *tikta* (bitter), *kashaya* (astringent) *rasa*, *ushna* (hot), *laghu* (light), *ruksha* (dry) *guna pradhana aahara dravyas*; *Vihara* (Exercise, Yoga, Mediation); *Aushadhi* (Medicinal herbs) have been described for the prevention and management of *Madhumeha*. Fifteen medicinal plants, described in different Ayurvedic classical texts for their efficacy in the management of *Madhumeha* are screened for antidiabetic activity on different animal experimental models and through clinical studies were presented in a comprehensive way. The observed result may be helpful in planning further scientific studies through quadrangular approach about the efficacy of these plants on prevention as well as management of diabetes.

**Key words:** Diabetes mellitus, metabolic disorder, *Madhumeha*, lifestyle disease, medicinal herbs

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## INTRODUCTION:

Sedentary life style and stressful mental conditions, now a days, have called for many distressing diseases, foremost among them being “diabetes mellitus” – a perfect example for a lifestyle disorder. The number of people suffering from diabetes all over the world is increasing progressively. According to WHO statistics diabetes is the sixth leading cause of disease-related death in the world. The prevalence of diabetes is predicted to double globally from 171 million in 2000 to 366 million in 2030<sup>[1]</sup>.

Diabetes can damage the heart, blood vessels, eyes, kidneys, and nerves. In a multinational study, it is concluded that 50% of people with diabetes die of cardiovascular disease (primarily heart disease and stroke)<sup>[2]</sup>. According to a survey, there will be a 42 percent increase, from 51 million to 72 million, in the developed countries and 70% increase, from 84 to 228 million, in the developing countries<sup>[3]</sup>.

Diabetes mellitus is a chronic metabolic disorder characterized by high blood levels of glucose due to absence of insulin or improper utilization of insulin by target cells<sup>[4]</sup>. Clinical manifestations include Polyuria (excessive urine), Polyphagia (excessive hunger), Polydipsia (excessive thirst), weakness, weight loss, muscle wasting, sensory abnormality, skin pigmentation<sup>[5]</sup>.

In the management of diabetes, oral hypoglycemic medications (e.g. metformin etc.), insulin and lifestyle management are followed. Lifestyle modifications are recommended to control diabetes which includes patient education, dietetic support and controlled physical exercise with the goal of keeping both short-term and long-term blood glucose levels within controlled limits. The most common side effect of these includes weight gain, nausea, rashes and flatulence. Examples of more serious side effects are heart issues, liver damage, or low blood sugar. In spite of tremendous advancement of modern system of medicine i.e. oral hypoglycemic agent and insulin till date, an ideal drug which can cure diabetes is not yet available and still scientists are struggling to search an effective and safe remedy. In this review article an attempt has been made to focus on hypoglycemic plants along with proper diet, meditation, yoga and exercise.

## MATERIALS AND METHODS

Different Ayurvedic classics i.e *Charaka Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*, *Madhava Nidana*, *Yogarantakara* and lexicons (*Nighantus*) were thoroughly reviewed for compiling the relevant data reported about management of diabetes in Ayurveda. Published research data from various research journals and books were referred to gather the

information regarding the available scientific documentation of the role of Ayurveda in the prevention and management of diabetes and its complications. The available data are presented in a scientific manner with regards to *Samprapti* of *Prameha*, *Ahara* (diet), *Vihara* (exercise, yoga) and herbs indicated in *Prameha* and botanical identity and reported activity of herbs in diabetes and other related complications.

#### REVIEW OF LITERATURE:

##### Diabetes mellitus - Ayurveda perspective:

*Prameha* has been correlated with the signs and symptoms of diabetes<sup>[6]</sup>. Amongst the twenty types of *Pramehas* described in Ayurveda, *Madhumeha* caused by vitiation of *vata dosha* has many clinical similarities to the modern day diabetes mellitus. *Madhumeha* consists of two words- '*madhu* and *meha*' where '*madhu*' denotes sweetness and '*meha*' stands for urination. So, the disease in which the urination is having urine quality concordant with *madhu* (honey) in its colour, taste, smell and consistency along with the clinical features of *Prameha* (i.e. increased frequency and quantity of urine) is *Madhumeha*.

