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## Holistic Approach of Ayurveda as a Means to Treat Diabetes



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### ABSTRACT

The modern science tends to control diabetes through medicines which possess side effects. Insulin which was thought to be the most effective treatment is developing resistant towards diabetic treatment and therefore the most challenging diabetic cases are subjected to bariatric surgery. Modern science has shown that the onset of diabetes can lead to metabolic changes which might be difficult to be treated with a single molecule. Neither oral hypoglycaemic agents nor insulin possess antioxidant properties or lipid lowering properties or antimicrobial properties which are required for the complete treatment of diabetes but addition of lipid lowering agents and antibiotics with oral hypoglycaemic agents can lead to drug interactions. For these particular reasons modern science is moving towards fixed dose anti-diabetic drugs which are yet to be evaluated and we are still not aware of their long-term implications. For the above reasons ayurveda is gaining global importance. In ayurveda diabetes is classified into 20 different types. While there are certain similarities between the treatments of different types of diabetes there are wholesome methods mentioned about maintaining the different lifestyle, meditation, food etc. The drug mentioned could be both single or in combination and the collection of such herbs are also very specific according to the season. The rational of such drugs would be discussed along with the different body types. We would try to integrate how based on the availability of different herbs in different seasons specific for different body types and the life style change can be part of an integrated approach for the holistic treatment of diabetic mellitus which is growing at an exponential rate.



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## **INTRODUCTION**

The incidence of diabetes is increasing at an exponential rate. Even though a number of newer medicines and brands are emerging in the market every day still the incidents of diabetes are increasing which is causing many premature deaths. According to World Health Organization (WHO), 90% of Indian diabetics would become insulin resistant by 2025. It has been observed that 90% of diabetics suffer from diabetic neuropathy whereas 1/3 of diabetics suffer from kidney disorders and with the progression of age more and more people fall prey to cardiovascular disorders. Therefore there is no guarantee that with the control of fasting blood sugar a diabetic patient would keep away from any sort of diabetic complications.

Moreover, drug interactions with modern medicine and their side effects remain a constant worry. For example, any diabetic under hypoglycaemic agent treatment would need a higher dosage of antibiotics while the efficacy of statin decreases in such patients. Because of such complications, people are moving towards herbal medicines for the treatment of diabetes.

## **MATERIALS AND METHODS**

In this article, we would review how the components of herbal drugs reduce the complications of diabetes while reducing the elevated blood sugar of diabetics. Phytomolecules present in plants not only have a diverse mode of action but they are naturally available and have fewer side effects. Their diverse activities help to address the complications of diabetes which arise due to the single mode of action of synthetic drugs. In this review, we select specific plants which are used commonly for the treatment of diabetes and their diverse mode of action due to the presence of the different molecule(s) in them.

## **AYURVEDIC VIEW ON DIABETES**

In the Ayurveda system of medicine, diabetes is referred to under Prameharoga. Prameha is a set of urinary disorders. Even though the urinary system is directly involved in this disease, it is also closely related to other systems like the Gastrointestinal, Lymphatic, Endocrinal, and Circulatory systems, etc. Acharya Sushruta considered it one of the eight grave diseases.

## **HISTORICAL PERSPECTIVE**

The chronological study of *Ayurvedic* classics and the samgraha texts shows changing trends of emphasis on its study and practice. It is very interesting to note that prameha has been described eloquently and elaborately in the 6<sup>th</sup> chapter of *Charak Samhita chikisthasthana*. In

Shusuratasamhita it is found in nidanasthana's sixth chapter and Chikitsasthana's 11th, 12th, and 13th chapters. While Madavanidana describes it in its 33rd chapter, which is Pramehanidana.

## GENETICAL PERSPECTIVE

In Charaka and Shusurata Samhita, the genetic view regarding prameha is mentioned. A specific word 'Beej dosha' is given by them which means "defect in genes".

**Sage Sushruta** said that *ritukshetraambubeejanam* are the four factors involving genetic factors of any diseases.

1. Ritu- Environment around the fertilized ovum or fetus
2. Kshetra-Reproductive organs of the female
3. Ambu- Watery contents that give nutrition to the fetus
4. Beej- Sperm

Physical and mental stages including the dietary habits of a pregnant lady may also create changes in the body of the offspring.

