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# Toxicological Perspective on Diabetes Mellitus

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## Abstract

Diabetes mellitus (DM) arises not solely from genetic or lifestyle factors but also from chronic exposure to environmental toxins, as evidenced by rising global incidence rates unexplained by traditional risk factors alone. Endocrine disruptors and heavy metals interfere with glucose metabolism, insulin signaling, and beta-cell function through mechanisms like epigenetic modifications, oxidative stress, and inflammation. This review explores toxin-specific links to DM, mechanisms of action, and *Ayurvedic* management via *Dushi Visha chikitsa yogas*, advocating toxin-aware prevention strategies.

**Keywords:** diabetes mellitus; environmental toxins; endocrine disruptors; *dushi visha*; *ayurveda*

## Introduction

Global diabetes rates continue escalating despite lifestyle interventions, affecting non-obese youth, and suggesting environmental contributors like toxins. The toxicological lens views DM as influenced by chemicals disrupting endocrine functions, including hormone mimicry, synthesis alteration, and receptor interference. This integrates modern toxicology with Ayurveda, where persistent low-potency toxins (*Dushi Visha*) accumulate, leading to metabolic disorders.

### Mechanisms of Toxin-Induced Diabetes

Toxins provoke DM via endocrine disruption, epigenetic changes, oxidative stress, and inflammation. Epigenetic effects include DNA methylation by arsenic/BPA inactivating insulin genes, histone modifications by dioxins/cadmium altering signaling, miRNAs by phthalates disrupting secretion, and chromatin remodeling by pollutants affecting metabolic genes. Heavy metals generate reactive oxygen species, fostering insulin resistance, while persistent exposure impairs beta-cell function and sensitivity. In *Ayurveda*, *Nidana sevana* (toxin re-exposure) aggravates *Kapha-avaranajanya* symptoms like polyuria and fatigue.

### Key Toxins Linked to DM

Environmental and lifestyle toxins strongly associate with DM risk [1-8].

**Table 1:** Major toxins and their diabetes associations.

| Toxin Category | Examples | Diabetes Link |
|---|---|---|
| Heavy Metals | Cadmium, Arsenic, Lead | Elevated fasting glucose, stress |
| Persistent Pollutants | Dioxins, PCBs, POPs (e.g., DDT) | Glucose dysregulation, endocrine disruption |
| Pesticides | Organophosphates, Organochlorines | Pancreatic damage, insulin resistance |
| Consumer Chemicals | Phthalates, Triclosan/Triclocarban, BPA | Beta-cell dysfunction, hyperglycaemia |
| Lifestyle Factors | Alcohol, Smoking, Drugs (e.g., glucocorticoids, antipsychotics) | Insulin resistance, 30-40% higher T2DM risk in smokers |

### Ayurvedic Correlation

*Dushi Visha*, low-virya toxins accumulating over years due to *Kapha avarana* (SuKa 23.3; AH.U.35.33), manifests DM-like *lakshanas: Praseka* (salivation), *sheetata* (coldness), *trishna* (thirst) (SuKa 22.9; SuSu 24.9). Persistent *Nidana* leads to hyperglycemia despite therapy (Cha.Chi 6.4). Diagnosis involves toxin history and metabolic markers.

### Management Strategies

*Dushi Visha* line of management must be chosen.

**Table 2:** Key Chikitsa Yogas.

| Formulation | Reference |
|---|---|
| Dushivishari Agada | AH.U.35.39 |
| Aragwadadi Gana | SuSu 15.17-18 |
| Lodhradi Gana | SuSu 15.26-27 |
| Arkadi Gana | SuSu 15.28-29 |
| Vishaghna Mahakashaya | ChSu 4.16 |

*This Yogas (formulations) target toxin elimination.*

## Discussion

Certain patients exhibit persistent or fluctuating hyperglycaemia despite compliance with antidiabetic pharmacotherapy, dietary regimens, and lifestyle interventions. This phenomenon may stem from chronic direct or indirect toxin exposure, which induces insulin resistance and metabolic dysregulation. In *Ayurvedic* parlance, such cumulative toxin effects align with the concept of *Dushi Visha*, and targeted management protocols for this condition could facilitate glycemic stabilization. Acknowledging the etiological role of toxins in diabetes mellitus pathogenesis supports the development of comprehensive preventive strategies and toxin-neutralizing therapeutic modalities.

## Conclusion

Understanding the toxicological perspective of diabetes mellitus is crucial in today's context due to increasing exposure to environmental pollutants. It highlights the role of toxins in disrupting metabolic processes and contributing to disease onset. This knowledge supports improved prevention, early intervention, and the development of therapeutic strategies.

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