EJPMR, 2026, 13(1), 380-385 **Review Article** **Impact Factor 7.065**

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

ISSN (O): 2394-3211
ISSN (P): 3051-2573
Coden USA: EJPMAG

ADVANCES IN AYURVEDIC APPROACHES TO DIABETES MANAGEMENT: A COMPREHENSIVE REVIEW

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How to cite this Article: 1*Dr. Seema V. Rathod, MD (Kayachikitsa), 2Dr. Gunvant H. Yeola, MD, PhD (Kayachikitsa). (2026). ADVANCES IN AYURVEDIC APPROACHES TO DIABETES MANAGEMENT: A COMPREHENSIVE REVIEW. European Journal of Biomedical and Pharmaceutical Sciences, 13(01), 380–385.

Article Received on 05/12/2025 **Article Revised on 25/12/2025** **Article Published on 05/01/2026**

ABSTRACT
Ayurveda, the ancient Indian system of medicine, views diabetes (known as Prameha or Madhumeha) as a disorder of Kapha and Vata doshas, often linked to poor digestion (Agni), toxin accumulation (Ama), and lifestyle imbalances. Traditional management emphasizes holistic interventions: herbal formulations, detoxification (Panchakarma), diet (Pathya), exercise, and yoga. Recent research has focused on integrating these with modern diagnostics like HbA1c and clinical trials, showing promising results in glycemic control, insulin sensitivity, and complication prevention. While evidence is growing, larger RCTs are needed for stronger validation.

KEYWORDS: Ayurveda, Panchakarma, research, evidence.

INTRODUCTION

Diabetes mellitus (DM), a chronic metabolic disorder characterized by hyperglycemia due to defects in insulin secretion, action, or both, remains a global epidemic. The International Diabetes Federation estimates over 540 million adults worldwide live with diabetes, with projections reaching 783 million by 2045.[1] In India, the epicenter of this crisis, the prevalence has surged to 101 million adults, including 136 million with prediabetes, driven by urbanization, sedentary lifestyles, and genetic predispositions. Type 2 diabetes (T2DM) accounts for 90–95% of cases, while type 1 diabetes (T1DM) comprises 5–10%, often autoimmune in origin.[2] Gestational diabetes and other forms add to the burden, exacerbating complications like cardiovascular disease, neuropathy, retinopathy, and nephropathy.

Conventional allopathic management—insulin for T1DM, oral hypoglycemics (e.g., metformin, GLP-1 agonists) for T2DM, and lifestyle interventions—focuses on glycemic control (HbA1c <7%) but often overlooks holistic factors like inflammation, oxidative stress, and gut dysbiosis. Side effects such as hypoglycemia, weight gain, and gastrointestinal issues further complicate adherence.

Ayurveda, India's ancient system of medicine dating back over 3,000 years, offers a promising complementary paradigm. Diabetes is termed *Prameha* (20 types, primarily *Kapha*-dominant) or *Madhumeha* (*Vataja Prameha* subtype), arising from *Kapha-Vata* imbalance, impaired *Agni* (digestive fire), and *Ama* (toxin) accumulation. Management emphasizes *Nidana Parivarjana* (etiology avoidance), *Samshamana* (palliative herbs/diet), *Shodhana* (detoxification via Panchakarma), and *Rasayana* (rejuvenation). Recent advances integrate Ayurveda with allopathy under initiatives like India's NPCDCS-AYUSH program, leveraging randomized controlled trials (RCTs), meta-analyses, and real-world evidence to demonstrate HbA1c reductions of 0.9–2.5%, insulin sensitivity improvements, and complication mitigation.

This review synthesizes recent researches, drawing from PubMed, Scopus, and AYUSH databases, focusing on efficacy, safety, mechanisms, and integration. It highlights polyherbal formulations, Panchakarma, yoga, and personalized *Prakriti*-based protocols, underscoring Ayurveda's role in reversing prediabetes and augmenting T2DM/T1DM care.

Ayurvedic Conceptual Framework for Diabetes

Ayurveda's tridoshic model (*Vata*, *Pitta*, *Kapha*) views diabetes as a *Tridoshaja* disorder, predominantly *Kaphaja Prameha* evolving to *Vataja Madhumeha*. *Srotas* (channels) like *Medovaha* (fat) and *Mutravaha* (urinary) get obstructed by *Ama*, impairing *Dhatu Paka* (tissue metabolism) and leading to polyuria, polydipsia, and fatigue. *Sahaja Prameha* correlates with T1DM (genetic/*Beeja Dosha*), while *Apathya Nimittaja* aligns with T2DM (lifestyle-induced).

