



Review Article

MECHANISTIC INSIGHTS INTO AYURVEDIC *PATHYA AHARA* FOR *PRAMEHA* (DIABETES MELLITUS): A MOLECULAR AND PHARMACOLOGICAL PERSPECTIVE

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ABSTRACT

Diabetes Mellitus (DM) is a metabolic disorder characterized by persistent hyperglycemia due to impaired insulin secretion, reduced glucose utilization, and increased glucose production influenced by genetic and environmental factors. In Ayurveda, DM can be associated with *Prameha*, a metabolic disorder associated with excessive urination, metabolic imbalance, and derangement of *Kapha*, *Meda*, and *Kleda*. Ayurveda considers *Aahara* (diet) as one of the *Trayopasthamba* (three pillars of life) and emphasizes *Pathya-Apathya* as the primary disease management strategy. **Aim:** To analyze the molecular and pharmacological mechanisms underlying Ayurvedic *Pathya Ahara* recommended for *Prameha*. **Materials and Methods:** A comprehensive review of classical Ayurvedic texts was conducted, along with an analysis of modern biomedical databases, including PubMed, Scopus, and Google Scholar, to evaluate the metabolic and molecular effects of *Pathya* foods. **Discussion:** *Prameha* Management emphasizes *Apatarpana*, *Kapha*-pacifying diet, regular exercise (*Vyayama*), and adherence to a daily regimen. Ayurvedic *Pathya Aahara* exerts antidiabetic effects through multiple mechanisms, including modulation of glucose metabolism, improvement of insulin signaling, antioxidant activity, and gut microbiota regulation. **Conclusion:** *Pathya Aahara's* recommendations align with modern metabolic principles and may offer complementary strategies for diabetes management.

INTRODUCTION

Diabetes mellitus represents one of the most prevalent metabolic disorders worldwide. The World Health Organization reports that diabetes prevalence has increased dramatically over the past decades due to sedentary lifestyles, obesity, and dietary changes. India is one of the seven countries and territories of the IDF South-East Asia region. 589 million people have diabetes in the world, and 107 million people in the SEA Region; by 2050, this will rise to 185 million.<sup>[1]</sup> In Ayurveda, *Prameha* is one of the eight serious illnesses documented in ancient medical literature, and

it was identified as a *Maharoga* (major ailment) as early as 1552 BC. *Prameha* was thought to be an affluent disease that primarily affected people from upper socioeconomic classes.<sup>[2]</sup> It is classified based on body constitution and the predominance of specific *Dosha*, characterized by frequent, copious, and turbid urination<sup>[3]</sup>, thereby defining *Prameha* as a clinical syndrome rather than a single symptom. Its etiology is largely attributed to improper dietary habits and lifestyle factors, which correspond closely to the modern understanding of Diabetes mellitus in the present context.<sup>[4]</sup> Classical Ayurvedic texts classify *Prameha* into *Sahaja* (genetic predisposition) and *Apathyanimittaja* types. *Apathyanimittaja Prameha* closely resembles type 2 diabetes mellitus, as it is linked to an unhealthy diet and lifestyle. Additionally, Ayurveda describes the condition of *Sthula Pramehi*, which parallels contemporary understanding of obesity and highlights excess adiposity as a major risk factor in the pathogenesis of type 2 diabetes.

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Insulin resistance is the primary pathological mechanism leading to chronic hyperglycemia in diabetes mellitus. Type 2 diabetes mellitus (T2DM) develops through multiple interacting pathways that cause insulin resistance and progressive pancreatic  $\beta$ -cell dysfunction. Its etiology involves a complex interplay of genetic susceptibility and environmental factors. A substantial loss of  $\beta$ -cell function ( $\approx 80\%$ ), together with insulin resistance in skeletal muscle and the liver, forms a key pathological triad underlying the disease.<sup>[5]</sup>

Pancreatic islets contain  $\beta$ -cells (48–59%) that secrete insulin,  $\alpha$ -cells (33–46%) producing glucagon, along with  $\delta$ -cells and PP (F) cells. These cells communicate through paracrine signaling, primarily initiated by  $\beta$ -cells. Although most research focuses on  $\beta$ -cell dysfunction, interactions among other islet cells are also important for glucose regulation.<sup>[6]</sup>

In addition, T2DM pathogenesis involves multiple organs, including adipose tissue (increased lipolysis), the gastrointestinal tract (impaired incretin effect),  $\alpha$ -cells (hyperglucagonemia), kidneys (enhanced glucose reabsorption), and the central nervous system (insulin resistance). These mechanisms interact with genetic factors and collectively contribute to disease progression.<sup>[7]</sup>

Diabetes, being a chronic and potentially severe metabolic disorder, requires a comprehensive approach focusing on three fundamental aspects of treatment: (a) *Aushadha* (medication), (b) *Aahara* (diet), and (c) *Vihara* (physical activity and lifestyle modification). Modern medical practice similarly highlights this threefold therapeutic strategy. Although the advent of oral hypoglycaemic agents and insulin therapy has significantly improved glycemic control, the importance of dietary regulation and physical activity remains paramount and cannot be underestimated.