The synonyms mentioned for diabetes in Ayurvedic texts are – *Madhumeha*, *Ksaudrameha* and *Ojomeha*. *Madhumeha* is one of the four types of *vataja Pramehas*. *Prameha roga* comprises of a number of

diseases with various physical and chemical changes in urine. *Acharya Madhava* described term *Prameha* as "*Prakarshena Prabhutam Prachuram Varam Varam Va Mehati Mutratyagam Karoti Yasmina Roge Sa Pramehah*"<sup>[7]</sup> which means repeated (*prakarsha*) excessive (*prabhoota*) and turbid urination in terms of frequency, quantity etc. *Madhumeha* included among the *Astamaharoga* (eight major disorders) in *Charaka Samhita*<sup>[8]</sup> which indicates the graveness of the disease described by the *Acharyas*. It seems that disease was quite prevalent among the masses in ancient time and was considered incurable, if not managed.

##### *Samprapti*<sup>[9,10,11]</sup> (Pathogenesis)

The detail of *Samprapti* of *Prameha* has been presented in diagrammatic format in figure-1.

##### Complications:

*Acharya Charaka* enumerated the general complications while *Sushruta* and *Vagbhata* described according to the *dosha* predominance.

##### (1) General complications:

These are *Trisna*, *Atisara*, *Jwara*, *Daha*, *Daurbalya*, *Arochaka*, *Avipaka*, *Putimamsapidaka*, *Alaji* and *Vidradhi*<sup>[12]</sup>.

##### (2) Specific complications<sup>[13]</sup>:

(a) *Kaphajameha* *Janmanam:*  
*Makshikopasarpanam*, *Alasya*, *Mamsopacaya*, *Pratisyaya*, *Shaithilya*, *Arochaka*, *Avipaka*, *Kaphapraseka*, *Chardi*, *Nidra*, *Kasa* and *Swasa*.

**(b)Pittajameha Janmanam:** *Vrsandaavadaran, Bastibheda, Medhratoda, Hrdisula, Amlika, Jwara, Atisara, Arochaka, Vamathu, Paridhupanam, Daha, Murcha, Pipasa, Nidranasa, Panduroga, Pitvidmutranetratva* and *Vidabheda*.

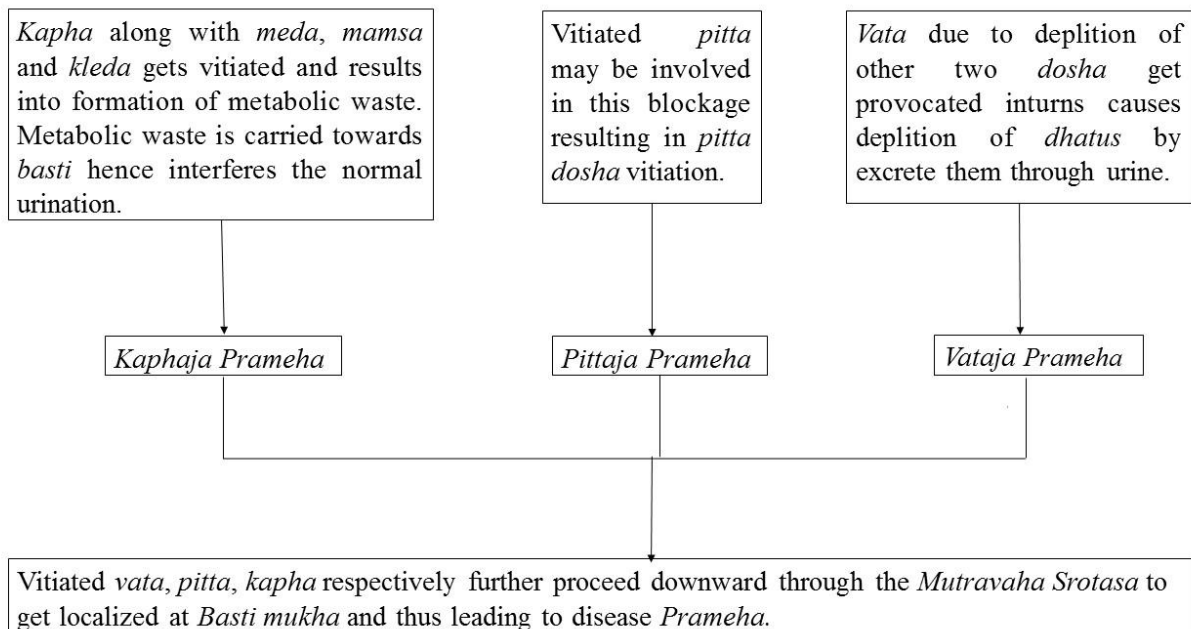
**(c)Vatajameha Janmanam:** *Hridgraha, Laulyam, Anidra, Stambha, Kampa, Sula, Badhapurisetvam, Sosha, Kasa* and *Swasa*.