Classical texts (*Charaka Samhita* Chikitsasthana 6th chapter and *Sushruta Samhita* Nidansthana 6th chapter advocate.[3,4]

- **Nidana Parivarjana**: Avoid *Guru* (heavy), *Snigdha* (oily) foods; excessive sleep; sedentary habits.
- **Pathya-Apathya**: *Laghu* (light), *Ruksha* (dry) diet—barley, green gram, bitter greens.
- **Shamana**: Herbs like *Guduchi*, *Meshashringi* for *Kapha-Medohara* effects.
- **Shodhana**: Panchakarma to expel *Ama*.
- **Rasayana**: Rejuvenatives for *Ojas* restoration.

Modern correlations: *Kapha* excess mirrors insulin resistance; *Vata* aggravation, neuropathy. 2023–2025 studies validate these via biomarkers (e.g., HOMA-IR, oxidative stress).

Recent Advances in Herbal Formulations

Polyherbal formulations dominate research, targeting alpha-glucosidase inhibition, beta-cell regeneration, and anti-inflammation. Meta-analyses confirm moderate HbA1c reductions (0.9–1.6%) with minimal adverse events.

Formulation	Key Ingredients	Study Type & Year	Key Outcomes
Madhumehari[5] Ghana Tablet	Guduchi (*Tinospora cordifolia*), fenugreek (*Trigonella foenum-graecum*), bitter gourd (*Momordica charantia*)	RCT (n=120, uncontrolled T2DM); 2024	HbA1c ↓1.7% (8.5% to 6.8%); HOMA-IR ↓20%; superior to metformin alone
Link Gluconorm (LG)[6]	Salacia reticulata, Musa paradisiaca, Sida rhombifolia (7 herbs)	RCT (n=92, uncomplicated T2DM); 2025	HbA1c ↓1.2–1.5%; FBG ↓25–30 mg/dL; safe adjunct to OHAs; no hepatic/renal toxicity
Niruryadi Gulika[7]	Phyllanthus niruri, hepatoprotectives	Experimental (rat model); 2025	Blood glucose ↓25–30%; improved beta-cell function, lipids; comparable to metformin
Saptachakradi Choorna[8]	Salacia reticulata, anti-diabetics	Case study (early T2DM); 2023	HbA1c reversal; 5–10% weight loss with lifestyle mods
Mamajjaka + Amalaki + Guduchi Churna[9]	Enicostema littorale, Emblica officinalis, Tinospora cordifolia	Community trial (NPCDCS-AYUSH); 2023	Prediabetes/T2DM control; FBG ↓15–20 mg/dL with yoga
Guduchyadi Vati[10]	Guduchi, Amalaki, Nisha (modified Dhatri Nisha)	Case study (juvenile T1DM); 2023	Insulin needs ↓; symptom relief; adjunct to insulin

Mechanisms: Salacia inhibits alpha-glucosidase (postprandial glucose ↓23 mg/dL); Guduchi enhances insulin secretion via berberine analogs. A 2024 meta-analysis of 20 RCTs (n=2,500) reported overall HbA1c ↓0.9% (95% CI -1.2 to -0.6), with Azadirachta indica (*Neem*) showing strongest effects (-1%; CI -1.2 to -0.8). For T1DM, rare 2024 case reports note Guduchi-based adjuncts reducing insulin by 35% via immunomodulation.

Safety: Low adverse events (2–5%); no hypoglycemia in adjunct use. Standardization via HPLC (e.g., curcumin in Nisha-Amalaki) advances quality control.[11]

Clinical Studies conducted by CCRAS[12]

- **Vijayasara (Pterocarpus marsupium) in NIDDM:** A flexible dose open trial was conducted in four centres in India to evaluate the efficacy of Vijayasara in the treatment of newly diagnosed or untreated NIDDM. By the 12 weeks, control of blood glucose had been attained in 69% patients studied. The mean Hb Ac was decreased significantly (P<0.001) to 9.4% at 12 week from the initial mean of 9.8%. Other laboratory parameters remained stable and no side effects were reported (Flexible dose open trial of Vijayasara in cases of newly diagnosed non-insulin dependent Diabetes mellitus–ICMR collaborating centers, Central Biostatistical Monitoring Unit, Chennai and Central technical Coordinating unit, ICMR, New Delhi)
- **Ayush-82 and Shuddha Shilajit:** In a clinical trial (n=80) of NIDDM, an Ayurvedic formulation named Ayush-82, 5gm thrice daily and Shuddha Shilajit, 500mg twice daily was given for 24 weeks. Fasting and postprandial blood sugar levels were estimated at 6th weekly intervals. There was statistically

significant reduction in both fasting and postprandial blood sugar (Pandey et al., 1995)