### Concept of Pathya Ahara in Ayurveda

*Aahara* (diet) is one of the foundational pillars of Ayurveda, considered essential for maintaining health (*Swasthya*) and treating disease (*Vyadhi Prashamana*). Classical texts state that “*Ahara* is medicine and improper diet is the cause of disease,” highlighting its preventive and therapeutic significance. It is considered *Mahaushadha* i.e., the supreme medicine.

*Pathya* literally means wholesome diet, habits, and lifestyle regimens that nourish the body and mind, promoting health and recovery from disease. It implies following the right path to wellness, ensuring beneficial effects without causing harm.<sup>[8]</sup> *Pathya* acts synergistically with pharmacological treatments. The therapeutic significance of *Pathya* is so profound that adherence to an appropriate, individualized diet can maintain health and prevent disease progression to

such an extent that pharmacological intervention may become unnecessary. Conversely, if such dietary and lifestyle guidelines are neglected, even the most potent medications may fail to achieve optimal therapeutic outcomes. (Lolimbaraj)

*Pathya Aahara* refers to a wholesome and appropriate diet that maintains health and supports disease management. The term “*Pathya*” implies foods that facilitate the proper functioning of bodily channels (*Srotas*) and metabolic processes. Classical texts emphasize that diet should be tailored according to an individual's constitution (*Prakriti*), digestive capacity (*Agni*), disease state (*Vyadhi*), season (*Ritu*), and age (*Vaya*). (Ashtanga Hridaya Sutra Sthana 2 & 3 Describes diet regulation based on *Agni*, *Prakriti*, *Ritu*, and daily regimen.)<sup>[9,10]</sup>

Key principles include:

- **Ashtau Aahara Vidhi Visheshayatana** – Inherent qualities of food, method of preparation, geographic region and environment, individual digestive power, age, health condition, etc.<sup>[11]</sup>
- **Ahara Vidhi Vidhana** (dietary rules): Proper timing, quantity (*Matra*), and method of food intake.<sup>[12]</sup>
- **Viruddha Ahara**: Avoidance of incompatible food combinations.<sup>[13]</sup>
- **Rasa**: Inclusion of all six tastes (*Shadrasa*) with disease-specific modifications.<sup>[14]</sup>
- **Agnibala**: Selection based on *Laghu* (light) or *Guru* (heavy) qualities in relation to *Agni*.<sup>[15]</sup>
- **Purusham Purusham Vikshyam** (Individualization): Diet personalized to *Prakriti* and disease state<sup>[16]</sup>.

The primary role of *Aahara* in disease management is to regulate *Agni* (digestive and metabolic fire), ensuring efficient digestion, absorption, and assimilation of nutrients. Impaired *Agni* leads to the formation of *Ama* (metabolic toxins), which is implicated in the pathogenesis of most chronic and lifestyle-related diseases. Appropriate dietary interventions restore metabolic balance, reduce toxin accumulation, and enhance the body's intrinsic healing mechanisms.

Diet plays a crucial role in maintaining the equilibrium of *Dosha* and nourishing *Dhatu* (tissues). Therapeutic diets are selected based on individual constitution (*Prakriti*), disease state, and seasonal variations to correct imbalances. For example, in *Kapha*-dominant disorders, light, dry, and bitter-pungent foods are recommended, whereas in *Pitta*-dominant disorders, cooling and mildly sweet foods are advised.

Appropriate dietary interventions reduce the risk of secondary complications in chronic diseases. For instance, non-adherence to dietary guidelines in

*Pandu*, especially continued intake of *Pitta*-aggravating foods, may lead to progression into *Halimaka*, a severe state with hepatic dysfunction.

Similarly, persistent *Apathya sevana* in *Prameha* (diabetes mellitus) can result in *Prameha Pidaka*, representing secondary inflammatory or infectious skin complications.