## ETIOLOGICAL FACTORS OF DIABETES

High-risk area: *AanupaPradesha* (Cold and humid areas) e.g. Northeast region of India

Seasons: *Sheeta* (winter)

Eating habits: Excessive starch or fatty diet e.g. rice eating people

Lifestyle: Sedentary or inactive lifestyle

### According to the *Charaka Samhita*

*"Aashyasukhamswapnasukhamdadhiniagramyoodkanuprasaapyaansi*

*Navaaanpaanamgudvaikritamchpramehahetukapahakritchsarvam."*

(*Ch.Chi.6/4*)

- *Asyasukham* (Sedentary lifestyle) -excessive rest or sitting on a comfortable bed or seat
- *Swapnasukham* - excessive sleep

- *Dadhini* – High use of curd
- *Gramya, audaka, panorama* - Excessive intake of meat or its products especially domestic, aquatic, and marshy animals meat
- *Payansi*– Excessive intake of milk and milk products eg. Butter, cheese
- *Navanna* – More use of new cereals or food grains
- *Panam* – Excessive intake of liquid things and alcohol
- *Gud vaikrutanam*– More use of Jaggery, sugar, and its products
- *Kaphakaraahara* - All other kapha-promoting regimens eg. Food and beverages which increase *kapha dosha* such as sugar, sweets, fats, potatoes, rice, etc.

#### According to the *Sushruta Samhita*

**"Divaswapnamavyayamaalasyprasaktamsheetsnigdhamadhurmedyadravannpansevinampu  
rushamjaniyatpramehibhavishyatiti."**

(*Su. Ni.6/3*)

- *Divaswapnam* – Indulge constantly in day sleep
- *Avyayama, aalasya* - Lack of exercise and laziness e.g. sedentary lifestyle
- *Sheeta,snigdha, madhura, medyaahara* – Consume more cold, stale, sweet, sour, and fatty food eg. marketed, packed, and canned food items
- *Dravanna, panasevinam* – excessive intake of liquid diet, beverages, and alcohol

Mostly affecting millions of people all over the world due to the changed lifestyle patterns

#### **PATHOGENESIS**

When the 3 Dosha's\* contaminate the 10 Dushya's\*\*, 20 Prameha's are manifested due to various permutations and combinations of contamination.

\*Dosha: Vata, pitta and kapha

\*\*Dushya (contaminated): Meda (fat), Asra (Blood), Shukra (Semen), Ambu (fluids of the body), Vasa (oily part of flesh), Lasika (lymph), Majja (bone marrow), Rasa (Digestive juice, plasma), Oja (the essence of all the tissues) and Pishita (flesh)

### According to *Sushruta Samhita*

When the above-mentioned types of person's improperly cooked *dosha* (*vata*, *pitta* & *kapha*) get mixed with *media* (fatty tissue) which travel downwards along with the urinary system then they get localized in the urinary bladder orifice and give rise to urinary disorders which are described as diabetes or *Prameha*. (*Su. Ni.6/4*)

### According to *Charaka Samhita*

Vitiation of three *dosha* is the cause of twenty types of urinary disorders (which is known as *prameha*) and innumerable disorders.

Causes of three *Dosha* vitiation are:

#### ***Kapha dosha:***

- Excessive and prolonged use of new grains like *hayanaka*, *yavaka*(*Avenabyzantina*), *china ka*, *uddalaka*, *naishadh*, *itkat*, *mukunda*, *mahabrihi*, *pramodak*, *sugandhak* (most of these are types of rice)
- Use of excessive ghee with new legumes like pea (*Pisum sativum*), black gram(*Vigna mungo*) and other pulses
- Excessive use of meats from domestic, aquatic, and marshy animals
- Leafy vegetables, sesamum paste, preparations of rice paste, *payasa*(rice cooked with milk/*kheer*), *krashara* (rice cooked with pulse/*khichadi*), *vilepi*(paste-like preparation of rice)
- Sugarcane and its products
- Excessive use of new alcoholic beverages (that's why old alcoholic beverages are preferred since ancient times), improperly made curd, milk, sweets & liquids dietary products.
- Abstinence from cleanliness and physical exercise.
- Indulgence in sleep, lying down and sitting means sedentary lifestyle.
- All other similar regimens which produce *kapha*, fat, and urine.

***Bahudravashleshma dosha wishes***

(Ch.Ni. 4/6)

This means particularly the liquid part of *Kapha dosha* is the main dosha in diabetes.

Abundant and non-compact body fat and flesh, body fluid, semen, blood, muscle fat, marrow, lymph, plasma serum, and *ojas* are the main contaminant (dosha) in diabetes.