On long standing, diabetes mellitus leads to many micro and macro vascular complications.

The micro vascular complications of diabetes

mellitus are called “tripathy” which includes retinopathy, nephropathy and neuropathy where macro vascular complications include peripheral vascular disease, cerebro vascular disease and cardio vascular disease. These complications result in increased disability, reduced life expectancy and enormous health cost for virtually every society<sup>[14,15]</sup>.

**Fig. 1:Figure showing Samprapti of Prameha**



**MANAGEMENT OF DIABETES MELLITUS**

**1. Nidanaparivarjana** (Avoidance of etiological factors)

This is the prime treatment principle narrated by every *Acharya* before describing the treatment of every disease. *Acharya Charaka* enumerated that one should avoid all

etiological factors which are causing the disease *Prameha*, avoidance of the etiological factors is the prime treatment<sup>[16]</sup>. One should avoid faulty lifestyle, faulty dietary habit, mental stress, day sleep and awakening in night.

## 2. *Aahara* (Diet)

Diet plays an important role in the management of diabetes as it exerts a direct influence on the blood glucose level. The goal of diet therapy is to maintain and prolong a

healthy, productive and happy life. Diet having *katu* (spicy), *tikta* (bitter), *kashaya* (astringent) *rasa*, *ushna* (hot), *laghu* (light), *ruksha* (dry) *guna pradhana aahara dravyas* should be used in the management of NIDDM.

**Table no. 1: Diet recommended in diabetes according to Ayurveda<sup>[17]</sup>**

<b>Cereals</b>	Old rice ( <i>Oriza Sativa</i> ), Rice which crops within 60 days, Barley ( <i>Hordeum vulgare</i> ), Godhuma ( <i>Triticumaestivum</i> ) etc.
<b>Pulses</b>	<i>Adhaki</i> ( <i>Cajamus cajan</i> ), <i>Kulattha</i> ( <i>Dolichos biflorus</i> ), <i>Mudga</i> ( <i>Vignaradiata</i> ) <i>Chanaka</i> ( <i>Cicer arietinum</i> ) etc.
<b>Vegetables</b>	<i>Green Banana</i> , <i>Tanduleyaka</i> ( <i>Amaranthus spinosus</i> ), bitter vegetables ( <i>Tiktasakam</i> ) like <i>Karvellaka</i> ( <i>Momordica charantia</i> - Bitter gourd), <i>Methika</i> ( <i>Trigonella foenum-graecum</i> - Fenugreek), <i>Patola</i> ( <i>Trichosanthes dioica</i> ) etc.
<b>Fruits</b>	<i>Jambu</i> ( <i>Syzigium cumini</i> ), <i>Kapitha</i> ( <i>Feronia limonia</i> ), <i>Amalaki</i> ( <i>Embllica officinalis</i> ), <i>Tala phala</i> ( <i>Borassus flabellifer</i> ), <i>Kharjura</i> ( <i>Phoenix sylvestris</i> ), <i>Kamala</i> ( <i>Nelumbo nucifera</i> ) etc.
<b>Oils</b>	<i>Ingudi</i> ( <i>Balanitis aegyptiaca</i> ), <i>Atasi</i> ( <i>Linum usitatisimum</i> ) etc.