### Role in Disease Management (*Madhumeha*/Diabetes Mellitus)

*Pathya Aahara* plays a supportive and synergistic role in therapy by enhancing the effectiveness of medicines. Ayurveda has emphasized the role of *Agni* in the aetiology of diseases. *Pathya Aahara* helps maintain proper *Agni* (digestive fire), which is essential for the digestion, absorption, and assimilation of drugs. When *Agni* is balanced, medicines act more efficiently and produce quicker therapeutic results. It prevents the formation of *Ama* (toxins), which can otherwise obstruct drug efficacy. It also aids in *Dosha* balance, ensuring that the underlying cause of disease is controlled alongside drug action. *Pathya Aahara* varies with diseases depending on the involvement of *Dosha*. Additionally, a proper diet supports *Dhatu Poshana* (tissue nourishment) and ultimately *Oja* strengthening *Vyadhikshamatva* (immunity), thereby accelerating recovery.

A proper diet can enhance drug efficacy, reduce adverse effects, and improve patient outcomes. Overall, *Aahara* functions as a preventive, therapeutic, and supportive element in disease management. Thus, *Pathya Aahara* acts as an adjuvant to therapy, improving drug bioavailability, reducing disease

progression, and promoting holistic healing. Failure to follow *Pathya* may significantly reduce the effectiveness of medicines. By regulating metabolism, balancing physiological humors, reducing toxin accumulation, and complementing pharmacological therapies, *Pathya Aahara* forms a cornerstone of holistic healthcare in Ayurveda and aligns closely with modern principles of medical nutrition therapy.

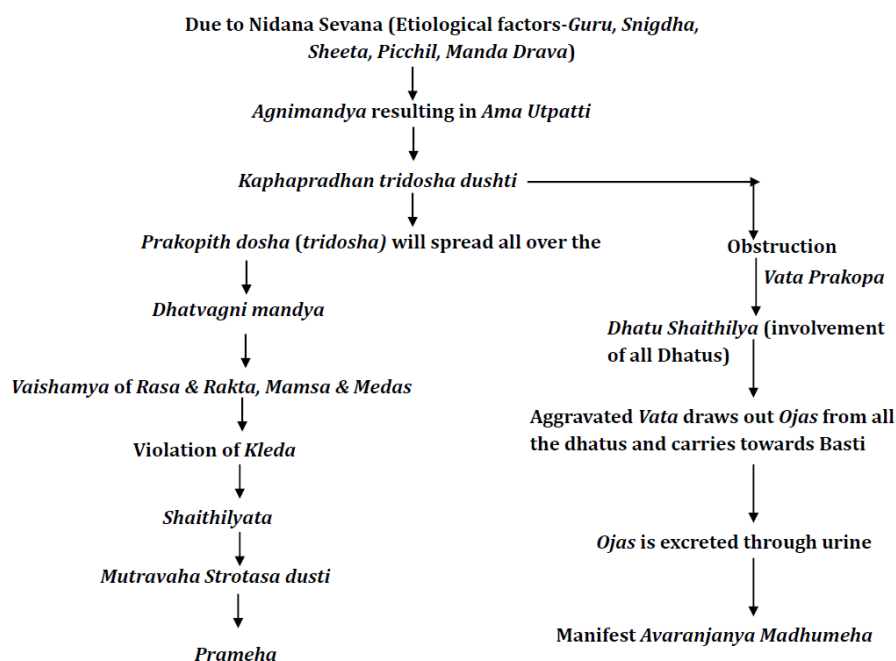
### Dietary Recommendations for *Prameha* in Ayurveda

*Prameha* a metabolic disorder associated with excessive urination, metabolic imbalance, and derangement of *Kapha*, *Meda*, and *Kleda*.<sup>[17]</sup> Consumption of foods that promote *Kapha* (heavy, moist, and slow qualities) can disrupt normal gastrointestinal function, including digestion and detoxification processes.<sup>[18]</sup> This disruption may lead to the accumulation of metabolic by-products and partially digested substances (comparable to toxins or reactive intermediates in modern physiology). These substances can obstruct physiological pathways at multiple levels, from organ systems to microcirculation. This obstruction affects the *Vata* regulatory mechanisms, leading to altered autonomic and metabolic function, and causes a reduction or impairment of *Oja* (vital essence). As *Oja* is drawn toward the *Basti* (urinary bladder), it influences the nature of urine. The depletion of this vital essence affects renal processing, resulting in urine that exhibits characteristics analogous to *Madhura* (Sweetness), *Kashaya* (astringent), and *Ruksha* (dryness).<sup>[19]</sup> These urinary changes correspond to the early signs of *Madhumeha*, which parallels the clinical concept of diabetes mellitus.