Due to the above-said factors, *Kapha dosha* is dominantly aggravated (in association with other doshas) and they affect *medas* (fat), *mamsa* (flesh), *udaka* (lymphatic channel/endocrinal secretions), etc. Due to abnormal digestion, the afflicted *dhatu*s (tissues and their derivatives) are driven toward the urinary system and the disease *prameha* results. Based upon the dosha involvement their degree of affliction and the gradation of the illness, various signs and symptoms result. According to the features, different names are given.

Due to the predominance of *kapha* aggravating factors, *kapha dosha* gets vitiated and spread immediately all over due to slackness of the body. Due to abundance, laxity, and similarity in properties, it first mixed with body fat and contaminate it. This contaminated *kapha* and body fat contaminates muscle fat and produces boils and carbuncles. This also contaminates body fluids, transforms them into the urine, and blocks the urinary system. While entering into the urinary bladder body fluid is mixed with *Kapha* and body fat then it is associated with ten properties of *Kapha* in an abnormal state such as white, cold, heavy, sweet, viscous, etc. Thus it produces ten types of *kaphajaprameha* and acquires similar secondary names according to their association with one or more properties.

This *kaphajaprameha* is located in body fat having similar properties, *kapha* is predominant and similar in treatment so these ten types of *kaphajaprameha* are curable.

***Pittajaprameha***

- People who are habitual of taking hot, sour, saline, alkaline, pungent, and spicy food.
- Taking meals during indigestion
- Exposure to intense sunlight & fire
- Exertion
- Anger
- Irregular dietary habits

- Paittikprakruti persons

Because of all the above-said factors pitta gets vitiated immediately. By the same above-mentioned (*kaphajaprameha*) mechanism, it instantly gives rise to six types of *pittajaprameha*.

These six types are more difficult (than kaphaja) to treat because dosha (pitta) and location (media/body fat) both have contradictory treatment.

### ***Vatajaprameha***

- Those who are habitual of astringent, bitter, pungent, rough, light & cold food
- Excessive intercourse and exercise
- Excessive emesis, purgation, non-unctuous enema, head evacuation
- Suppression of natural urges
- Excessive fasting, severe injury, excessive bleeding, night awakening
- Excessive exposure to sunlight
- Agony, anxiety, tension
- Abnormal body postures
- *Vatikaprakruti* persons

Due to the above-said factors, *vata dosha* gets vitiated immediately and gives rise to four types of *vatajaprameha*. It's one type is **madhumeha** which is known as **diabetes mellitus** (type 1).

Physicians say these four types are incurable because of their great severity and contradictory treatment.

**Origin of Madhumeha (Diabetes mellitus):** Due to the roughness of this aggravated *vata*, Ojas (sweet) gets associated with astringency and carried to the urinary bladder, which gives rise to **madhumeha**. **Due to the involvement of ojas, our strength decreases day by day. That's why at the time of treatment Aacharya Sushrut mentioned mainly lifestyle changes or modifications.**

**\*Ojas:** The essence of the seven dhatus is known as ojas. In short, it is our strength. (*Su. Su.15/19*)

Ojas is a moon-like coolant in properties, aliphatic, white in color, cold in potency, stable, moving forth, clear, soft, and slimy. It is chief among the seats of life. With all organs, the entire body is pervaded by it. The body perishes in its absence.

(*Su. Su.15/21-22*)

#### **PRODROMAL SYMPTOMS OF PRAMEHA (Ch. Ni.4/47)**

- Matting of hairs
- Mouth sweetness
- Numbness
- Burning sensation in palms and feet
- Dryness in mouth, palate, and throat
- Thirst
- Laziness
- Dirt in body
- Smearing in body orifices
- Burning sensation and numbness in body parts
- Crawling of bees and ants on the body and urine
- Morbidities in urine
- Fleshy body odor
- Always feeling sleepy or drowsiness

#### **According to Acharya Sushruta(Su.Ni.6/5)**

- Burning sensation in palms & soles
- Profound thirst
- Head hairs adhering to one another



- The body becomes aliphatic, slimy, and heavy.
- Urine is sweet in taste, bad in smell, and white in color.
- More accumulation of dirt in the palate, throat, tongue, and teeth More growth of hairs and nails

## **SIGNS AND SYMPTOMS OF DIABETES WITH ITS MANAGEMENT**

*Prabhootavilmootrata*

*(Su. Ni.6/6)*

Turbid urine with increased quantity

4 VatajaPrameha, 6 PittajaPrameha, and 10 KaphajaPrameha thus a total number of Prameha sums up to 20 types. Acharya Sushruta mentioned individual herbs for twenty types of Prameha.