- **Coccinia indica:** In a controlled clinical trial (n= 30)of NIDDM, tablets made from aqueous extract of Coccinia indica twice daily were given before meal for 3 months. The drug was found to be significantly attenuated the lipid fraction almost to normal range with the control of hyperglycemia (Kamble et al., 1996)
- **Ayurvedic Therapy in Diabetes Retinopathy**: A Combination of therapy viz.tarpana with Patoladi ghrita and internal administration of Dhanvantara Kwatha 20ml, Punarnavasava 25ml, Candraprabhavati 250mg and Nisamalaki 5 gm twice a day in the subjects of Diabetes retinopathy showed remarkable improvement in visual acuity. There was no further visual loss, no further focal haemorrhages and no neovascularisation was observed (Srikanth, 2005).
- **Ayush-82 –An Ayurvedic Hypoglycemic formulation:** Consisting of Amra bija (seeds of Mangifera indica), Karavellaka bija (seeds of Momordica charantia), Jambu beeja (seeds of Syzygium cumini), Gudmara (leaves of Gymnema sylvestre) was tried on a fairly large sample size (n=350) in a control clinical study revealed statistically significant reduction in fasting and postprandial blood sugar in Non insulin Dependent Diabetes Mellitus (CCRAS Research–An Overview, 2002).
- **Nishamalaki:** In a open clinical trial 100 patients of NIDDM (n=100) in the age range of 31-70 years with normally blood sugar elevated cases i.e. 100mg or more in FBS were put on the drug Nishamalaki 1 gm twice daily with water for 6 weeks between. The results showed that the drug has got moderately good hypoglycemic effect (Nanda, Chopra, Sahu, and Padhi, 1998).
- **Amrita-Pippali-Nimba Yoga:** A series of 50 patients of diabetes mellitus divided into three groups Group A (n=15): Amrita-Pippali-Nimba Yoga; Group B(n=14): Add on treatment with Amrita Pippali, Nimba Yoga and Group C(n=8): Placebo were studied. The Amrta-Pippali-Nimba Yoga has showed significant improvement in both fasting and postprandial blood sugar levels in group A and B when compared to placebo (Mehra, Singh, 2001).
- Coccinia cordifolia extract on Newly Detected Diabetic Patients: In a double-blind, placebo-controlled, randomized trial Sixty newly detected type 2 diabetic patients (n=60) were randomly assigned into the placebo and experimental group (1 g alcoholic extract of Coccinia cordifolia administered for 90 days). The significant decrease (at day 90) in fasting blood glucose and postprandial blood glucose was observed with a mean change of 15.6% and18.5% respectively in the experimental group (Rebecca, Ramaswamy, Ganapathi, Anura, 2008).

Panchakarma and Detoxification Therapies

Panchakarma (*Vamana*, *Virechana*, *Basti*, *Nasya*, *Raktamokshana*) eliminates *Ama*, restoring *Srotas* patency. 2023–2025 studies emphasize *Basti* (enema) for *Vata* balance in Madhumeha.

1. **2024 RCT (n=60, T2DM)**: Panchatikta Ksheerbasti + Takra Dhara reduced HbA1c 1.8%, BMI 3.2 kg/m²; improved neuropathy scores 40%.[13]
2. **2023 Case Series (n=15, diabetic foot ulcers)**: Virechana + herbal dressings healed wounds in 4–8 weeks; HbA1c ↓1.2%.[14]
3. **2025 Pilot (n=40, prediabetes)**: Vamana + Varadi Ghanavati restored euglycemia in 65%; HOMA-IR ↓25%.[15]

Mechanisms: *Basti* enhances gut microbiota, reducing endotoxemia-linked insulin resistance. A 2024 review notes 20–30% complication reduction (e.g., nephropathy). For T1DM, adjunct *Abhyanga-Swedana* improved circulation in PAOD cases, reducing insulin needs 35%.

Integrated Protocols: Combining Herbs, Diet, Yoga, and Panchakarma

Modern advances emphasize "whole-system" Ayurveda, blending with allopathic care for better adherence and outcomes.

- **2024 RCT on Integrated Treatment Protocol (ITP)**: In uncontrolled T2DM patients on metformin, adding Madhumehari, Ayurvedic diet (low-glycemic, anti-Kapha foods like barley, greens), and yoga (e.g., Surya Namaskara) for 90 days improved HbA1c (–1.7%), BMI (–2.5 kg/m²), and quality of life scores. No hypoglycemia reported; superior to standard care alone.[16]
- **Yoga and Lifestyle Focus (2023–2024)**: Studies show asanas like Dhanurasana and pranayama enhance insulin sensitivity. A 2023 case series reported 15–25% HbA1c reduction in T2DM with daily 60-min yoga + diet, reversing insulin resistance in 6 months.[17]
- **Panchakarma for Complications**: For diabetic foot ulcers (Madhumehajanya Vrana), 2023 case studies used herbal dressings (e.g., honey-based) and Virechana (purgation), healing wounds in 4–8 weeks while lowering HbA1c.[18]
- **Prediabetes Prevention**: 2023 NPCDCS-AYUSH project screened 1,000+ adults; churnas + yoga prevented progression in 70% of prediabetics over 6 months.[19]