## 3. *Vihara* (exercise, yoga and meditation)

Obese patients can start with different *asanas*, cleansing processes, *bhastrikapranayama* and relaxation. Lean and thin patients should start with relaxation and *pranayama* (breathing exercises), and practice in a relaxed manner<sup>[18]</sup>. It is important to note that vigorous and hard exercise is contraindicated in lean and weak patients with severe diabetes. In a study, 20 patients with type 2 diabetes mellitus, subjected to 40 days yoga routine by an expert yoga teacher. The postures performed were: *Suryanamaskar* (sun salutation), *Trikonasana* (triangle pose),

*Tadasana* (mountain pose), *Padmasana* (lotus pose), *Bhastrika* Pranayama (breathing exercise), *Pashimottanasana* (posterior stretch), *Ardhmatsyendrasana* (half spinal twist), *Pawanmuktasana* (joint freeing series), *Bhujangasana* (cobra pose), *Vajrasana* (thunderbolt pose), *Dhanurasana* (bow pose), and *Shavasana* (corpse pose). At the end of 40 days of performing the *asanas*, the study participants had a significant decrease in fasting glucose levels, waist-hip ratio and beneficial changes in insulin levels<sup>[19]</sup>.

In another study, 44 Type 2 diabetes mellitus patients were practiced yoga (n = 22) and

pranayama for three continuous months, 1 hour every day in the morning, by a yoga expert. They had significant decrease in FBS, Postprandial blood sugar (PPBS), glycosylated hemoglobin (HbA1c), triglycerides and LDL of test group with  $P < 0.001$ , compared with control group ( $n = 22$ ). The requirement of insulin in the yoga group was also significantly reduced<sup>[20]</sup>.

#### 4. *Aushadhi* (Medicinalherbs)

In Ayurveda, plants are always an excellent source of drugs; in fact many of the presently available modern drugs were derived either directly or indirectly from them. Recently, some medicinal plants have been reported to be useful in diabetes worldwide and have been used empirically as antidiabetic remedies. More than 400 plant species having hypoglycemic activity have been available in literature, however, searching for new antidiabetic drugs from natural plants is still attractive because they contain substances which demonstrate alternative and safe effects on diabetes mellitus. Here fifteen most common herbs have been described which are abundantly available but not frequently using for the treatment of diabetes. A brief description of these plants along with pharmacological and clinical studies which shows antidiabetic and related beneficial effects in *Madhumeha* are given below:

**1. *Amra* (*Mangifera indica* L.):** Common name- Mango [Family: *Anacardiaceae*]

It is mentioned in *Bhavaprakashanighantu* that flowers of *Aamra* is efficacious in *Prameha*<sup>[21]</sup>. The effect of the aqueous extract of the leaves when administered per os on blood glucose level was assessed in normoglycemic, glucose-induced hyperglycemic and STZ-diabetic rats and the results of this study indicated that the aqueous extract of the leaves of *Mangifera indica* possess hypoglycemic activity<sup>[22]</sup>. A significant decrease in mean concentration of plasma glucose two weeks after administration of high (1 g/kg/d) dose of powdered part, aqueous extract and alcoholic extract of leaves of *Mangifera indica* were found<sup>[23]</sup>. In another study, Wadood et al., (2000) found the anti-diabetic effects of alcoholic extract of the leaves of *Mangifera indica* at doses of 50, 100, 150 and 200 mg/kg body weight in rabbits<sup>[24]</sup>.