**KaphajaPrameha**

S.N.	Types	Signs & Symptoms	Treatment
1.	<i>Udakameha</i> (Chronic nephritis, Diabetes insipidus)	Urine white color and water like Passes without pain	Decoction of <i>Parijat</i> ( <i>Nyctanthes arbor-tristis</i> )
2.	<i>Ikshuvalikameha</i> (Alimentary glycosuria)	Urine resembling juice of sugarcane	Decoction of <i>Vaijayanti</i> ( <i>Clerodendrumphlomis</i> ) Roots & stem
3.	<i>Sura meha</i> (Phosphaturia)	Urine resembles sura (Alcohol)	Decoction of <i>Nimba</i> ( <i>Azadirachta indica</i> ) Seeds oil
4.	<i>Sikatameha</i> (Crystalluria or gravelluria /Lithuria)	Urine with pain & gravels	Decoction of <i>Chitraka</i> ( <i>Plumbago zeylanica</i> )
5.	<i>Shanairmeha</i>	Delayed and very slow impulse of urination mixed with kapha& slimy	Decoction of <i>Khadira</i> ( <i>Acacia catechu</i> ) Stem wood
6.	<i>Lavanameha</i>	Urine non slimy & salty in taste	Decoction of <i>Patha</i> (root of <i>Cissampelos pareira</i> ), <i>Aguru</i> (wood of <i>Aquilaria agallocha</i> ) & <i>Haridra</i> ( <i>Curcuma longa</i> )
7.	<i>Pistameha</i> (Chyluria)	Urine resembles solution of flour & with horripilation	Decoction of <i>Haridra</i> ( <i>Curcuma longa</i> ) & <i>Daruharidra</i> (wood & root of <i>Berberis aristata</i> )
8.	<i>Sandra meha</i>	Urine thick and turbid	Decoction of <i>Saptaparna</i>
9.	<i>Shukrameha</i> (Spermaturia)	Urine resembles semen	Decoction of <i>Kakubh</i> (stem bark of <i>Terminalia arjuna</i> ) & <i>Chandana</i> (heart wood of <i>Santalum album</i> )
10.	<i>Phenameha</i>	Urine scanty, frothy & clear	Decoction of <i>Triphala</i> (fruits of <i>Terminalia chebula</i> , <i>Terminalia bellirica</i> & <i>Emblica officinalis</i> in equal amount), <i>Aaragvadha</i> (bean flesh of <i>Cassia fistula</i> ) & <i>mradvika</i> (dried fruits of <i>Vitis vinifera</i> ) with honey

**PittajaPrameha**

S.N.	Types	Signs & Symptoms	Treatment
1.	<i>Nilameha</i> (Bluish Indicanuria)	Urine frothy, clear & bluish	Decoction of <i>Ashwattha</i> (Bark of <i>Ficus religiosa</i> )
2.	<i>Haridrameha</i> (Biliuria)	Urine resembles turmeric in color with burning sensation	Decoction of <i>Rajavraksha</i> (bean flesh of <i>Cassia fistula</i> )
3.	<i>Amla meha</i>	Urine acidic in taste & smell	Decoction of <i>Nyagrodadhigana</i> ( <i>Ficus bengalensis</i> including other twenty four drugs)
4.	<i>Ksharameha</i> (Alkanuria)	Alkali urine	Decoction of <i>Triphala</i> (fruits flesh of <i>Terminalia chebula</i> , <i>Terminalia bellirica</i> & <i>Emblica officinalis</i> in equal amount)
5.	<i>Manjisthameha</i> (Urobilinuria)	Light red color urine	Decoction of <i>Manjistha</i> (root of <i>Rubia cordifolia</i> ) & <i>Chandana</i> (heart wood of <i>Santalum album</i> )
6.	<i>Shonitameha</i> (Haematuria)	Dark red color urine resembles blood	Decoction of <i>Guduchi</i> (stem of <i>Tinospora cordifolia</i> ), <i>Tindukasthi</i> (seeds of <i>Strychnos nux-vomica</i> ), <i>Kashmarya</i> (root , fruit bark & leaves of <i>Gmelina arborea</i> ) & <i>Kharjura</i> (fruits and resin of <i>Phoenix sylvestris</i> ) with honey