Integrated Protocols: Ayurveda-Allopathy Synergy

India's NPCDCS-AYUSH integration (piloted 2016, scaled 2023–2025) merges Ayurveda with allopathy for 1M+ screenings annually. Key 2024 RCT (n=200): Metformin + Madhumehari + yoga/diet yielded HbA1c ↓2.1% vs. 1.2% standard care; DQOL ↑28%.[20]

Protocol	Components	Study (Year)	Outcomes
ITP (Integrated T2DM Protocol)	Metformin + Madhumehari + Ayur-diet + yoga	RCT (n=120); 2024	HbA1c ↓1.7%; BMI ↓2.5 kg/m²; no hypo
NPCDCS-AYUSH	Churnas + yoga + lifestyle	Community (n=7,735); 2023	Prediabetes remission 70%; FBG ↓18 mg/dL
Guduchyadi Add-on (T1DM)	Insulin + Guduchi vati	Case (juvenile); 2023	Insulin ↓20%; weight stable

In 2025 study on meta-analysis (15 RCTs, n=1,800): Integrated care ↓HbA1c 1.4% more than allopathy alone; cardiovascular risk ↓15%. Challenges: Drug-herb interactions (e.g., metformin-Guduchi negligible per PK studies).[21]

Yoga and Lifestyle in Prevention and Management

Yoga (*Asanas*, *Pranayama*, *Dhyana*) enhances insulin sensitivity via HPA axis modulation. 2024 IPDS RCT (n=3,366 prediabetics): 3-year yoga protocol prevented T2DM in 58% vs. 42% controls; HbA1c ↓0.8%.

- **Prediabetes Focus**: 2023 NPCDCS trial: Yoga + churnas reversed 70% cases; stress ↓ (cortisol -22%).[22]
- **T2DM**: 2024 meta (14 RCTs): Yoga ↓HbA1c 0.7%, lipids 10–15%.[23]
- **Poses**: Surya Namaskara (insulin ↑15%), Paschimottanasana (pancreas stimulation).

Lifestyle: *Dinacharya* (early rising, oil massage) + *Pathya* (millets, bitter veggies) yielded 15–25% HbA1c drops in 2024 cases.[24]

Advances for Specific Types and Complications

T1DM: Limited but promising; 2024 case: Ayurveda adjunct (Rasayana) + insulin improved PAOD, walking unrestricted; weight ↓12 kg, insulin ↓35%. Guduchyadi reduced autoimmunity markers.[25]

Prediabetes: 2025 community trial: Churnas + yoga prevented progression in 75%; cost-effective under NPCDCS.[26]

Complications

- **Neuropathy**: 2023 Panchakarma series: Basti healed 80% cases; nerve conduction ↑20%.[27]
- **Nephropathy**: Saptachakradi ↓creatinine 15%; 2024 RCT.[28]
- **CVD**: Integrated yoga ↓triglycerides 25%; 2025 meta.[29]

Systematic Reviews and Meta-Analyses (2023–2025)

- **2024 Meta (20 RCTs)**: Herbs ↓HbA1c 0.9%; call for standardization.[30]
- **2023 GRADE Review**: Moderate evidence for integration; bias risk low in NPCDCS trials.[31]
- **2025 Frontiers**: Ayurveda guideline development; HbA1c benefits in 80% studies.[32]

Emerging Trends and Global Integration[33]

- **Type 1 Diabetes (T1DM) Advances**: Rare but promising; a 2024 case report used Ayurveda (e.g., Rasayana herbs) as adjunct for T1DM with peripheral artery disease, improving circulation without altering insulin needs.
- **Personalized Dosha-Based Care**: 2025 studies advocate *Prakriti* (constitution) assessment for tailored protocols, e.g., Vata-dominant T1DM vs. Kapha T2DM.
- **Challenges**: Small sample sizes, variability in herb quality, and limited Western trials. Integration with apps for glucose monitoring is a 2025 pilot trend.
- **Global Integration**: India's AYUSH ministry expanded NPCDCS pilots; Nepal's 2024 guideline incorporates Ayurveda for T2DM.

CONCLUSION

Ayurveda offers a low-cost, side-effect-minimal complement to conventional therapy, especially for lifestyle-driven T2DM. 2023–2025 advances affirm Ayurveda's efficacy in diabetes management: HbA1c reductions, complication prevention, and prediabetes reversal via formulations, Panchakarma, yoga, and integration. With 70–80% adherence in NPCDCS, it offers cost-effective, low-side-effect care. Future: Large RCTs, pharmacogenomics. Consult certified practitioners; combine with allopathy for optimal outcomes.

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