**2. *Amalaki* (*Emblica officinalis* Gaertn.):** Common name- Indian Gooseberry [Family: *Euphorbiaceae*]

*Amalaki* and *haridra* are the best remedies for *Prameha* mentioned in *AshtangaHridayaSamhita*<sup>[25]</sup>. The aqueous extract of *Emblica officinalis* Gaertn seeds was investigated for its anti-diabetic activity in animal models. Streptozotocin (STZ)-induced

type 2 diabetes models were used for the study. This evidence clearly indicates that the aqueous extract of *E. officinalis* seeds has definite hypoglycemic potential as well as anti-diabetic activity<sup>[26]</sup>. The fruits are used in the treatment of diabetes<sup>[27]</sup>. Decoctions of the leaves and seeds are also used in the treatment of diabetes mellitus<sup>[28]</sup>.

**3. Aragvadha (*Cassia fistula* L.):** Common name- Golden rain tree [Family: *Fabaceae*] Decoction of *Aragvadha* is efficacious in *haridrameha* mentioned in *SushrutaSamhita*<sup>[29]</sup>. Ethyl acetate fraction of the bark of *Cassia fistula* exhibited significant anti-hyperglycaemic potential in alloxan induced diabetic rats as well as lowers lipid profile<sup>[30]</sup>. In another study showed that 70% ethanolic extract of *C. fistula* pod effectively lowered fasting blood glucose levels and glycosylated hemoglobin in blood and increased glycogen store in the liver of STZ-induced diabetic rats suggesting improved glycemic control in diabetic state and supports the traditional use of the *C. fistula* pod in management of diabetes mellitus<sup>[31]</sup>.

**4. Bhringaraja (*Ecliptaalba* Hassk):** [Family: *Asteraceae*] Oral administration of leaf suspension of *E. alba* (2 and 4 g/kg body weight) for 60 days resulted in significant reduction in blood

glucose, glycosylated hemoglobin HbA1c, a decrease in the activities of glucose-6 phosphatase and fructose1,6-bisphosphatase, and an increase in the activity of liver hexokinase. *E. alba* at dose of 2 g/kg body weight exhibited better sugar reduction than 4 g/kg body weight<sup>[32]</sup>. Thus, the present study clearly shows that the oral administration of *E. alba* possess potent antihyperglycemic activity. The extract of *Eclipta alba* have shown reduction in the lipid peroxidative damage and improved antioxidant status<sup>[33]</sup>. Results of the this study indicate that the extracts of *Eclipta alba* has a potential therapeutic efficacy in controlling diabetes and post diabetic complications by possessing both hypoglycemic as well as antioxidant properties.

**5. Bhoomyamalaki (*Phyllanthusamarus* Schum. & Thonn.):** [Family: *Euphorbiaceae*] According to *Yogaratanakara*, *Bhoomyamalaki* 20 gm and *maricha* twenty in number, pounded together and taken orally, alleviates all types of *Prameha* within a week<sup>[34]</sup>. Ethanolic leaf extract of *Phyllanthusamarus* possesses potent antidiabetic activity in alloxan induced diabetic mice<sup>[35]</sup>. Diuretic, hypotensive and hypoglycemic effects of *Phyllanthusamarus* on human subjects were assessed. Nine mild hypertensive (four of them also suffering from

diabetes mellitus) were treated per os with a preparation of the whole plant of *Phyllanthusamarus* for 10 days<sup>[36]</sup>. A significant reduction in systolic blood pressure in non-diabetic hypertensives subjects was noted. Blood glucose level was also significantly reduced in the treated group. Clinical observations revealed no harmful side effects. These observations indicated that *Phyllanthusamarus* is a potential diuretic, hypotensive and hypoglycemic drug for humans.

#### **6. Bilwa (*Aegle marmelos* (L.)**

**Correa):**Common name- Bael [Family: *Rutaceae*]

The aqueous extract of *Aegle marmelos* leaves significantly reduced blood glucose level and showed anti-oxidative activity on alloxan induced diabetic rats<sup>[37,38]</sup>. The ethanolic extract of *A. marmelos* leaves have a promising antidiabetic activity against alloxan induced diabetic rats<sup>[39]</sup>. Similar antidiabetic activity reports found in other trails where *Bilwa* leaves (*Aegle marmelos* Corr.) and *Methika* seeds (*Trigonella foenum-graceum* Linn.) used in non-insulin dependent diabetes mellitus patients<sup>[40]</sup>. In another study, it was also shown that this decoction (5 g/day for 1 month) potentiated hypoglycemic effect of standard oral drugs in Type 2 diabetes patients<sup>[41]</sup>.