**Table 1: Elements in the *Samprapti***

|                           |                                                                       |
|---------------------------|-----------------------------------------------------------------------|
| <i>Ghataka</i>            | <i>Vata, Pitta, Kapha</i>                                             |
| <i>Dushya</i>             | <i>Meda, Mamsa, Kleda, Rakta, Vasa, Majja, Lasika, Rasa, and Ojas</i> |
| <i>Agni</i>               | <i>Jatharagni, Dhatvagni, Bhutagni (particularly Medoagni)</i>        |
| <i>Ama</i>                | <i>Aparipakva Ama and Paripakva dushya</i>                            |
| <i>Srotas</i>             | <i>Mutravaha, Medovaha, Mamsavaha, Udakavaha</i>                      |
| <i>Srotodushti</i>        | Primarily <i>Atipravritti</i>                                         |
| <i>Roga Marga</i>         | <i>Abhyantara</i>                                                     |
| <i>Pratyatma Lakshana</i> | <i>Prabhuta Mutrata, Avila Mutrata</i>                                |
| <i>Udbhavasthana</i>      | <i>Kostha</i>                                                         |
| <i>Vyaktasthana</i>       | <i>Mutravaha Srotas</i>                                               |
| <i>Svabhava</i>           | <i>Chirakari</i>                                                      |



**Fig1: Samprapti**

In the management of *Madhumeha*, *Pathya Aahara* is a keystone intervention that targets underlying patho-physiological processes. It helps in:

- **Correction of Agnimandya:** Enhances metabolic efficiency and glucose utilization.
- **Reduction of Kapha and Meda:** Helps in weight management and improves insulin sensitivity.
- **Clearing Srotorodha:** Facilitates proper circulation and nutrient transport.
- **Restoration of Vata Dosha:** Manage *Dhatu kshaya* due to *Vata Dosha* vitiation & reduce symptoms like dryness, fatigue, polyuria, and weight loss.
- **Replenishment of Oja:** Helps counter chronic weakness & susceptibility to infections.

- **Prevention of complications:** Reduces the risk of microvascular and macrovascular damage.

The dietary recommendations (*Aahara dravya*) in the classical Ayurvedic *Samhita* focus on light, dry, warm, and easily digestible foods to prevent *Ama* accumulation, avoiding *Kapha* aggravating foods, inclusion of spices & herbs to enhance digestion, and regular meal timing and moderation to regulate the formation of *Vata* and maintain *Vata* balance. *Laghu* (light), *Ruksha* (dry), and *Tikta-Katu* (bitter/pungent), help mitigate *Kapha* and *Meda* accumulation. This aligns with modern dietary principles emphasizing low glycemic index, high fiber, and metabolically favorable foods. These dietary recommendations are summarized in Table 2.

**Table 2: Aharaja Pathya**

| Category of Aahara |               | Rasa/anurasa   | Guna                      | Virya | Vipaka | Karma                                             | Glycemic Index |
|--------------------|---------------|----------------|---------------------------|-------|--------|---------------------------------------------------|----------------|
| Shuka Dhanya       | Yava          | Kashaya        | Laghu, Ruksha, Lekhana    | Shita | Katu   | Kapha, and Medho Nashaka                          | 25             |
|                    | Sastika Shali | Madhur         | Snigdha                   | Shita | Madhur | Tridoshagna, Shiratmaka                           |                |
|                    | Godhuma       | Madhur         | Snigdha and Sthairya Kara | Shita | Madhur | Jeevana, Brimhana, Vrishya                        | 41             |
|                    | Bajara        | Madhura        | Ruksha, Laghu             | Ushna | Katu   |                                                   | ~25            |
|                    | Kodrava       | Kashaya, Tikta | Laghu, Ruksha             | Shita | Katu   | Param grahi, Vishahara, Avrishya, Pathya in Vrana | ~56            |