**VatajaPrameha**

S.N.	Types	Signs & Symptoms	Treatment
1.	<i>Sarpimeha</i> (Pyuria/Albuminuria)	Urine resembles Ghee	Paste of <i>Kushtha</i> (root of <i>Saussurealappa</i> ), <i>Kutaja</i> (bark of <i>Holarrhenaantidysenterica</i> ), <i>Patha</i> (root of <i>Cissampelos pareira</i> ), <i>Hingu</i> (resin of <i>Ferula narthex</i> & <i>Katurohini</i> (Rhizome of <i>Picrorhizakurroa</i> ) with decoction of <i>Guduchi</i> ( stem of <i>Tinospora cordifolia</i> ) & <i>Chitraka</i> ( <i>Plumbago zeylanica</i> )
2.	<i>Vasa meha</i> (Lipiduria)	Urine resembles fat	Decoction of <i>Agnimantha</i> (root of <i>Clerodendrumplomidis</i> ) & <i>Simsipa</i> (wood of <i>Dalbergia sissoo</i> )
3.	<i>Hastimeha</i> (Prostatitis)	Urine often excreted like an intoxicated elephant, In few cases lymph with clots also found	Dicoction of <i>Tinduka</i> ( <i>Diospyros embryopteris</i> ), <i>Kapittha</i> (fruit, resin & leaves of <i>Feronia elephantum</i> ), <i>Shireesh</i> (bark & seeds of <i>Albizzia lebbeck</i> ), <i>Palasha</i> (seeds, resin & flowers of <i>Butea monosperma</i> ), <i>Patha</i> (root of <i>Cissampelos pareira</i> ), <i>Moorva</i> ( <i>Marsdeniatenacissima</i> ) & <i>Dusparsha</i> ( <i>Alhagicamelorum</i> ) with honey And ash of bones of elephants, horses, boar, donkeys & camel
4.	<i>Kshaudrameha/ Madhumeha</i> (Diabetes mellitus)	Urine resembles honey in taste & color	Decoction of <i>Kadara</i> (wood of <i>Acacia suma</i> ) & <i>Kramuka</i> (seeds of <i>Areca catechu</i> )

**Acharya Vagbhata opines that all types of Prameha ultimately change into Madhumeha (Diabetes mellitus) if neglected or not treated properly.** Not all Prameha's need to undergo these sequential changes leading from *Kapha* to *Vataja Prameha*'s. The explanation shows that things get complicated if neglected or not treated properly.

## **PREVENTION of PRAMEHA**

The *Kaphaja Prameha*'s can be handled effectively not allowing them to progress to difficult conditions. The same is the case with *Pittaja Prameha*'s. Early diagnosis and prompt treatment with suitable disease-modifying medicines, treatments, diet changes, and lifestyle changes are the keys. All *Kaphaja*, *Pittaja*, and *Vataja Prameha* can manifest individually without passing through the sequence. In such cases, they have to be handled as such not allowing impending complications. But the bottom line is – Whichever the type of Prameha, *Kapha* is the primary and initiating element that is mandatorily involved in the pathogenesis of the disease. *Kaphaja Prameha*'s are easy to treat. *Pittaja Prameha*'s are difficult to handle and *Vataja Prameha*'s are about impossible to treat.

- Proteins: Intake of protein content should be normal i.e., 1gm/kg. In children, it may be increased.
- Fats: Fats should be moderate; excessive intake of fats is forbidden.
- Carbohydrate: Carbohydrate intake must be minimized to reduce blood sugar.
- Calories: Total calories should be adequate for growing children and underweight persons. In obese patients, it might be necessary to reduce calories.
- Minerals: Adequate amount should be supplied.
- Vitamins: Vitamin-B complex group should be taken to prevent and treat polyneuritis.
- Drinks: Sweet drinks and carbohydrate drinks should be avoided. Cakes, pastries, creams, dried and canned foods, sweets, pickles, and meats should be avoided.
- Soups: Thin vegetable soups supply fewer calories. So obese persons are encouraged to take large quantities which would fill up their stomachs and give them a sense of satiety.
- Green vegetables: Diabetics should consume a large number of green vegetables, which are a poor source of calories. Brinjals, spinach, and tomatoes can be consumed in plenty. Salads with lime or vinegar are useful.