#### **7. Bimbi (*Coccinia indica* Wight & Arn.):**

Common name- Ivy gourd [Family: *Cucurbitaceae*]

A significant anti-diabetic activity was observed in ethanolic extract in terms of reduction of fasting blood glucose level in alloxan induced diabetic rats<sup>[42]</sup>. Administration of *Cocciniaindica* leaf extract, to normal and STZ-diabetic animals exhibited significant hypoglycemic and antihyperglycemic effect and reversed the associated with diabetes biochemical alterations<sup>[43]</sup>. The results indicated that the per os administration of *Cocciniaindica* leaf extract to diabetic animals normalized blood glucose and caused marked improvement of altered carbohydrate metabolizing enzymes during diabetes.

#### **8. Kalmegha (*Andrographispaniculata* Nees):**

Common name- King of Bitter [Family: *Acanthaceae*]

The anti-diabetic effect of a crude ethanolic extract of *Andrographispaniculata* in normal and STZ-diabetic rats was investigated<sup>[44]</sup>. *A.paniculata* leaves possessed significant antihyperglycemic and antioxidant effect in streptozotocin induced diabetic rat which might be due to its islet cell restoring and regenerative ability as well as the upregulation of antioxidant enzymes<sup>[45]</sup>. Andrographolide



obtained from *Andrographis paniculata* (Burm. f.) Nees showed hypoglycemic and hypolipidemic effects in high-fat-fructose-fed rat<sup>[46]</sup>.

**9. Kapikacchu (*Mucunapruriens* (L.) DC.):**

Common name- Velvet bean [Family: *Fabaceae*]

Alcoholic extract of plant (100, 200, 400mg/kg/day) is given to alloxanized rats reported significant glucose lowering effect. Hypoglycemic activity of plant extract (200mg/kg) reported on daily oral feeding of extract for 40 days in streptozotocin induced diabetic mice<sup>[47]</sup>. In a study results showed that *Mucuna Pruriens* seed extract (200mg/kg) were effectively controlled blood glucose levels in diabetic rats. Serum insulin and cholesterol levels were significantly improved when compared to diabetic group ( $p > 0.05$ ). In pancreas, the islets showed increase in beta cell mass and reduced necrotic changes. Liver functions were partially restored and hepatocytes showed minimal necrotic changes<sup>[48]</sup>. In another study results showed that oral administration of the plant extract at all doses resulted to a significant decrease on the levels of blood glucose in alloxan-induced diabetic. The histopathological studies carried out indicated that the ethanolic leaf extract of *Mucuna pruriens* caused a restoration of

pancreatic islet cells in alloxan-induced diabetic wistar rats<sup>[49]</sup>.

**10. Nimba (*Azadirachta indica* A. Juss.):** Common name- Margosa [Family: *Meliaceae*]

Decoction of *Nimba* is the specific remedy of *surameha* mentioned in *SushrutaSamhita*<sup>[29]</sup>. Aqueous extract of neem leaf extract in streptozotocin induced models showed significant anti-hyperglycaemic potential in male albino rats of wistar strains<sup>[50]</sup>. In a study results showed that *Azadirachta indica* had beneficial effects on blood glucose levels in glucose-fed hyperglycemic and diabetic rats<sup>[51]</sup>. *Azadirachta indica* fruit aqueous extract had beneficial effects on blood glucose levels in normoglycemic rabbits<sup>[52]</sup>.