|                                 |                                                |                                  |                                                              |               |                |                                                                                                          |                       |
|---------------------------------|------------------------------------------------|----------------------------------|--------------------------------------------------------------|---------------|----------------|----------------------------------------------------------------------------------------------------------|-----------------------|
|                                 | <i>Shyamaka</i>                                | <i>Kashaya</i>                   | <i>Laghu, Ruksha</i>                                         | <i>Sheeta</i> | <i>Katu</i>    | <i>Kaphapittagna, bowel binding property with Lekhana and Kapahahara</i>                                 | ~41.7                 |
|                                 | <i>Nartiki (Ragi)</i>                          | <i>Tikta Madhura and Kashaya</i> | <i>Snigdha</i>                                               | <i>Sheeta</i> | <i>Katu</i>    | <i>Balya, Sthoulya and Pramehhar</i>                                                                     | ~54-68                |
| <i>Shami Dhanya</i>             | <i>Mudga</i>                                   | <i>Kashaya, Madhura</i>          | <i>Laghu, Ruksha</i>                                         | <i>Sheeta</i> | <i>Madhura</i> | <i>Kaphahara (Mudga Yusha)</i>                                                                           | ~6                    |
|                                 | <i>Chanaka (Bengal gram)</i>                   | <i>Kashaya</i>                   | <i>Laghu, Ruksha</i>                                         | <i>Sheeta</i> | <i>Katu</i>    | <i>Kaphahara</i>                                                                                         | ~6                    |
|                                 | <i>Adhaki</i>                                  | <i>Kashaya</i>                   | <i>Laghu Ruksha</i>                                          | <i>Sheeta</i> | <i>Katu</i>    | <i>Kaphahara</i>                                                                                         | ~ 29-35               |
|                                 | <i>Kulattha</i>                                | <i>Kashaya</i>                   | <i>Laghu Ruksha, and Tikshna</i>                             | <i>Ushna</i>  | <i>Katu</i>    | <i>Medohara, Kaphahara, Bhedana, and Lekhana. hypolipidaemic, hypoglycaemic, and hypocholesterolemic</i> | Glycemic index~25-40  |
| <i>Mamsa Varga (Meat)</i>       | <i>Aja Mamsa (goat meat),</i>                  |                                  | <i>Sheeta, not Guru, not Annigdha &amp; not Abhishyandi.</i> |               |                |                                                                                                          | ~0                    |
|                                 | <i>Birds like (Kapota, Tityra, Lavaka)</i>     | <i>Madhura</i>                   | <i>Laghu</i>                                                 | <i>Sheeta</i> |                | <i>Tridohahar</i>                                                                                        | ~0                    |
|                                 | <i>Gramya Kukkuta Mamsa (domestic chicken)</i> | <i>Tikta</i>                     | <i>Laghu</i>                                                 | <i>Ushna</i>  |                | <i>Kaphahara</i>                                                                                         | ~0                    |
| <i>Shaka Varga (vegetables)</i> | <i>Patola (Pointed gourd)</i>                  | <i>Tikta</i>                     | <i>Laghu</i>                                                 | <i>Ushna</i>  | <i>Katu</i>    | <i>Kaphahara</i>                                                                                         | ~<20-30)              |
|                                 | <i>Shigru (Drum stick)</i>                     | <i>Tikta Kashaya</i>             | <i>Laghu, Ruksha</i>                                         | <i>Ushna</i>  | <i>Katu</i>    | <i>Kaphahara</i>                                                                                         | ~<30)                 |
|                                 | <i>Koshataki (Ridge gourd)</i>                 | <i>Tikta</i>                     | <i>Laghu, Ruksha, Tikshna</i>                                | <i>Ushna</i>  | <i>Katu</i>    | <i>Kaphahara. Acts as a hypoglycemic</i>                                                                 | Glycemic index~<20-30 |
|                                 | <i>Karavellaka (Bitter gourd)</i>              | <i>Tikta</i>                     | <i>Laghu</i>                                                 | <i>Ushna</i>  | <i>Katu</i>    | <i>Kaphahara, Pramehaghna</i>                                                                            | ~18                   |
|                                 | <i>Thanduliyaka (Amaranthus)</i>               | <i>Tikta</i>                     | <i>Laghu Ruksha</i>                                          | <i>Sheeta</i> | <i>Katu</i>    | <i>Kaphahara</i>                                                                                         | ~<30)                 |