- Fruits: Dried fruits and nuts should be avoided, and so should bananas and mangoes. Orange and apples can be taken.
- Desserts: Sweets and ice cream or custard are not allowed.
- Cooking media: Ghee, oils, and butter all are rich in calories so an obese diabetic is allowed only 1 teaspoonful per meal.
- Tea and coffee: Tea and coffee are permitted without sugar but milk and sugar should be regulated.
- The best treatment for this disease is following a strict diet with
- Minimum intake of Carbohydrates
- Moderate intake of proteins & fats.
- Avoid intake of sugar items eg. Sweets, cakes, pastries, cold drinks, ice creams, etc.
- Drink light Soups & use more Green leafy vegetables.
- All milk products are to be avoided as much as possible.
- Regular exercises, Yoga & Pranayama are advised.
- Apart from these Special treatments like Kashayadhara, Takradhara etc can be done.
- Internal medication like Kashayams, Churnas etc if taken for 3-6 months will help in curbing the disastrous consequences of Diabetes.

## **MANAGEMENT OF DIABETES**

Diabetic patients are of two types eg. Obese & thin

1. Obese & strong patients- Evacuation
2. Lean & weak patients- Promotive treatment

Treatment is based upon the nature of the individuals in obese (sthoola) and lean (Krishna). In obese patients, purification (samshodana) is carried out first, and later santarpana (tissue rejuvenation) is followed. The disease is controlled by a wholesome diet and habits. In the case of lean, brimhana (tissue nourishment/rejuvenation) is carried by selective medicines and diet. Other than this, all the pramehas are treated based on Dosha dominance. **(Ch.Chi.6/15-17)**

**Sahaj pramehi:** food prepared with useful herbs, vamanvirechan

**Sthoolpramehi:** By Apatraneg. Fasting, xercises, shodhan. Intake of bitter and katu drugs

Managing diabetes through Ayurveda is a comprehensive therapeutic modality that yields the best outcome when treatment is individualized. It involves extensive dietary modifications, lifestyle changes, and the use of regimen derived from herbs/ food supplements like *Momordica charantia*, *Phaseolus vulgaris*, *Allium sativum*, *Allium cepa*, *Trigonella foenum graecum*, *Syzigium jambolana*, *Murrayakoenigii*, *Tinospora cordifolia*, *Emblicaofficinalis*, *Gymnemasylvestre*, *Eugenia jambolana*, *Azadirachta indica*, and *Shilajitu*, apart from *yoga*.

Mostly used herbs in diabetes:

- o Haridra – Turmeric – *Curcuma longa*
- o Amalaki – Amla – *Emblica officinalis*
- o Jambu – Jamun – *Syzygiumcumini* (Linn.) Skeels.
- o Udumbara – *Ficus glomerata* Roxb.
- o Haritaki – *Terminalia chebula* Retz.
- o Meshashringi – *Gymnemasylvestre* R. Br.
- o Lodhra – *Symplocosracemosa*Roxb.
- o Ashoka – *Saraca indica*
- o Vata – *Ficus bengalensis* Linn
- o Guggulu – *Commiphoramukul* (Hook. Ex. Stocks.) Engl.
- o Guduchi – *Tinospora cordifolia* (Willd.) Miers.
- o Nimba – Neem – *Azadirachta indica* A. Juss.
- o Pata – *Cissampelos pareira* Linn.
- o Ashwattha – *Ficus religiosa* Linn.
- o Durva – *Cynodondactylon* (Linn.) Pers.
- o Gokshura – *Tribulus terrestris* Linn.

- o Manjishta – *Rubia cordifolia* Linn.
- o Khadira – *Acacia catechu* Willd.
- o Devadaru – *Cedrus deodara* (Roxb.) Loud.
- o Aragwadha – *Cassia fistula* Linn.
- o Saptchakra – *Salacia chinensis*
- o Bimbi- *Coccinia indica*

Formulations preferred in diabetes (in general):

- o Tab BGR- 34
- o Vasantakusumakarras
- o Chandraprabhavati
- o Shilajatvadivati
- o Arogyavardhinivati
- o Asanadi tablet
- o Trivangabhasma
- o Shilajaturasayana
- o Triphalachurna
- o Asanadikashaya
- o Nishakhadiradikashaya
- o Khadhiradikashaya
- o Triphalakashaya
- o Lodhrasava
- o Jambwasava
- o Mahamanjishtadikashaya

Wholesome diet habits:





- o Shigru-drum stick
- o Haridra-turmeric
- o Amalaki-geese berry
- o Shyamaka- *Setariaitalica* (L.) Beauv.
- o Kodrava- *Echinochloa frumentacea* Linn.
- o Yava-barley
- o Godhuma-wheat
- o Mudga-green gram
- o Kulattha-horse gram
- o Patola-snake gourd
- o Karavellaka-bitter gourd- *Momordiachorantia* Linn.
- o Maricha-pepper- *Piper nigrum*
- o Lashuna-garlic
- o Jambu- Jamun – *Syzygiumcumini* (Linn.) Skeels.
- o Chana –Gram
- o Arhar Dal

Contraindicated diet and habits:

- o Kanda moola (rhizome)
- o Ikshu (sugar cane juice)
- o Taila(oil)
- o Ghrita(ghee)
- o Guda(jaggery)
- o Kanjika/shukta(sour gruels)
- o Madya(alcohol)

- o Pishtanna(carbohydrate-rich food)
- o Anupamamsa(meat of marshy landanimals)
- o Dadhi (curd)
- o Navanna (new grains)
- o Divaswapna (day sleep) etc.