**11. Palandu (*Allium cepa* L.):** Common name- onion [Family: *Liliaceae*]

*Allium cepa* is also known to have antioxidant and hypolipidaemic activity. *Allium cepa* aqueous extracts showed hypoglycaemic and hypolipidaemic activity in alloxan-induced diabetic experimental animals<sup>[53]</sup>. Acute hypoglycemic effect of *A. cepa* was also observed in a self-controlled study on twenty patients with Type 2 diabetes. It was also able to attenuate (37%) rise in plasma glucose 2 h after glucose ingestion<sup>[54]</sup>. More recently, it was shown that intake of 100 g *A. cepa* can decrease FBG level and improve glucose

tolerance test (GTT) in both T1D and T2D patients<sup>[55]</sup>. Thus it could be used as a dietary supplement in management of type 1 and/or type 2 diabetes mellitus.

**12. Punarnava (*Boerhavia diffusa* L.):**

Common name- Spreading hogweed [Family: *Nyctaginaceae*]

Aqueous extract of leaves of *Boerhavia diffusa* shows anti diabetic activity in alloxan induced diabetic rats<sup>[56]</sup>. A study was designed to investigate the antihyperlipidemic activity of an aqueous extract of *Boerhaviadiffusa* leaves in alloxan diabetic rats<sup>[57]</sup>. Hyperlipidemia is an associated complication of diabetes mellitus. A study was carried out to investigate the effects of daily oral administration of aqueous solution of *Boerhaviadiffusa* L. leaf extract (BLEt) (200 mg/kg) for 4 weeks on blood glucose concentration and hepatic enzymes in normal and alloxan induced diabetic rats. A significant decrease in blood glucose and significant increase in plasma insulin levels were observed in normal and diabetic rats treated with BLEt<sup>[58]</sup>.

**13. Rasona (*Allium sativum* L.):**Common

name- garlic [Family: *Liliaceae*]

*Alliumsativum* (garlic) has been used in cooking for thousands of years and S-allyl cysteine sulphoxide (SACS), a sulphur containing amino acid of which is the

precursor of allicin, produced significant anti diabetic effects in alloxan diabetic rats<sup>[59]</sup>. Daily treatment of STZ-induced diabetic rats with an extract of raw garlic (500mg/kg intraperitoneally) for seven weeks showed 57% less serum glucose, 40% lower serum cholesterol levels and 35% lower triglyceride compared to control diabetic rats<sup>[60]</sup>. An *in vitro* assessment of aqueous extracts of *A. sativum* Linn. roots at concentrations of 5, 10, 20 and 40g plant extract on glucose diffusion in intestine, glucose movement across the dialysis membrane was reduced up to 54% as compared to the control. Extracts having 10, 20, 40 g/L concentrations significantly prevented glucose transfer<sup>[61]</sup>. In a clinical study, initially all the subjects were given powdered bulbs of *A. sativum* orally, at 20 mg/kg, 30 mg/kg and 45 mg/kg doses, for 14 days. At day 15, blood and urine sampling was done. After 1 week, all the subjects were administered aqueous extract of *A. sativum* bulbs orally, at 20 mg/kg, 30 mg/kg and 45 mg/kg doses, for 14 days. Both the dosage forms decreased blood and urine glucose levels in type-II diabetics<sup>[62]</sup>.

**14. Tulsi (*Ocimum sanctum* L.):** Common name- Holy Basil [Family: *Lamiaceae*]

A significant decrease in diabetic symptoms (polydipsia, polyphagia and tiredness) has been observed in 30 T2D patients consuming

(2 g/day/for 3 months) leaf powder of *Ocimum sanctum*<sup>[63]</sup>. Oral administration of alcoholic extract of leaves of *Ocimum sanctum* led to marked lowering of blood sugar level in normal, glucose fed hyperglycemic and STZ (Streptozotocin) diabetic rats<sup>[64]</sup>. *O. sanctum* has therapeutic usefulness in type 2 diabetes mellitus patients as an adjuvant drug<sup>[65]</sup>. Whole plant methanol extract of *O. sanctum* showed antidiabetic activity in STZ induced mice diabetic models<sup>[66]</sup>.