|                    |                                                            |                                            |                                 |                      |                |                                                                                                                                  |                       |
|--------------------|------------------------------------------------------------|--------------------------------------------|---------------------------------|----------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------|-----------------------|
|                    | <i>Koshataki</i><br>(Ridge gourd)                          | <i>Tikta</i>                               | <i>Laghu</i>                    | <i>Sheeta</i>        | <i>Katu</i>    | <i>Pramehaghna</i>                                                                                                               | ~<20-30               |
|                    | <i>Rasona</i>                                              | <i>Pancharasa</i><br>(except <i>Amla</i> ) | <i>Snigdha</i>                  | <i>Ushna</i>         | <i>Katu</i>    | <i>Kapavatahar</i>                                                                                                               | Glycemic index~<15-20 |
|                    | <i>Sarshapa</i>                                            | <i>Katu, tikta</i>                         | <i>Laghu</i>                    | <i>Ushna</i>         | <i>Katu</i>    | <i>Natyushnah, Kaphavatagno, Grahi, Tridoshaghna</i>                                                                             | ~0                    |
|                    | <i>Udumbara</i>                                            | <i>Madhura Kashaya</i>                     | <i>Ruksha, Guru</i>             | <i>Sheeta</i>        | <i>Katu</i>    |                                                                                                                                  | ~35-50                |
|                    | <i>Kakamachi</i>                                           | <i>Katu Tikta</i>                          | <i>Laghu, Ruksha</i>            | <i>Anushna Shita</i> | <i>Katu</i>    |                                                                                                                                  | ~<30                  |
|                    | <i>Shigru</i><br>(Drum stick)                              | <i>Katu</i>                                | <i>Laghu Ruksha</i>             | <i>Ushna</i>         | <i>Katu</i>    | <i>Kaphahara, Medohara, Krimihara, Deepana, and Pachana.</i><br>And it acts as an antioxidant and a diuretic. With low glycemic. | ~<30                  |
| <i>Phala Varga</i> | <i>Jambu</i>                                               | <i>Kashaya</i>                             | <i>Laghu Ruksha</i>             | <i>Sheeta</i>        | <i>Katu</i>    | <i>Kaphaghna</i>                                                                                                                 | ~25-40                |
|                    | <i>Dadima</i><br>(Pomegranate)                             | <i>Kashaya</i>                             | <i>Laghu Guna</i>               | <i>Ushna</i>         | <i>Madhur</i>  | <i>Kaphahara</i>                                                                                                                 | ~35-50                |
|                    | <i>Kapitha</i><br>(wood apple)                             | <i>Kashaya</i>                             | <i>Laghu</i>                    |                      |                | <i>Kaphahara</i>                                                                                                                 |                       |
|                    | <i>Amalaki</i><br>(Indian gooseberry)                      | <i>Lavana Varjita Sarva Rasa</i>           | <i>Laghu, Ruksha</i>            | <i>Sheeta</i>        | <i>Madhura</i> | <i>Kaphahara</i>                                                                                                                 | Glycemic index~<30    |
|                    | <i>Tinduka</i><br>(Indian persimmon)                       | <i>Kashaya</i>                             | <i>Laghu</i>                    | <i>Sheeta</i>        | <i>Katu</i>    | <i>Pramehahar</i>                                                                                                                |                       |
|                    | <i>Pakva mocha</i><br>(ripened banana)                     | <i>Kashaya Rasa</i>                        |                                 |                      |                | <i>Prameha</i>                                                                                                                   |                       |
| <i>Madya</i>       | <i>Purana Sura</i><br>(old wine)                           |                                            | <i>Laghu</i>                    |                      |                | <i>Srotoshuddhi</i><br>(clarifies the channels), and digestive                                                                   | ~0-15                 |
| Seeds              | <i>Kamal seed</i>                                          | <i>Kashaya, Tikta, Madhura</i>             | <i>laghu, Snigdha, Picchila</i> | <i>Sheeta</i>        | <i>Madhura</i> | <i>Kaphapittahar, Pramehahar</i>                                                                                                 | ~50-55                |
| <i>Taila</i>       | <i>Atasi Danti Oil</i><br>( <i>Baliospermum montanum</i> ) | <i>Katu</i>                                | <i>Laghu, Tishana, Sara</i>     | <i>Ushna</i>         | <i>Katu</i>    | <i>Kaphavatahara, Pramehahara</i>                                                                                                | ~0                    |
|                    | <i>Sarshapa (mustard oil)</i>                              | <i>Katu</i>                                | <i>Lekhanade epan Laghu</i>     | <i>Ushna</i>         | <i>Katu</i>    | <i>Kapamedoanilhar</i>                                                                                                           | ~0                    |

|              |       |                 |                     |  |  |                                                                                                  |     |
|--------------|-------|-----------------|---------------------|--|--|--------------------------------------------------------------------------------------------------|-----|
| Purana Madhu | Madhu | Kashaya Anurasa | Laghu Ruksha, Karma |  |  | Kaphahara, Atilekhana, Ropana, Medogna, Pramehahara, Stoulyahara, Yogavahi (catalyst substance). | ~58 |
|--------------|-------|-----------------|---------------------|--|--|--------------------------------------------------------------------------------------------------|-----|

## DISCUSSION

The present aims to highlight the mechanistic relevance of Ayurvedic *Pathya Aahara* in the management of *Prameha*, drawing parallels between classical concepts and contemporary molecular insights. The findings underscore that dietary regulation in Ayurveda is not merely supportive but constitutes a central therapeutic pillar with multi-targeted metabolic effects.

Diabetes mellitus, correlated with *Prameha* in Ayurveda, is primarily described as a disorder involving vitiation of *Kapha dosha*, *Meda dhatu* (adipose tissue), and impaired metabolic function (*Agni mandya*).