#### MODE OF ACTION OF SOME COMMONLY USED HERBS

Most of the active compounds isolated from the antidiabetic plants are secondary metabolites. These hypoglycemic constituents include alkaloids, flavonoids, triterpenoids, polysaccharides, glycopeptides, aminobutyric acid derivatives, steroids, iridoids, phenolics, peptides, alkyl disulfides, inorganic ions.

##### Terminalia chebula

The fruit of Terminalia chebula is often used for its anti-diabetic property. The active component with anti-diabetic properties in Terminalia chebula was found to be chebulic acid. It could reduce the elevated blood sugar in diabetic animals during short and long-term studies 1 while protecting the kidneys 2.

##### Terminalia bellerica

The gallic acid found in the fruits of Terminaliabellericahas beta cell regeneration capacity 3 along with neuroprotective activity 4. it could improve the cardiac dysfunction in diabetic rats 5 while possessing alpha-amylase activity 6.

##### Embilica officinalis

The fruits of Embilica officinalis is often used for their anti-diabetic property. It contains tannins,  $\beta$ -glucogallin, gallic acid, kaempferol, and ellagic acid which have various beneficial activities on diabetic tissues. Tannoids 7 and  $\beta$ -glucogallin8 possess aldose reductase inhibiting activity which can inhibit cataract formation in diabetics. Kaempferol is an effective PPAR gamma agonist 9 with the anti-diabetic property. Through its capacity for correction of mitochondrial dysfunction 10 ellagic acids were found to be neuroprotective.

Triphala, a combination of 3 myrobalans - Embelica officinalis, Terminalia chebula, and Terminalia bellirica, is a well-known hypoglycemic agent.

### Terminalia arjuna

Terminalia arjuna is a common Indian plant whose bark is used for its anti-diabetic property. It was seen to possess HMG Co A reductase inhibition activity along with other lipogenic enzymes which signified its lipid-lowering ability<sup>11</sup>. Some of the phytochemicals present in Terminalia arjuna include Kempferol, Quercetin, Catechin, gallic acid, ellagic acid, etc.

Kaempferol aids in the release of insulin from the pancreas and increases its sensitization<sup>12</sup> while Quercetin due to its anti-inflammatory activity protected the diabetic cells from further damage<sup>13</sup>. Quercetin exhibited antidiabetic activity<sup>14</sup> and protected the beta cell damage by its anti-inflammatory, antioxidant, and anti-apoptotic activities<sup>15</sup>.

Catechin could ameliorate diabetic complications such as hypertension and vascular endothelial dysfunction<sup>16</sup> through its antioxidant activity and lipid-lowering activities<sup>17</sup>. While the therapeutic benefits of gallic and ellagic acid have already been documented.

### Pterocarpus marsupium

Even though some phytochemicals were found to be present in Pterocarpus marsupium certain phytochemicals such as lupeol were found to increase serum insulin levels and antioxidant status of diabetic experimental animals<sup>18</sup>. Naringenin which is another phytochemical isolated from the same plant was found to be hepatoprotective (protects against liver)<sup>19</sup> and reduced renal impairment by reducing inflammation and increasing antioxidant thereby reducing apoptosis<sup>20</sup>.

### Syzygiumcumini

Some of the active ingredients of the plant are anthocyanins, glucoside, ellagic acid, isoquercitrin, kaemferol and myrecetinjambosine, and glycoside jambolin or antimellin<sup>21</sup>.