**15. Vata (*Ficus bengalensis* L.):** Common name- Banyan tree [Family: *Moraceae*]

*Yogaratanakara* reports that *Nygrodhadichurna* (*Vata churna*) is efficacious in all types of *Pramehas*<sup>[67]</sup>. The aqueous extract of *Ficus bengalensis* at a dose of 500mg/kg/day exhibits significant antidiabetic and ameliorative activity as evidenced by histological studies in normal and *Ficus bengalensis* treated streptozotocin induced diabetic rats<sup>[68]</sup>. Hot water extract of *Ficus bengalensis* noticed beneficial effect in alloxan induced diabetes mellitus in rabbits<sup>[69]</sup>.

#### **DISCUSSION:**

*NidanaPrivarjana* is the very first treatment in *Prameha*. Avoidance of all etiological factors which are causing the disease *Prameha* is *NidanaPrivarjana*. Hard exercises are prescribed for obese patients while lean and

week patients are advised to perform yoga and *Pranayama*. Exercise reduces the *meda*, helps to increase the digestive power and maintain the compactness in the body tissues. These functions are very necessary to combat the *shaithilya* and excess *meda*.

Yoga improves all sorts of metabolism in the body. *Suryanamaskara* is very good exercise for people suffering from diabetes, it increases the blood supply to various parts of the body, improving insulin administration in the body, it gives all the benefits of exercise, if practiced at 3-6 rounds in a day. Above mentioned *Yogasanas* increases blood supply, oxygen supply to the organs, increase the efficiency and functioning of the organ. Through stretching various glands resulting in increased efficiency of the endocrine system. These asana have positive effect on pancreas and also insulin functioning. But to get this result, one needs to maintain the asana for a longer duration while relaxing the muscles. *Yogasana* should be used as an adjunct with diet and drugs in the management of Non-Insulin Dependent Diabetes Mellitus (NIDDM).

*BhramariPranayama* has calming effect on mind, brain and nervous system. *BhastrikaPranayama* is revitalizing *Pranayama*, which increases oxygen levels and reduces carbon dioxide levels in the blood. Meditation is an important part of yoga practice. As much as stretching and moving

help the body rest and rejuvenate, meditation is a healing balm for brain chemistry, helping to bring the mind to a state of awakened calm. The meditations in *Kundalini* Yoga are described as benefiting the brain chemistry, the hormonal balance, and the stimulation of communication between the brain hemispheres<sup>[70]</sup>.

All the herbal drugs discussed in the review exhibit significant clinical and pharmacological activity against diabetes mellitus. Antihyperglycemic effects of these plants are attributed to their ability to restore the function of pancreatic tissues by causing an increase in insulin output or inhibit the intestinal absorption of glucose or to the facilitation of metabolites in insulin dependent processes. Some of these drugs like *amalaki*, *bilva*, *nimba*, *aragvadha*, *amra*, *palandu* etc. have also been mentioned in *Ayurved* classics and *nighantus* for their antidiabetic potential. These drugs are easily available and cheaper. These herbal drugs have significant potency and negligible side effects than the synthetic antidiabetic drugs.

### CONCLUSION:

From the above cited management modalities, it can be inferred that diabetes being a metabolic disorder, is hard to get cured by any single treatment protocol. *Ayurveda* prefers a holistic approach to treatment of any disease.

Majority of drugs mentioned above can be used as single drug in daily life like *palandu*, *rasona*, *tulasi*, *amra*, *amalaki* etc. and can be included in diet in various forms. In such scenario, the ancient *Ayurvedic* principles of preventive (*Nidana parivarjana*) and purificative measures (*Shodhana Chikitsa*) with due consideration of appropriate single herbs (*Aushadi*), *Aahara* (*pathya-apathya*) and *Vihara* (exercise, yoga, *pranayama*, meditation) have to be proved fruitful for better wellbeing in *Madhumeha* patients. Management of *Madhumeha* (diabetes mellitus) through Ayurveda, which is oriented toward prevention and health maintenance, one can stay healthy with benefits of a personalized treatment plan, diabetes-friendly diet, and lifestyle.

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