One of the most significant overlaps between Ayurvedic and modern perspectives is the emphasis on low-GI foods. Foods such as *Yava* (barley), *Mudga* (green gram), *Chanaka* (Bengal gram), and *Bajra* exhibit low glycemic indices, resulting in slower digestion and gradual glucose absorption. Modern research supports that low-GI diets improve postprandial glycemic control and reduce insulin resistance. A review published in 2026 highlighted that low-GI foods play a crucial role in managing metabolic disorders, including type 2 diabetes, by stabilizing blood glucose levels and reducing glycemic variability.<sup>[20]</sup>

Barley (*Yava*), extensively praised in Ayurveda for its *Lekhana* and *Medohara* properties, has also been scientifically validated for its hypoglycemic effects. A study conducted by the Central Food Technological Research Institute (CFTRI) demonstrated that barley-based formulations significantly reduced fasting blood glucose and improved glucose tolerance. This effect was attributed to the inhibition of carbohydrate-digesting enzymes such as  $\alpha$ -amylase and  $\alpha$ -glucosidase, thereby delaying glucose release into circulation.<sup>[21]</sup>

Similarly, legumes categorized under *Shami dhanya*, including *Mudga*, *Chanaka*, and *Kulattha*, are rich in protein and dietary fiber and possess very low GI values. Clinical studies have shown that regular consumption of legumes improves glycemic control, reduces HbA1c levels, and enhances insulin sensitivity. These effects are largely due to their high soluble fiber content, which slows gastric emptying and carbohydrate absorption.<sup>[22]</sup>

The inclusion of *Tikta* (bitter) and *Kashaya* (astringent) *Rasa*-dominant vegetables such as *Karavellaka* (bitter gourd), *Patola*, and *Shigru* is another important aspect of this dietary regimen. Bitter gourd, in particular, has been widely studied for its antidiabetic properties. Experimental and clinical studies indicate that it contains bioactive compounds such as charantin and polypeptide-p, which exhibit insulin-like activity and contribute to significant reductions in blood glucose levels<sup>[23]</sup>. Recent findings also suggest its role in improving glucose uptake and modulating key metabolic pathways.

Fruits like *Jambu* (*Syzygium cumini*) and *Amalaki* (*Embllica officinalis*), categorized under *Phala varga*, are known for their antioxidant properties and moderate to low GI. These fruits help reduce oxidative stress, which is a major contributing factor in the progression of diabetes and its complications. Antioxidant-rich diets have been shown to improve pancreatic  $\beta$ -cell function and reduce insulin resistance<sup>[24]</sup>.

The use of lean protein sources such as goat meat (*Aja mamsa*) and domestic chicken further complements this dietary approach. These foods have negligible glycemic impact and support muscle mass maintenance, which is essential for improving glucose utilization and metabolic health.

Additionally, traditional fats such as mustard oil (*Sarshapa taila*) are known for their *Deepana* (digestive-enhancing) and *Kapha-medohara* properties. Modern studies suggest that mustard oil, rich in monounsaturated and omega-3 fatty acids, may improve lipid profiles and reduce cardiovascular risk factors associated with diabetes.

While *Purana madhu* (aged honey) is described in Ayurveda as having *Lekhana* and *Pramehahara* properties, its use in diabetic patients must be approached cautiously due to its moderate glycemic index. Contemporary nutritional guidelines recommend limiting simple sugars, even when derived from natural sources.

From an Ayurvedic standpoint, *Madhumeha* arises due to *Agnimandya* (impaired metabolic fire), *Kapha-Meda vridhhi* (increased adiposity and metabolic load), and *Srotorodha* (obstruction of microchannels), ultimately leading to *Ojakshaya*. These processes closely resemble the modern understanding



of insulin resistance, chronic low-grade inflammation, glucotoxicity, and oxidative stress. The convergence of these paradigms suggests that Ayurvedic dietary interventions may exert their effects through modulation of core metabolic pathways involved in glucose homeostasis.

The dietary framework in Ayurveda emphasizes *Shuka dhanya*, *Shami dhanya*, *Shaka varga*, and other food groups possessing *Laghu* (light), *Ruksha* (dry), and *Lekhana* (scraping) properties, which are traditionally indicated for the management of *Prameha*. When examined through a modern nutritional lens, these dietary recommendations align closely with evidence-based strategies for glycemic control, particularly the use of low glycemic index (GI) foods, high dietary fiber, and plant-based proteins.