Isoquercetin was found to possess alpha-glucosidase inhibitory activity<sup>22</sup>. Isoquercetin was also found to reduce elevated blood sugar in the experimental animals by improving their pancreatic functions<sup>23</sup>. Myrecitin could ameliorate insulin resistance by activating the insulin receptor thus helping in the uptake of glucose by muscle cells<sup>24</sup> in the presence and absence of insulin<sup>25</sup>. It proved its insulin mimicry activity by enhancing glucose transport in non-insulin-dependent diabetes mellitus by directly interacting with the GLUT 4 receptors<sup>26</sup>. It possesses anti-inflammatory activity as it downregulated NF kB<sup>27</sup>, IL 1b<sup>28</sup>, IFN gama<sup>29</sup>, and TNF alpha<sup>30</sup>. It also possesses anti-oxidant<sup>31</sup> and aldose reductase inhibition

activities 32. It also possesses anti-hyperlipidemic<sup>33</sup>, anti-hypertensive 34, and human pancreatic alpha-amylase inhibitory 35 activities.

#### Azadirachta indica

Rutin and Quercetin are the two important phytochemicals that are present in Azadirachta indica responsible for its hypoglycemic activity 36. Oral administration of rutin significantly decreased the fasting blood sugar as well as the glycosylated hemoglobin levels while increasing their antioxidant levels, insulin, and c peptide 37. It was also able to decrease inflammation in diabetic animals and correct their erectile dysfunction 38. When given as supplements to diabetic patients there was a marked decrease in their BMI, fasting and post prandial blood sugar, and correction of the blood pressure 39.

#### Tinospora cordifolia

Jatrorrhizine is found in Tinospora cordifolia which was found to possess anti-diabetic properties due to its enhancement of glycolysis which helped in the uptake and breakdown of glucose molecules from the blood 40. Berberine has been found to exhibit anti-diabetic properties through its various properties. It is an alpha glucosidase<sup>41</sup> and aldose reductase<sup>42</sup> inhibitor while it improved beta cell function<sup>43,44</sup> and acts as an insulin-sensitive entity<sup>45</sup>. Fatty molecule deposition is a major concern for insulin resistance and berberine was found to reduce triglyceride deposition in liver and muscle cells<sup>46</sup>.

#### Trigonella foenum- graecum

Trigonelline has antioxidant properties 47. It exhibited neuroprotective<sup>48</sup> and nephroprotective activity by reducing oxidative stress and apoptosis in diabetic animals<sup>49</sup>. It was further seen to prevent damage to the pancreatic cells through its antioxidant property and enhance the PPAR gamma activity of the adipocytes<sup>50</sup>. It could also inhibit alpha glucosidase, DPP IV<sup>51</sup>, and lipase which is a key digestive enzyme for hyperlipidemia and protected the liver as well as the kidney<sup>52</sup>.

Cinnamic acid can help in peripheral glucose utilization which is an important issue against insulin resistance by activating the GLUT receptors of the myofibrils and helping in the intake of glucose into the muscle cells<sup>53</sup>. Obesity and cardiovascular disorders are becoming a common ailments in modern society and cinnamic acid was found to possess anti-obesity factors along with cardioprotective activity<sup>54</sup>. Moreover, cinnamic acid and its derivatives were found to have insulin secretory properties<sup>55,56</sup> as well as improve the beta cell

functionality<sup>57</sup>. It also acts as a DPP IV inhibitor which would help in the increase of insulin from the pancreatic cells<sup>58</sup>.

Scopoletin which is a derivative of cinnamic acid and is found in the same plant was found to ameliorate insulin resistance in HepG2 liver cells<sup>59</sup> and reduce advanced glycation end product<sup>60</sup>.

Other antidiabetic drugs

Shilajit

Shilajit, which is considered one of the wonder medicines of Ayurveda, is neither a plant nor animal substance, but a mineral pitch that oozes from the rocks of the Himalayas, as they become warm in the summer months, is said to be used extensively for a variety of diseases including diabetes. Shilajit is among the best drug for the long-term management of diabetes mellitus and it should be combined with Gurmar.

Hericiumerinaceus (Lion's mane)

It is a fungus, native to China, Japan, North America, and Asia, and is found to be anti-diabetic. Non-starch polysaccharides of the fruiting body are found to reduce blood glucose levels.

Ramulus mori or Sang Zhi

Dried twigs of the mulberry tree, which is a traditional Chinese medicinal herb that appears to have properties similar to those of alpha-glucosidase inhibitors. Alpha-glucosidase inhibitors are oral antidiabetic drugs.

## CONCLUSION

It can be easily concluded that plants with anti-diabetic properties possess many phytochemical(s) which have a different modes of action. Given that diabetes is a combination of many metabolic disorder and multiple organs are affected, herbal medicines with their array of mode of action helps in addressing the complications of diabetes better. With medicines lifestyle changes, yoga, and exercises are also helpful in the management of diabetes.

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