One of the primary mechanisms through which *Pathya Aahara* influences glycemic control is the inhibition of carbohydrate-digesting enzymes such as  $\alpha$ -amylase and  $\alpha$ -glucosidase. Functional foods like *Syzygium cumini* (*Jamun*) and *Trigonella foenum-graecum* (fenugreek) have demonstrated significant inhibitory activity against these enzymes, thereby delaying glucose absorption and reducing postprandial hyperglycemia. This mechanism is analogous to that of conventional pharmacological agents such as acarbose, highlighting the therapeutic equivalence of certain dietary components.<sup>[25,26]</sup>

In addition, improvement in insulin sensitivity represents a key pharmacological action of several Ayurvedic dietary components. Bioactive compounds such as charantin and polypeptide-p from *Momordica charantia* (bitter melon) have been shown to enhance insulin receptor activity and facilitate glucose uptake via the PI3K/Akt signaling pathway. Similarly, 4-hydroxyisoleucine from fenugreek stimulates insulin secretion and improves peripheral glucose utilization. These findings support the Ayurvedic concept of restoring *Agni* and balancing *Doṣas*, particularly *Kapha*, which is closely associated with metabolic dysregulation.<sup>[27]</sup>

Oxidative stress plays a crucial role in the progression of diabetes and its complications, particularly through  $\beta$ -cell dysfunction and apoptosis. *Ayurvedic Pathya Aahara* includes antioxidant-rich foods such as *Emblica officinalis* (*Amla*), which contain high levels of vitamin C and polyphenols. These compounds neutralize reactive oxygen species (ROS), enhance endogenous antioxidant defenses, and protect pancreatic  $\beta$ -cells from oxidative damage. This aligns with the concept of preserving *Oja*, which can be interpreted as maintaining cellular integrity and immune resilience.<sup>[28]</sup>

Chronic inflammation is another critical factor in the pathogenesis of insulin resistance and vascular complications. Dietary phytochemicals present in

Ayurvedic foods may exert anti-inflammatory effects by downregulating pro-inflammatory cytokines such as TNF- $\alpha$ , IL-6, and NF- $\kappa$ B signaling pathways. This anti-inflammatory action may contribute to the prevention of microvascular and macrovascular complications associated with diabetes, thereby addressing both disease progression and its sequelae.<sup>[29]</sup>

Emerging evidence also highlights the role of gut microbiota in metabolic health, providing a novel dimension to the understanding of *Pathya Aahara*. High-fiber foods such as barley (*Hordeum vulgare*), rich in  $\beta$ -glucan, modulate gut microbiota composition, enhance short-chain fatty acid production, and improve insulin sensitivity.<sup>[30]</sup> This can be correlated with the Ayurvedic concept of maintaining *Srotas* integrity and proper nutrient assimilation. The gut-metabolism axis thus represents a promising area where traditional dietary principles intersect with cutting-edge biomedical research.

Overall, the dietary principles outlined in this framework demonstrate a strong convergence between Ayurvedic wisdom and modern nutritional science. The emphasis on low-GI foods, high fiber intake, plant-based proteins, and functional vegetables provides a comprehensive approach to managing diabetes. These dietary interventions exhibit multiple pharmacological actions, including antihyperglycemic, antioxidant, and anti-inflammatory effects. These actions correspond to key therapeutic targets in diabetes management, such as improving insulin signalling, reducing postprandial glucose spikes, and protecting pancreatic  $\beta$ -cells.<sup>[31]</sup>

The concept of *Pathya Aahara* aligns closely with contemporary nutritional therapy for diabetes, which emphasizes individualized diet plans, glycemic control, and lifestyle modification. Modern research increasingly supports the idea that dietary interventions can modulate gene expression, metabolic pathways, and gut microbiota, thereby influencing disease outcomes at a molecular level.

Despite these promising insights, several challenges remain in translating Ayurvedic dietary recommendations into evidence-based clinical practice. Variability in dietary composition, lack of standardized protocols, and limited large-scale clinical trials restrict the generalizability of current findings. Furthermore, most studies focus on isolated compounds rather than whole dietary patterns, which may not fully capture the synergistic effects emphasized in Ayurveda. Therefore, future research should adopt integrative methodologies, including systems biology, metabolomics, and randomized controlled trials, to validate and refine these traditional approaches.



**CONCLUSION**

*Pathya Ahara* offers a scientifically plausible and therapeutically valuable approach to the management of *Madhumeha*. By targeting multiple molecular pathways, ranging from enzyme inhibition and insulin sensitization to antioxidant and anti-inflammatory effects, Ayurvedic dietary interventions provide a holistic framework that complements modern pharmacotherapy. Bridging traditional knowledge with contemporary science may facilitate the development of novel dietary strategies and nutraceuticals for effective and sustainable diabetes management.

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